MECHANISM AND GENETICS OF GRAIN MOLD RESISTANCE IN SORGHUM

THESIS

Submitted to the
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
in partial fulfillment of the requirement
for the degree of

DOCTOR OF PHILOSOPHY
IN
AGRICULTURE
(PLANT PATHOLOGY)

BY

GULAB DAULATRAO AGARKAR

DEPARTMENT OF PLANT PATHOLOGY
POST GRADUATE INSTITUTE,

Dr. PANJABRAO DESHMUKH
KRISHI VIDYAPEETH, AKOLA (M. S.)
INDIA

Enrolment No. AGNG/1/78/69 1999

DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of thesis entitled **"Mechanism and genetics of grain mold resistance in sorghum"** or part there of has not been submitted for any other degree or diploma of any University nor the data have been derived from any thesis/ publication of any University or Scientific Organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

Akola

Dated :

G.D. AGARKAR
Enrolment No. AGNG/1/78/69

CERTIFICATE

This is to certify that the thesis entitled "**Mechanism and genetics of grain mold resistance in sorghum**' submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Ph. D.) in Agriculture of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Shri. Gulab Daulatrao Agarkar,** under my guidance and supervision. The subject of the thesis has been approved by the Students Advisory Committee.

Akola :

Date : 30/06/99

Dr. R. B. Somani
Chairman,
Adivosry Committee

Courtersigned

Associate Dean ,
Post Graduate Institute
Dr. Panjabrao Deshmukh Krishi
Vidyapeeth, Akola

THESIS APPROVED BY THE STUDENTS ADVISORY COMMITTEE INCLUDING EXTERNAL EXAMINER (AFTER *VIVA-VOCE*)

Chairman	(Dr. R. B. Somani)	
Co-chairman	(Dr. R. P. Thakur)	
Member	(Dr. K. B. Gahukar)	
Member	(Dr. V. B. Shekar)	
Member	(Dr. Umaid Singh)	
External Member	(Dr. K·H·ANAHOSUR)	

ACKNOWLEDGEMENT

I feel immense pleasure for having this opportunity to express my sincere, humbly and deepest sense of gratitude to Dr. R.B. Somani, Ph.D., Asso. Professor of Plant Pathology and Head, Agro-Products Development Research Centre, Dr. PDKV Akola and Chairman of the Advisory Committee for suggesting the outline of this research work, keen interest, valuable guidance, constructive criticism and constant encouragement during the course of investigation.

I wish to express my profound sense of gratitude and sincere thanks to Dr. R.P. Thakur, Sr. Scientist (Pathology), Genetic Resources and Enhancement Program, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, Co-chairman of Advisory Committee for suggesting the collaborative research project between Dr. PDKV, Akola and ICRISAT Patancheru, and for his valuable guidance, constructive criticism and rendering all types of help and facilities provided during the course of investigation.

I am indebted to Dr. K.B. Gahukar, Ex. Associate Dean, PGI and Dean, Faculty of Agriculture, Dr. PDKV, Akola and member of my Advisory Committee for providing necessary guidance and help during the tenure of the present investigation.

I hereby expressing my whole hearted sense of gratitude to Dr. V.B. Shekar, Associate Dean, College of Agriculture, Akola and Director of Research and member of Advisory Committee for providing valuable guidance in the course of this investigation .

I express my sincere thanks to Dr. Umaid Singh, Ex. Sr. Scientist, Crop Quality Unit, ICRISAT, Patancheru, Andhra Pradesh and presently Head, Nutrition Department, College of Home Science, C.S.S. University of Agricultural and Technology, Hissar, Harayana and Advisory Committee member for rendering help during biochemical analysis at Crop Quality Unit ICRISAT Patancheru.

I am thankful to Dr. N.L. Peshney, Head, University Department of Plant Pathology, Dr. PDKV, Akola for rendering all types of help and facilities during the course of investigation.

I wish to express my sincere and heartfelt thanks to Dr. S.B. Atale, Senior Research Scientist (Sorghum), Sorghum Research Unit, Dr. PDKV, Akola, for his valuable guidance, constructive criticisms during the preparation of manuscripts and providing laboratory and field facilities for carrying out the research project.

I acknowledge my special thanks to Dr. S.G. Thote, Associate Professor and Incharge Computer Centre for guidance in Statistical Analysis of the data. Further I am obliged to Prof. S.B. Sakhare, Assistant Professor of Agriculture Botany, Dr. PDKV, Akola for assisting in carrying out diallel analysis.

I am obliged to all staff members of Cereals Pathology and Crop Quality Unit ICRISAT, Patancheru, Andhra Pradesh, worth mentioning Dr. S.D. Singh, Sr. Scientist, Dr. R. Bandyopadhyay, Sr. Scientist, Shri. V. Panduranga Rao, Shri S.S. Navi, P.J. Mohan Rao, P.V. Rao, G. Venkateswara Rao, G. Soma Raju for extending their full co-operation during the course of my study at ICRISAT and S.M. Ahmed, for his untiring efforts in helping with typing and other help.

Special thanks to Director ICRISAT for approving the collaborative research programme, funding of project and providing an opportunity to utilize facilities at ICRISAT.

I shall ever be grateful to Hon'ble Vice-Chancellor, Dr. PDKV, Akola for granting the study leaves during the Ph.D. course work without which I could not have complete the studies.

I am thankful to all staff members of Department of Plant Pathology Dr. PDKV, Akola, Dr. N.K . Raut, Dr. K.N. Sapkal, Dr. K.B Kale and Dr. R.W. Ingle, for extending their full co-operation during the course investigation.

I am also thankful to all staff members of Sorghum Research Unit, Dr. PDKV, Akola, Dr. R.S. Wadhokar, Dr. S.K. Jilani, Sorghum Breeder, Shri H. G. Kandalkar, Sorghum Entomologist, Shri S.S. Wanjari, Sorghum Agronomist, Shri P.W. Deshmukh, Jr. Sorghum Breeder, Shri N.R. Potdukhe, Asstt. Cotton Breeder, Ms. Manjusha Ghodki, and Ms. Kavita More, JRA for their full co-operation till the completion of this project. I am also thankful to Shri A.D. Pore, Adesh Computer for solution typing and other services render for preparation of manuscript.

Last but not the least I wish to record my affection and love for my family member Mrs. Rajani Agarkar, my wife, dear daughter Ku. Smita Agarkar, beloved sons Mr. Anup Agarkar and Amol Agarkar, whose encouragement and well wishes have helped me to attain this goal. My gratitude and obligation towards them shall be ever lasting and never ending.

Place : Akola

Dated :

(G.D. AGARKAR)

Enrolment No.AGNG/1/78/69

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX – IV

APPENDIX – VIII

LIST OF PLATES

LIST OF FIGURES

ABBREVIATIONS USED

Abbreviated forms/symbol	Terms/unit
1	2
AFP	Antifungal protein
am	Ante meridian
CD	Criticle difference
CE	Catechin equivalent
Cl	*Curvularia lunata*
cm	Centimeter(s)
cv(s)	Cultivars
dSm^{-1}	desi Simen
DAA	Days after anthesis
DAF	Days after flowering
ed.	editor(s)
e.g.,	for example
et al.	and others
°C	Degree centigrade
F_1	First filial generation
F_2	Second filial generation
f.sp.	Formae specialis
FAA	Formalin Acetic-acid Alcohol
F.p.	*Fusarium pallidoroseum*
g	gram(s)
gca	general combining ability
ha	hectare
h	hour(s)
pH	H ion conc.
H_1	Heterosis (over mid parent)
H_2	Heterobeltiosis (over better parent)
i.e.	that is
in vitro	in glass
kg/cm^{-2}	Kilogram per centimeter square
L	Linieus
l	litre
min	minutes
mol wt	molecular weight
max	maximum
min	minimum
M	molar
ml	millilitre
mg	milligram
μm	micrometer
nm	nanometer (10^{-9} meter)

1	2
N	normal
no	number
PA	Phenolic acid
PC	Phenolic compound
p.m.	post meridian
%	Percent
sca	specific combining ability
SE	standard error
spp.	species plural
vol	volume
v/v	volume/volume
var	variety
wt	weight
vivavoce	orally
vs.	against
viz.	Namely
%	per cent
+	plus minus
<	is less than
≥	is more than or equal than
≈	is equal to plus or minus
×	is multiplied by

CHAPTER – I

INTRODUCTION

PAGES : 1 - 5

CHAPTER – I

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth major cereal crop in the world after wheat (*Triticum* spp.), rice (*Oryzae* spp.), maize (*Zea mays*) and barley (*Hordeum vulgre*). It is cultivated widely throughout tropical, sub-tropical and temperate regions within latitudes of 45°N and 45°S and mainly in Africa, Asia, North and South America.

The countries of Semi Arid Tropics (SAT) accounts 83% (about 36 million ha) of the total world area sown (43 million ha) under sorghum. In India the crop is grown on 12.5 million ha which accounts for 35% of the sorghum area in the SAT. The SAT countries produce on an average about 63% of world sorghum, of which Indian contribution accounts for 21% (FAO, 1995).

In India, sorghum is grown in areas receiving 500 to 1000 mm annual precipitation with temperature ranging between 26 and 32°C. Plain and plateau below 1000 m elevation offer excellent scope for successful cultivation of the crop in two seasons viz., '*Kharif*' (June to October) as rainfed crop and '*Rabi*' (October to February) with protective irrigation constituting 60 and 40 percent cultivation respectively. The main areas of sorghum cultivation in India are in states of Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, and Rajasthan. It is mostly used as staple food, feed and forage in the states of Maharashtra, Northern Karnataka and part of Madhya Pradesh.

Sorghums in the tropics, have to sustain a hostile environment where unreliable rainfall, poor soils, pests, diseases and parasitic weeds all constantly exert a harsh selection pressure. The traditional cultivars are photo-sensitive and when rains cease earlier, there is poor grain filling which results in low yields. Therefore, to have cultivars of short duration, photo in-sensitive and good grain filling and drought tolerant is the primary objective of breeders. Several early maturing and high yielding hybrids have been developed which have replaced the traditional varieties to a large extent. However, these cultivars, lack the inherent grain mold escape mechanism of the local sorghums and the grains that mature during the wet weather are always vulnerable to infection by several fungi. The grain mold problem has achieved a greater significance and because of this, control of grain mold has become a major activity in many sorghum improvement programs.

Definitions of 'grain mold' (GM) found in recent literature appear to fit into one of the two general concepts of fungal- related grain deterioration. The first concept describes a condition resulting from fungal infection and colonization of grain, occurring any time between anthesis and harvest. Here GM can be broadly defined as a fungal component of pre-harvest grain deterioration, involving numerous fungal species interacting in different ways with the plant (i.e. parasitically and/or saprophytically).

The second concept restricts the definition of GM to a condition caused by infection and colonization of spikelet tissues prior to grain maturity. In this limited definition, few fungi are thought to be involved. The magnitude of field fungi that colonize grain after physiological maturity are not part of GM *per-se*, but rather constitute a component of weathering, or general post harvest grain deterioration.

On practical level, the two concepts are similar. Early and late infections in first concept can be seen as analogous to the GM and weathering of second concept (Forbes *et al.*, 1992). Various terms (e.g. grain molds, seed molds, grain deterioration, grain weathering, head molds and head blight) have been used in literature to describe the association between deteriorated grain of sorghum and numerous fungal species (Castor, 1981; Williams and Rao, 1981). Fungal related grain deterioration, whether occurring before or after grain maturity, can cause economic losses in several ways viz., a) moldy and discolored pericarp, b) a soft and chalky endosperm, c) decreased grain filling and size (low yields), d) reduced germination, e) presence of mycotoxins, f) decreased dry matter, density and test weight, g) altered composition of grain, h) low storability, i) low nutritive value, j) low acceptability by the consumers and farmers and k) low market price.

The mold may develop in sorghum inflorescence at any stage from the young inflorescence to the mature head, provided that climatic conditions are suitably humid. Generally, it seems that wet weather following flowering is necessary for grain mold development and longer the wet period greater the mold development (Rao and Williams, 1977). Dry weather during flowering and grain development followed by wet weather near maturity will not promote such serious mold as when the wet weather occurs from the time of flowering onward.

Few fungi infect sorghum spikelet tissues during early stages of grain development. These are (in approximate order of importance) *Fusarium moniliforme* Sheld., *Curvularia lunata* (Wakker) Boedijn, *Fusarium pallidoroseum* (Cooke) Sacc. (*F. semitectum* Berg., and Rave.), and *Phoma sorghina* (Sacc.). *F. moniliforme* and *C. lunata*, and they are significant worldwide (Castor, 1981; Frederiksen *et al.* 1982; Williams and Rao, 1981; Bandyopadhyay, 1986). Several fungi belonging to about 21 genera have been reported so far with sorghum grain by various workers.

In Vidarbha region of Maharashtra, the most common grain mold fungi in relative order of frequencies are *C. lunata* (40-60%), *F. moniliforme* (15-20%), *F. pallidoroseum*, *Drechslera* spp., *Phoma sorghina, Alternaria* spp. and *Aspergillus* spp. (5-30%) (Anon., 1984).

C. lunata and *F. moniliforme* secrete amylases, cellulases and pectinases resulting in disintegration of endosperm and germ tissue. These fungi also interfere with carbohydrate transloction to developing kernels causing reduction in size and weight of the kernels, causing physical, physiological and chemical changes. Endosperm of molded grain appears chalky because of partial hydrolysis of starch and protein. Molded grain may be contaminated with mycotoxins and present health hazards to consumers (Castor and Frederiksen, 1980).

In general, avoidance and/or sowing GM resistant cultivars are the only practical and economical methods for control of GM in sorghum. Chemical control of GM is usually impractical and too costly.

Several characteristics contribute resistance to field deterioration of grain viz., loose heads, seed completely enclosed in glumes (Murty, 1975), colored grain with high tannins and presence of pigmented testa (Harris and Burns, 1973). However, some white-grained varieties and relatively small glumes and even a cultivar with compact panicle have been reported to be less susceptible (Williams and Rao, 1978). Thin mesocarp, rate of water absorption and conductivity of seed leachates (Glueck *et al.,* 1977), hardness of seed (Rana *et al.,* 1978), endosperm texture, pericarp thickness, surface wax and grain integrity (Glueck and Rooney, 1977), flavan-4-ols and hardness of grain (Jambunathan *et al.,* 1991) and phenolic acid (Hahn and Rooney, 1986) are known to influence GM resistance. Presence of phenolic compounds (PC) and phenolic acid (PA) in mature caryopsis of sorghum in wet or dry environment (Waniska *et al.,*1989), stele layer and its thickness and electrical conductivity of grain leachates (Somani, 1992) are also reported to play roles in resistance. It is apparent that several factors, independently or in combination, contribute to GM resistance. The most important are tannins, flavan-4-ols, and phenolic acids, type of proteins and grain hardness.

The recently improved early-maturing cultivars have higher harvest index and give stable and high yields under favorable environment, but when they flower fill grains and often mature in wet weather, it results in:

i) increased susceptibility to parasitic and saprophytic fungi that destroy the grain,

ii) loss of seed viability and sprouting on the panicle, and

iii) poor food quality.

Since farmers preferences depend upon the consumption value of the grain and its market price, grain deterioration problem becomes crucial for the extension and adoption of high yielding cultivars.

The high yielding, white-grained cultivars developed recently do not possess sufficient levels of resistance to grain molds. Colored–grained sorghum germplasm lines with high level of mold resistance have been used for developing white-grained genotypes with good levels of resistance in elite materials (varieties) of good grain quality and yield. Mold resistance in white-grained types is associated with grain hardness, while that of brown-grained types with either high tannins or flavan-4-ols or grain hardness. Cultivars with a combination of these factors are highly resistant. It appears that flavan-4-ols is not produced in white-grained types, either mold-resistant or mold-susceptible. At present the only factor known to be responsible for mold resistance in white-grained cultivars is grain hardness. Intensification of efforts to breed mold resistance into high-yielding cultivars is in order, so that farmers can efficiently grow mold-free sorghums (Mukuru, 1992). Due to grain mold problem, seed production of the hybrids that are grown in Maharashtra state is being taken up in southern States. The Maharashtra State Government is thus emphasizing priority to grain mold research in the state.

In view of the above, and the recommendations made at the International workshop held at Harare, Zimbabwe in March, 1988 grain mold has been identified as number one problem of sorghum in India. The present investigation, undertaken at Sorghum Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth (Dr PDKV), Akola (M.S.) during 1994-1997 and at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh during 1995-1997 had the following objectives.

1. To determine the infection sites and colonization of *F.moniliforme, F. pallidorseum* and *C. lunata* at different stages of host maturity.
2. To understand mold resistance heritability using a simple 10 x 10 diallel among resistant and susceptible lines.
3. To study the physical characters viz. glume color, glume covering, grain hardness, electrical conductivity of grain leachates, endosperm texture, pericarp color and thickness, presence of testa layer in relation to mechanisms of resistance to grain mold.
4. To study the biochemical parameters viz., i) proteins ii) soluble sugar iii) tannins iv) flavan-4-ols v) protein fractions viz., albumin and globulin, prolamin, cross-link prolamin, glutelin-like, glutelin and residues in relation to biochemical mechanism of host resistance.

CHAPTER – II

REVIEW OF LITERATURE

PAGES : 6 - 39

CHAPTER II

REVIEW OF LITERATURE

2.1 Predisposition

It is well recognized that predisposition of sorghum panicles to wet and humid weather from flowering to grain maturity period favors infection by grain mold fungi . (Tarr ,1962; Balasubramanian, 1977; Gray *et al.* 1971; Koteswara Rao and Poornachandrudu, 1977; Williams and Rao, 1978; Gangadharan et al., 1978) reported that the wet weather and heavy rainfall stimulate the development of molds at all the stages from the emergence of ears to the ripening of grains, wet weather conditions have a greater bearing on the extent of moldiness. A highly significant correlation exist between the percent of mold grains in earhead and rainfall.

Siddiqui and Khan (1973) reported that grain maturity and not the flowering stage, must coincide with rains for grain mold development, other factors being normal. Under favorable high moisture conditions mature sorghum grains are invaded by *Alternaria, Cladosporium, Phoma* and *Fusarium semitectum* (Seitz *et al.*, 1975).

Dry weather during flowering and grain development followed by wet weather at maturity does not promote serious mold of wet weather that continues from the time of flowering onwards (Williams and Rao, 1978).

Screening of sorghum lines for grain mold resistance under field conditions has successfully been done by spraying panicles with water (Anahosur, 1983; Deshmukh, 1989) or by providing sprinkler irrigation on rainfree days (Butler and Bandyopadhyay, 1990).

A good level of grain mold development was recorded at Hyderabad, Coimbatore, Dharwad and Baraut in years when rainfall was high during flowering to grain maturity period (Indira et aL, 1991). Somani (1992) also highlighted the importance of rainfall in grain mold development.

2.2 Screening/Identification of grain mold resistance

Screening methods used by different workers and sources of resistant/tolerant to grain mold are summarised below:

Reference	Lines	Remarks
1	2	3
Kulkarni et al. (1975)	Selections H-142, H-143, and H-145 from a cross CSV-4 (resistant) x H-112 (susceptible)	-
Glueck (1977)	E-35-1, IS-2327 and IS-2328 (less susceptible)	relatively small glumes
Gangadharan et al. (1976)	K-3 (resistant), CSV-4 (CS-3541), CO-21, CO-22, SPV-34, SPV-181 and IS-3880 (moderately resistant)	-
Anahosur and Patil (1982)	IS-14332, IS-3443 and IS-2328	-
Rao and Rao (1982)	IS(s)-14332 (completely free), 2328, E-35-1, M(s)-38776,6090,90324,61743, 62467,62522 and 64083 (resistant), SPV-104 and CSH-1 (susceptible).	-
	SPV-126, M-90894, E-35-1,SPV(s)-315,312,371 and 311 (resistant), 138, SPV-247, CS-3541, CSV-8R, and M-90253 (moderately resistant)	Field & labora-tary ratings

Contd..

1	2	3
Rao et al. (1984)	CS-3541 (resistant) CSV-5, SPV(s)-35,81,102,126,141 and 249 (moderately resistant) IS(s)-3927,9327,9333 and IS-9530 (resistant)	ICRISAT genetic stock
Chandrasekaran et al. (1985)	SPV(s)-126,346,544,617 and 679 and IS(s) 6265, 8283 and 14332 (promising)	TGMR, disease intensity and germination
Shrotria et al. (1986)	IS(s) 4006,5959,6047,6335,7237, 8131,2930,13798,13804,13598 and PAB-105	Field and laboratory test.
Stenhouse et al. (1990)	IS(s)-9470,15119 (moderately resistant) IS(s)9470, 25077,23585,1815,10696, 10942 and 20884 (resistant)	Male sterility
Anahosur (1992)	SPV(s)-126,312,346,351,386,472, 2219B,DMS-1B,MR(s)-750,849, IS(s)-3443,3547,14332,10892, 14372,14380,22995, and 24996 (resistant)	Screening methods, field grade, TGMR, germination, no loss in 100 grain mass

Contd..

Contd..

1	2	3
	IS(s)-14375,14380,24995, 24996 and 108922	Brown sorghums
Rao et al. (1995)	IS(s)-7173,23773,23783 and 34219 (resistant)	*in vitro* with *F.moniliforme* *C.lunata* *F.pallido-roseum*

2.3 Effect of grain mold on seed weight

Infection by *F. moniliforme* and *C. lunata* has been reported to interfere with carbohydrate translocation to developing kernels, and thus causing reduction in size and weight of seed (Bhatnagar, 1971; Gray *et al.*, 1971; Mathur *et al.*, 1975; Castor and Frederiksen , 1977).

Significant grain weight losses (40-70%) due to infection by several grain mold fungi have been reported (Gray *et al.*, 1971; Sundaram et al., 1972; Glueck and Rooney, 1976; Castor, 1977; Singh and Agrawal, 1989).

Forbes, *et al.* (1989) compared severity with loss in grain weight, the standard deviation of grain weight, grain density, electrolyte leachate, percentage germination and visual appraisal of moldy, off colored or smaller grain. Grain density and grain weight were less closely associated with severity.

Somani (1992) recorded reduction in test weight by 53,51,24 and 9% in combine inoculations (*F. moniliforme and C. lunata),* 46,40,20 and 8% due to *C. lunata* and 42,25,7 and 5% due to *F. moniliforme* when inoculated at 10,20,30 and 40 DAF in 296-B cultivar. Martinez *et al.* (1994) reported decrease in test weight and percentage of seed germination and molding was higher in the white cultivars than in red or brown ones.

2.4 Effect of grain hardness on mold development

Plant breeders and technologists have used the terms "hardness" or "vitreousness" to describe the endosperm textural characteristics of sorghum grain. Although a substantial number of reports have dealt with techniques to measure hardness of wheat grains (Obuchowski and Bushuk, 1980) only limited data available on hardness of sorghum grain (Rooney and Sullins, 1969; Maxson *et al.*,1971).

Grainhardness in sorghum is contributed by several factors, such as grain shape and size, thickness of pericarp, the adherence of pericarp to endosperm and starch-protein interactions (Greenwell and Schofield, 1986). Abedelrahman and Hoseney (1984) reported that cross-link prolamin may be advantageous as it confers hardness to grain.

Rana *et al.* (1977) reported that tan plant type having grains with lower water absorption capacity and higher grain hardness could contribute to mold resistant cultivars. Glueck and Rooney (1980) opined that corneous endosperm texture and more epicuticular wax contributed to increased weathering resistance. Rana *et al.* (1984) reported hardness and rate of absorption of water are predominant additive character offering resistance to grain deterioration.

Mukuru (1988,1992) reported that mold resistance in the white-grain advanced selection was associated with grain hardness. Resistance in red-grain types was associated with flavan-4-ols and grain hardness, while that of brown grain types was associated with either high tannins or flavan-4-ols or grain hardness. Cultivars with combination of these factors are highly resistant. At present the only factor known to be responsible for mold resistance in white-grained cultivars is grain hardness.

In white sorghum without test, grain hardness contributes positively to mold resistance (Bandyopadhyay, 1988; Stenhouse *et al.*, 1990).

Ratios of hardness to grain mass in white-red and brown grained sorghums suggested, that resistance in white and red grains might be due to hardness. Correlations between hardness, grain mass and threshed grain mold ratings (TGMR) generally supported the conclusions (Reddy *et al.* 1991). It was further pointed out that, the flavan-4-ols and hardness were inherited as dominant traits and these together were responsible for resistance in red grained hybrids. Mold resistance in white grained sorghum genotypes without testa could be attributed to their having harder grains than mold susceptible genotypes. Association of both flavan-4-ols and grain hardness with resistance to grain mold is reported. Grain hardness is governed by prolamin content.

Kumari *et al.* (1992) reported that hard grains showed less incidence of grain molds than soft grains during development. Microscopic examination showed more intense deposition of protein bodies in hard than in the soft grains. The presence of fungal hyphae in the endosperm of soft grains and pitted starch granules was clearly visible microscopically. Extract of immature and mature hard and soft endosperm were inhibitory to *F. moniliforme* growth. These inhibitors were heat labile and non-dialyzable indicating that protein factors may be involved. The activities of inhibitors to serene proteases were comparatively higher in endosperm of hard grain during development. The endosperm of hard grain contained more protein and prolamin than that of soft grains.

Mukuru (1992) suggests that for sorghum lines to be mold-resistant their grain must remain hard and vitreous in the field under wet and warm conditions - the ideal environment for grain mold development. Sorghum grains with hard and vitreous endosperm are also known to be least susceptible to storage weevils. However, it was reported that grains with a harder, more vitreous endosperm were less digestible than those having soft endosperm.

2.5 Endosperm texture in relation to grain mold

The relative proportion of the corneous to floury endosperm within a sorghum kernel is often referred to as endosperm texture. Texture can be determined by a visual examination of longitudinal half kernel. The rating ranges from 1 to 5, where 1 means very little floury endosperm (<20%) almost completely corneous and 5 rating means essentially all floury (>80%) endosperm. Munck (1981) reported that determination of percent of soft (or 'floury') portion in kernels of sorghum is another measure of hardness.

Kirleis *et al.* (1984) developed a method for measuring endosperm texture by quantitatively determining the corneous and floury areas of sectioned sorghum grain using a light microscope. The corneous endosperm characteristics are not necessary for resistance to weathering; however, if all other things were equal, a line with more corneous grain would resist deterioration more than a floury endosperm line, because of the more dense structure and organization (Clark *et al.,* 1973; Ellis, 1972, 1975; Garud, 1992).

Glueck *et al.* (1977) and Glueck and Rooney (1980) used several lines that had consistently ranked high among the most resistant to weathering at all locations in several years of testing, and concluded that grains with more corneous endosperms were more likely to resist deterioration than floury endosperm lines. However, Mansuetus (1990) reported that endosperm texture had no effect on grain mold score, but in all cases the presence of the testa decreased mold incidence.

Somani (1992) reported that corneousness of endosperm contributes towards resistance in white grain genotypes. He used iodine vaporization method. Hardness grades were attributed on the basis of lower absorption corneous endosperm do not take much color.

2.6 Electrical conductivity of grain leachates and grain mold development

Glueck *et al.* (1977) suggest several possible mechanisms for resistance to grain deterioration, including rate of water absorption and conductivity of seed leachates and these tests may be useful as preliminary screening method. Glueck and Rooney (1980) reported that cultivars with rapid rate of water uptake exhibited less resistance to weathering. Composition of leachates from these cultivars was richer in nutrients. A thicker mesocarp and softer endosperm texture usually corresponded to increased water absorption and richer leachates. Forbes (1986) reported that automatic measuring of seed leachates and its correlation with seed germination could become an efficient technique for studying the effect of GM severity on viability. Grain mold severity, caused by *F. moniliforme* was positively correlated with electrolyte leachates (Forbes et al., 1989).

Somani (1992) also reported that electrical conductivity of seed leachates was more in susceptible cultivars.

2.7 Glume color and glume covering

Murty (1975) noticed *Curvularia* infection on the portion of seed not covered by glume and concluded that open heads with seeds completely enclosed in long papery glumes are relatively resistant to field deterioration. Gangadharan *et al.* (1978) noticed that fully enclosed grain by glume and loose heads are the factors associated with resistance. Glueck and Rooney (1980) reported that panicle shape, glume characters, wet season avoidance, seed size contribute to increased resistance to grain molding. Longer glumes are considered protective to the grain, but only if the glumes do not trap water. Narayana and Prasad (1980) suggested besides permeability of grain, hard grain, papery pericarp as reported by various workers, the glume characters, viz. glume permeability, tight/loose attachment of glume to seed were also other possible factors and structural and chemical composition of seed also contribute to resistance. Studies of Mansuetus, *et al.* (1988) showed that disease incidence was negatively associated with glume cover (r=-0.56), glume length (-0.56) and glume area (-0.62) at the boot stage. Somani (1992) also reported that covered kernel with compact glumes showed less grain molds.

2.8 Pericarp/Mesocarp

Swanson and Hunter (1936) pointed out that the great discrepancy between laboratory and field germination of better known sorghum varieties was due to the relative thickness of starchy layer of cells located in mesocarp. When seeds soaked in water for 2 hours, the varieties having thick mesocarp (70-80 µm) absorbed about 33% more moisture than the varieties which had thin mesocarp (20-50 μm). Glueck and Rooney (1977) found that water enters through the pericarp, especially through hilum area. Long enveloping glumes does not necessarily protect the grain from weathering, open glume types are probably more vulnerable to sprouting on the head, pigmentation in pericarp and glume is not necessary related to resistance, though it may impart slight degree of resistance. They also reported that thin mesocarp sorghum withstand weathering better than those with thick mesocarp and that quantity of surface wax was probably not a factor since the most susceptible lines had adequate or greater quantities of surface wax when compared to resistant lines. However, alteration in the distribution of wax on the surface of pericarp may affect water uptake by the grain. A thin pericarp on sorghum caryopsis normally corresponds to less weathering. Glueck and Rooney (1980) reported that at physiological maturity, colonies of fungi was observed in starchy mesocarp and the cross and tube cells of the pericarp in all cultivars. Since fungal colonies were observed inside the pericarp are readily hydrolyzed by saprophytic fungi. Hence, a thick mesocarp that contains starch and protein support more fungal colonies than sorghum with thin mesocarp. The mesocarp is thin when the Z gene is dominant (Z-) and thick when the gene is recessive (zz). Also most of free phenolic compounds are located in pericarp and the adjoining testa layer. These apparently bioactive compounds would be diluted with starch etc, in a thick pericarp.

Narayana and Prasad (1980) suggested besides permeability of grain, hard grain, papery pericarp as reported by various workers, the glume characters, viz. glume permeability, tight / loose attachment of glume to seed were also other possible factors and structural and chemical composition of seed also contribute to resistance.

Castor (1981) from his histopathological studies reported that mesocarp provides an ideal environment for early colonization and a jumping – off point for fungi to continue the deterioration on the grain after the infection has taken place. Miller (1981) noticed that thick mesocarp types are susceptible to grain mold. Bandyopadhyay *et al.* (1988) when screened 26564 selected accessions from the world collection of sorghum germplasm in field during the 1980-85 rainy seasons found that all resistant accessions except one, had colored pericarp. Waniska *et al.* (1992) observed that sorghum cultivars that exhibit some resistance to deterioration have thin pericarp besides corneous endosperm and specific phenolics. The red pericarp trait also conferred grain mold resistance to certain extent. The effect of a red pericarp was enhanced by the presence of a intensifier gene. The effect of both pigmented testa and red pericarp were additive. Mesocarp thickness did not play a significant role in grain mold resistance.

2.9 Loss of seed viability and germination

Tarr (1962) reported that *Aspergillus, Fusarium* and *Rhizoctonia* species were responsible for poor emergence of sorghum seedlings, since these fungi destroy starchy endosperm of seed and thus deprive young seedling of it's food. Arif and Ahmed (1969) found that *Fusarium* spp. were the most harmful, followed by *Aspergillus, Penicillium* and *Helminthosporium* in reducing germination. Narasimhan and Rangaswamy (1969) found a viability reduction of 40 to 80% when healthy sorghum seeds were treated with mold isolates. Bhatnagar (1971) and Castor (1977) noticed that fungus infected seeds often exhibited a reduction in germination and emergence, which caused poor stand in the farmers fields.

Tripathi (1974) obtained 56% germination with moldy sorghum grains, whereas apparently clean grains gave 76% germination. Further, they reported reduced germination by (42%) due to *Colletotrichum graminicola* followed by *C. lunata* (40%), *F. moniliforme* (37%), *Phoma insidiosa* (26%), *Penicillium* spp. (23%) and *Aspergillus flavus* (18%). Castor (1977) reported reduction of germination from 95 to 77% with grain harvested from *Fusarium* spp. inoculated heads. Rao and Williams (1977) obtained viability loss upto 100% in sorghum grains with severe *Fusarium* and *Curvularia* infection. Denis and Girard (1977) and Castor and Frederiksen (1980) considered, loss in viability to be so important part of grain mold, that they recommend a germination test as part of standard evaluation for identification of grain mold resistance. Munghate (1980) recorded 0.75 to 25.25% and 0.75 to 5.30% loss in germination due to *C. lunata* and *F. moniliforme,* respectively. Bhale and Khare (1982) observed pre- and post-emergence mortality due to seed borne *C. lunata* and

F. moniliforme in water agar seedling symptom test method. Vidyasekaran (1983) and Granja and Zambolim (1984) recorded low germination of sorghum seeds due to severe infection of *F. moniliforme.*

Forbes (1986) stated that severity appears to be more closely associated with seed viability than with yield, two measures of severity (ergosterol concentration and propagules of *F. moniliforme* g-1 seed tissue) were highly correlated with percent germination than with seed mass or grain density. Automatic measuring of seed leachates and correlation with germination could become an efficient technique for studying the effect of GM severity on viability. Deshmukh (1989) reported that *C. lunata, F. moniliforme* and *Exserohilum halodes* caused considerable reduction in germination. Singh and Agrawal (1989) noted that seedling from infected seeds were less vigourous than those from healthy seeds. Wu and Cheng (1990) reported that the incidence of *C. lunata* in blotter test was negatively correlated with seed vigour. The incidence of three pathogens (*C. lunata, F. moniliforme* and *P. sorghina*) in blotter test was significantly correlated with abnormal seedlings in seedling evaluation, seedling growth and accelerated aging tests.

2.10 Seed mycoflora

Seed mycoflora of sorghum varies from region to region. Frequently occurring fungi associated with moldy sorghum grain mold complex reported by different workers throughout the world is summarised below:

Location	Fungi detected	Infection frequency(%)	Reference
1	2	3	4
Georgia	*Colletotrichum graminicola*, *Curvularia* spp., *Fusarium* spp., and *Penicillium* spp.	-	Luttrell (1950)

Contd..

Contd..

1	2	3	4
Kansas, USA	*Alternaria tenuis*, *Curvularia* spp., *Fusarium* spp, and *Aspergillus* spp.	-	Swarup (1955)
India	*Curvularia* spp., *F. moniliforme*, and *F. oxysporum*,	-	Mathur et al. (1967)
Edembergh	*Ascochyta sorghi* *F. moniliforme*, *C. lunata*, *C. graminicola*, *Drechslera* spp., and *Peronosclerospora sorghi*.	-	Noble and Richardson (1968)
Maharashtra	*Aspergillus niger*, *C. lunata*, *F. moniliforme*, *F. semitectum*, *Helminsthosporium rostratum* and *H. tetramera*	-	Bhagwat and Pedgaonkar (1973)
	F. moniliforme	-	Bhagwat and Datar (1974)
	C. lunata	42%	Tripathi (1974)
	F. moniliforme	19%	
	A. flavus -	15%	
	Phoma insidiosa	13%	

Contd..

Contd..

1	2	3	4
India	*F. moniliforme* and *F. semitectum*	-	Mathur et al. (1975)
	C. lunata	35%	Khare et al. (1976)
	A.tenuis	31.2%	
	F. moniliforme	10.0%	
	F. roseum	12.5%	
	A.niger	3.1%	
	F. oxysporum	2.5%	
Madhya Pradesh	*C. lunata*, *Alternaria* spp., *Fusarium* spp. and *Verticillium* spp.	-	Sharma et al. (1976)
USA	*Fusarium* and *Curvularia*	-	Castor 7)
USA	*C. lunata* and *F. moniliforme*	-	Castor and Frederiksen (1977)
India	*Curvularia*, *Fusarium* and *Phoma*	-	Reddy and Reddy(1977)
USA	*Alternaria* spp., *C. lunata*	-	Castor and Frederiksen (1980)
	F. moniliforme, *Fusarium* spp., *H. tetramera* and *Phoma* spp.		
India	*Curvularia* spp and *Fusarium* spp.	-	Williams and Rao (1978)

Contd..

Contd..

1	2	3	4
Brazil	*Alternaria alternata* and *Curvularia* spp.	-	Pinherio et al. (1979)
Karnataka	*A. alternata, C. lunata Drechslera specifera, F. moniliforme, F. semitectum, Phoma sorghina* and *Trichothecium roseum*	-	Anahosur and Hegde (1980)
USA	*Gibberella fujikuroi*	-	Castor and Frederiksen (1981)
India	*Curvularia* spp and *Fusarium* spp.		Williams and Rao (1981)
Madhya Pradesh	*C. lunata*	2-49%	Bhale and Khare (1982)
	F. moniliforme	4-30%	
	P. insidiosa	2-5%	
Philippines	*F. moniliforme* and *C. lunata*	-	Dayan and Dalmacio (1982)
Taiwan	*F. moniliforme, C. lunata,* and *Phoma sorghina*	-	Wu (1983)
India	*F. moniliforme, F. oxysporum,* *F. semitectum* and *F. solani*	-	Gopinath and Shetty (1985)

Contd..

Contd..

1	2	3	4
India	*C. lunata*	27.7%	Singh and Agrawal (1987)
	F. moniliforme	9.4%	
	P. sorghina	8.4%	
	C. lunata, Drechslera sorghicola	-	Gupta and Singh (1988)
	F. moniliforme and *Phoma* spp.	-	
China	*F. moniliforme* and *F. oxysporum*		Liang and Bai (1988)
Vidarbha	*C. lunata*	62%	Deshmukh (1989)
	F. moniliforme	26%	
Inida	*C. lunata, F. moniliforme* and	-	Singh and Agrawal (1989)
	Phoma sorghina		
Taiwan	*C. lunata, Drechslera maydis* and *F. moniliforme*	-	Wu and Cheng(1990)
Thailand	*C. lunata, Fusarium* spp.,	-	Boon-Long (1992)
	Colletotrichum spp. and		

Contd..

Contd..

1	2	3	4
	Phoma spp.		
Central America Carribean Basin	*F. moniliforme* and *C. lunata*	-	Wall and Meckenstock (1992)
Vidarbha	*C. lunata* and	44.6%	Somani
	F. moniliforme	40.8%	(1992)

Biochemical parameters

2.11 Proteins (protein fractions)

Sorghum proteins varied in their properties and amino acid composition. It has also been reported that protein content has been negatively related to lysine content. (Virupaksha and Sastry, 1968). Deosthale *et al.* (1972) reported that sorghum genotypes, growing environment and nitrogen fertilization influenced the protein content in sorghum. Gupta and Gupta (1974) suggested that the quality of protein depends on amino acid composition and proportion of various classes of proteins. They also observed that in sorghum levels of prolamin and glutelin progressively increased from early milky stage to maturity stage. There was progressive increase in the fraction IV (glutelin like) from 7 to 35 days of maturity period, which then stabilized until maturity. Insoluble protein contents in the residues were high during the first 7 days and decreased until 21 days, with very little change thereafter.

Jambunathan *et al.* (1975) and Guiragossian *et al.* (1978) reported distribution of nitrogen in different fractions of proteins from the grains of IS-11167 and IS-11758. Glueck *et al.* (1977) reported that the proteins are hydrolyzed and partially used in the synthesis of fungal protein and remain in the moldy grain. Guiragossian *et al.* (1978) observed that mutation in P-721 sorghum decreased quantity of kafirin (Prolamin) with an increase in the albumin-globulin fraction. Rooney and Miller (1982) reported that the matrix protein is comprised mainly of glutelins (alkali-soluble proteins) and prolamins. (alcohol-soluble protein). The prolamin, exists in small spheres called protein bodies. Physical and chemical characteristics of the grain from different sorghum varieties influenced solubility's and chemical scores of protein fractions (Neucere and Sumrell, 1979). Nwasike *et al.* (1979) observed that, in general cross-link prolamin is high in sorghum, as compared to pearl millet and corn. Jambunathan *et al.* (1983) reported that protein content in 146 grain samples obtained from the ICRISAT breeding program, lysine, normal sorghum grains and their progenies, ranged from 7.1 to 19.1%.

Subramanian *et al.* (1983) reported 8.8 to 13.2% with mean value 10.56% protein content in 18 brown sorghum genotypes. They also reported protein content in 8 grain samples comprising land races, hybrids and local cultivars, ranged from 6.8 to 19.6%. Also observed that protein content of developing grain was high 7 and 14 days after anthesis, and a decline was observed towards maturity. Cross link prolamin may be advantageous as it confers hardness to the grain (Abdelrahman and Hoseney, 1984). Subramanian and Jambunathan (1984) estimated protein content in sorghum germplasm accessions that varied from4.4% to 21.1% with mean value of 11.4%. Van Scoyoc *et al.* (1988) reported that the percentage distribution of fraction I, expressed as percent of total nitrogen, declined rapidly and steadily in developing sorghum grain. However, when expressed as N content/ endosperm, the patterns of nitrogen per endosperm for fraction I were very different from those expressed as a percentage of total protein. Prolamin synthesis was low during first seven days after anthesis (DAA), reached to its maximum from 14 to 28 days and declined thereafter. Synthesis of cross-linked prolamin steadily increased until maturity. This suggests that prolamin was synthesized in different proportion during different stages of grain development. Onset of active synthesis of glutelin was observed from 21 days after anthesis, with little change until maturity.

Subramanian *et al.* (1990) studied the distribution of protein fractions in grains revealed that, fraction I, comprising albumin - globulin including non-protein nitrogen, and fraction V (glutelin) together constitute about 41.55% of the protein in eight sorghum cultivars. Variation in fraction II (prolamin) fraction III (cross-linked prolamin) contents was observed among the cultivars. To elucidate the pattern of synthesis of protein fraction in grain, studies were made at different grain maturity periods, using one cultivar. Fraction I, synthesis was initiated at seven DAA. Prolamin increased from 14 to 28 days and declined toward maturity. Glutelin did not change beyond 14 days and declined toward maturity. Glutelin did not change beyond 14 day after anthesis until maturity.

Indira *et al.* (1991) noticed that grain hardness is generally governed by prolamin content. Desai *et al.* (1994) reported grain protein content from 8.94% to 12.38%, averaging 10.63% in 13 sorghum cultivars comprises of land race hybrids, local cultivars. Kumari and Chandrashekar (1992) reported the endosperm of hard grains contained more protein and prolamin than that of soft grains. Somani *et al.* (1993) in analysis of grain revealed that the crude protein content was slightly reduced in the discolored grain. The amino acid spectrum was also changed in these grains and it is suggested that this may be due by hydrolysis of weakened protein matrix.

Seetharaman *et al.* (1994) reported the presence of antifungal proteins in several sorghum cultivars using antibodies raised against zeamatin, barley chitinase and bean chitinase. Seetharaman *et al.* (1996) reported changes in sorghum caryopsis antifungal proteins (AFP) in different tissues and during development imbibition, and germination, Somatin, chitinase and glucanase levels increased during caryopsis development and highest at physiological maturity (30 DAA). Ribosome inactivating protein levels were higher at 15 DAA and decreased subsequently. Somatin and chitinase levels were significantly different between sorghum cultivars. Somatin content at physiological maturity correlated with mold rating (R(2) = 0.65). Seed AFPs were present in endosperm and migrated toward the extension of caryopsis upon imbibition. AFPs leached out of immature seeds but were retained in the pericarp of mature seeds. Levels of these proteins also changed significantly during seed germination and were present in the shoots of germinating caryopsis.

2.12 Soluble sugars

Edwards and Curtis (1943) analysed 26 sorghum samples for soluble sugars and the content varied from 0.81 to 1.59%. Sorghum seed with sugary endosperms have been reported to contain at least twice the quantity of sugars that normal seed contain (Karper and Quinby, 1963).

Glueck *et al.* (1977) reported that in deteriorated grain the soluble carbohydrates are usually decreased as they are used to provide energy for the growth and development of the fungi. Neucere and Sumrell (1980) reported that free sugar content in five varieties of sorghum varied from 2.34 to 6.01%. Subramanian *et al.* (1980) reported the total sugar content of the 10 sorghum cultivars varied from 1.30 to 5.19%. The high lysine Ethiopian lines, IS-11163 and IS-11758 had higher sugar content i.e. 5.19 and 4.43 % respectively. They also estimated that sucrose is the predominant sugar in the sorghum grain. The proportion of sucrose ranged from 68.7 to 82.7% of soluble sugars in the sorghum cultivars. Subramanian *et al.* (1983) reported the soluble sugar content of the 18 brown sorghum genotypes ranges from 1.1. to 2.5%.

2.13 Tannins and Flavan-4-ols

Swain and Bate-Smith (1962) defined tannins as phenolic compounds (PC) having molecular weights between 500 and 3000. Depending on their molecular structure, tannins are customarily divided into hydrolyzable and condensed tannins. Hydrolyzable tannins are complex molecules containing ester type linkages, which yield on hydrolysis, a sugar and phenol residue consisting ester type linkages. These consist of either gallic or ellagic acid, which is dimer of the former. Condensed tannins are formed by the polymerization of molecular units having the general structure of flavanoids, the most important of which are flavan-3-ols (catechin) and flavan-3, 4-diols (leucoanthocyanidins). Relatively little is known about the occurrence and distribution of proanthocyanidins and leucoanthocyanidins in sorghum tissues. As a result of injury or physiological stress, sorghum leaf tissue frequently develop red coloration due to anthocyanidins. Leucoanthocyanidins could be precursors of these pigments. Harris (1969) reported that brown-seeded hybrids have higher tannins levels than red or yellow seeded hybrids. Weinges *et al.* (1969) and Watterson and Butler (1983) noticed that certain monomeric flavanols, such as flavan-3,4-diols and flavan-4-ols can give rise to anthocyanidins and therefore these can be distinguished from the oligomeric flavan-3-ols by the name "leucoanthocyanidins".

Maxson et al. (1972) stated that kernels with a testa or a coloured pericarp should be tested for tannins and those with values lower than 0.05 catechin equivalents/g of sorghum be selected. McMillan *et al.* (1972) mentioned that tannins present in the grains of certain varieties resist bird depredation. Bullard and Elias (1980) reported that resistance to bird depredation is a complex phenomenon that may be associated with non-tannin polyphenols, as well as tannins.

Harris and Burns (1973) reported that sorghum seed tannins content was strongly and negatively correlated with pre harvested seed molding indices. Brown seed with high tannin contents and the presence of pigmented testa are relatively resistant to field deterioration (Ellis, 1972; Murty, 1975). High tannin sorghums tend to be less digestible and nutritionally inferior to sorghums in which tannin is absent or present at low levels (Maxson *et al.,* 1973; Jambunathan and Mertz, 1973; Mabbayard and Tipton, 1975) reported that pericarp color may not be a reliable indicator for tannin concentration.

Price *et al.* (1979) and Hagerman and Butler (1981) noticed that tannins binds certain proteins very strongly and thereby diminish the digestibility and nutritional value of high tannin sorghum grains. Most cultivars with pigmented testa containing polymer of flavan-3-ols (tannins) resist weathering. (Glueck and Rooney, 1980; Hahn *et al.,* 1983; Bandyopadhyay *et al.,* 1988). Hagerman and Butler (1980) noticed tannin associated proteins consists of three major components, two of which are high molecular weight prolamins and one of these was quite rich in proline. Butler (1981,1982) reported that the most important factor controlling the affinity of a protein for sorghum tannin, was the amount of proline that it contains. The affinity of protein for tannin can be predicated with reasonable accuracy from its proline content. Also reported that flavan-4-ols monomers may contribute to bird repellency of high-tannin sorghums. Rooney and Miller (1981) pointed that phenolic compounds in sorghum caryopsis improve resistance to birds, insects and molds as well as pre harvest germination.

Hahn *et al.* (1983) separated PA and identified eight acids from sorghum extracts by HPLC, their concentration and whether bound or free differed with cultivar. Sorghum grain resistant to fungal attack contained both a greater variety and larger amounts of identified PA and unidentified compounds. Resistant cultivars had more PA in free form. Subramanian *et al.* (1983) reported tannin content (catechin equivalents) in 18 brown sorghum genotypes which ranged from 0.13 to 7.22 CE % . They reported that variation in nin content was much larger than variation in the other constituents. Detailed polyphenol analysis on selected genotypes indicated that some lines had insignificant levels of condensed tannins, that none of them was a group II sorghum and that the levels of flavan-4-ols were relatively high. Cultivars with red pericarp (with or without pigmented testa) containing significant levels of flavan-4-ols exhibit resistance to weathering. Mukuru (1992) found that cultivars with white pericarp without pigmented testa do not contain significant levels of flavan-4-ols, yet some of these cultivars exhibit resistance to weathering. Apparently, flavan-4-ols and related compounds are involved in some way with resistance to grain weathering. Hahn *et al.* (1984) concluded that phenolic compounds i.e. phenolic acids, flavanoides, anthocyanidins and tannins are located primarily in the pericarp and testa layers of the sorghum caryopsis. Ring (1984) detected phenolic compounds in leaves and glumes of sorghum. Jambunathan *et al.* (1986) analysed polyphenol concentrations in grain, leaf and callus tissues of mold susceptible and mold resistant sorghum cultivars and reported that the level of flavan-4-ols were two to three-fold higher in mold-resistant cultivars than in mold-susceptible cultivars. Doherty *et al.* (1987) and Forbes (1986) reported that free PC and tannin contents in caryopses increase significantly during development, reaching maximum levels 7-18 DAA. At maximum, the levels of free PC and tannins were two to eight times higher than those observed in mature grain. PC and tannins are apparently being bound to cellular tissues, and therefore are not extractable for analysis. The high level of free PC and tannins occurred during the period of early invasion and colonization of fungi of the caryopsis. Hence, it is likely that these compounds are involved in the resistant mechanisms of grain weathering. Bandyopadhyay *et al.* (1988) reported 24 grain mold resistant accessions with colored pericarp had negligible amounts of tannin (less than 1.0 CE%) and 14 of the 24 lacked the testa layer. The range of tannin content in the resistant accessions was 0.1-10.7 CE%. Mansuetus *et al.* (1988) observed that resistant cultivars had higher free PC content in their glumes and mature cayopses, and showed greater increase in these compounds in response to infection than susceptible cultivars. Measurements of parahydroxybenzoic, coumaric, vanillic and gentisic acid contents indicated that phenolic-bound acids provide the plant with back-up defence to *F. moniliforme* when free PA have been depleted from the caryopses.

Forbes *et al.* (1989) reported that resistant cultivars also respond more quickly to fungal invasion via increased levels of PC and pigmentation of spikelet tissues than do susceptible cultivars. Waniska *et al.* (1989) quantified PC and PA in mature caryopses of sorghum grown in wet or dry environments. Seventeen cultivars varying in pericarp color and presence of pigmented testa exhibited different degree of resistance to molding in wet environment. Sorghum caryopses with white pericarp had lower free PC contents (14 micro g/ caryopses) than those with red pericarp (41 micro g / caryopses) when grown in the dry environment. This difference diminished under humid conditions Cultivars with a pigmented testa were more resistant to grain mold, had higher free PC content (151 micro g/ caryopses), and had softer endosperm texture than cultivars without a pigmented testa. In cultivars without pigmented testa, higher free PC and free PA contents especially free P-coumaric, ferulic and caffeic acids, were observed in mold susceptible cultivars. A scatter plot of free PC vs. free P-coumaric acids indicated that mold susceptibility was related to higher levels of P-coumaric acid, regardless of environment. Jambunathan *et al.* (1990) analysed methanol and acidified-methanol extracts of grains harvested at different developmental stages for flavan-4-ols and reported that the concentration of flavan-4-ols in mold-resistant grains were at least 2-fold higher than in mold-susceptible grains in both extract at or after 30 days flowering (DAF). Concentration of flavan-4-ols in mature grains could, therefore, be an indicator of their potential resistance or susceptibility to grain mold, and this method could be an important tool in screening sorghum cultivars for such characteristics.

Jambunathan and Kherdekar (1991) reported that methanol and acidified methanol extract of leaves of mold resistant accessions contained at least 3-fold higher concentrations of flavan-4-ols than susceptible accessions at 56,63 and 70 DAF. The concentration of flavan-4-ols was monitored in the flag leaves of mold resistant accession that had no testa at 77,84 91 and 98 DAF, and it decreased sharply at or after 70 DAF. The estimation of concentration of flavan-4-ols in sorghum leaves, therefore offer scope for screening sorghum accessions for their grain mold resistance. Jambunathan *et al.* (1991) reported that ergosterol concentration increased with increasing DAF in the mold susceptible accessions and was 10-fold higher in grains collected at 50 DAF than in the corresponding mold-resistant accessions. It is suggested that ergosterol concentration could be used to assess the magnitude of mold damage in sorghum grains. The correlation coefficient between ergosterol and flavan-4-ols concentration was significant ($P < 0.01$) and negative in colored mold-susceptible and mold-resistant accessions that did not have testa, but no significant correlation was observed in white mold resistant and mold-susceptible sorghum. It was concluded that there could be another genetic factor or mechanism besides flavan-4-ols associated with mold resistance in white grained sorghums. Mukuru (1992) reported mold resistance in the white-grained types was associated with grain hardness, while that of brown-grained types was associated with either high-tannin or flavan-4-ols or grain hardness. and also reported that flavan-4-ols is not produced in white-grained types, either mold-resistant or mold-susceptible.

Resistant cultivars respond more quickly than the susceptible cultivars to fungal invasion via increased levels of phenolic compounds in glume tissues. Extensive deterioration does not occur before physiological maturity because the developing grain contains 3 to 10 times the level of specific phenolic compounds of mature grain. In sorghum grown under wet conditions, grain of resistant cultivars contains lower levels of free phenolic compounds at maturity compared with grain of susceptible cultivars, hence phenolic compounds content in grain is a predictor of the sorghum cultivars level of resistance to grain molding Waniska et al. (1992). Martinez *et al.* (1994) evaluated 9 sorghum cultivars for resistance to *F. moniliforme [G. fujikuroi]* in field experiment in Argentina. Three cultivars (SC-630-11E, MF-5107 an MF-5097) were resistant; these cultivars had a higher concentration of flavan-4-ols than the white pericarp cultivars (BTX623, ICSB-34, BArg 34 and Bvar) and less tannin than the control brown pericarp cultivars (B-1509 and MF-5194). Melakeberhan *et al.* (1996) evaluated 10 sorghum genotypes with differences in phenolic compound concentration and grain mold resistant over three crop seasons (1989, 1990 and 1992) to assess changes in phenolic compounds during seed development and how these changes influence grain molding. Flavan-4-ols concentration were high and similar for both the mold resistant and mold-susceptible genotypes at early stages of seed development. In susceptible genotypes, the flavan-4-ols concentration dropped by 67% between third and last sampling dates compared with a 20% decline for the resistant genotypes in the same period. The results also showed that highest incidence of seed infection by fungi occurred between 25 and 35 days after anthesis. *Alternaria, Fusarium* (especially *F. moniliforme*) *Cladosporium*, and *Epicoccum* species were the major fungi isolated from the seeds. Menkir *et al.* (1996) identified sorghum accessions with high level of grain mold resistance, originating from diverse geographical areas and belonging to different botanical races. Resistance to grain mold in these sorghums was strongly associated with high concentration of phenolic compounds (apigeninidin, flavan-4-ols and tannin), kernel hardness and pericarp color. Each of these kernel properties contributed to grain mold resistance differently in white, red and brown pericarp sorghum accessions, respectively.

2.14 Presence of testa layer and resistance to grain mold

Ellis (1972) studied the morphological characters indicating grain mold resistance and reported that pigmented testa was the most influential seed characteristic affecting weathering resistance in the field. Furthermore, within a given genetic background and when the pigmented testa was absent, lines with red or lemon yellow were more resistant than lines with white pericarp to grain mold. The ability of pigmented testa to resist grain mold development is attributed to its high tannin content.

Maxson *et al.* (1972) described the level of tannins and their effect on nutritional value as related to the presence or absence of the testa and spreader in sorghum. Cummings and Axtell (1973) proposed a scheme to classify sorghum in groups I,II and III based on chemical analysis and redefined by Price and Butler (1977). Group I does not have testa, group II has a testa (B1-B2-SS), and group III has a testa and spreader (B1-B2-S-). Harris and Burns (1973) and Murty (1975) reported that brown seed with high tannin content and the presence of pigmented testa are resistant to field deterioration. Glueck and Rooney (1980) identified that sorghum lines high in tannin content and having testa layer were more resistant to grain mold fungi. The presence or absence of testa layer is controlled by the B1 and B2 genes. When the complementary B1 and B2 genes are dominant (B1-B2-), testa pigmentation is present and when either or both genes are homozygous recessive (B_1-b_2b_2, b_1b_1 B_2-, or $b_1b_1b_2b_2$), pigmented testa is controlled by another gene (Tp) in which brown is dominant to purple. The spreader gene (S) allows the brown colour of pigmented testa to be present in epicarp (S-).

Bandyopadhyay (1986) pointed out that IS-14384 has no testa and no tannin and is promising against grain mold (ICRISAT, 1986). Cultivars with red pericarp (with or without a pigmented testa) containing significant level of flavan-4-ols exhibit resistance to weathering (Jambunathan *et al.*, 1986; Mukuru, 1992).

Jimnez and Valleja (1986) reported that tolerant entries to *C. lunata* were those which had a pigmented testa and floury endosperm. In the presence of testa, texture was not an important trait but in the absence of testa corneousness or floury endosperm showed maximum tolerance than those with intermediate texture. Waniska *et al.* (1989) reported that, PC and PA were quantified in mature caryopses of sorghum grown in wet or dry environments. Seventeen cultivars varying in pericarp color and presence of a pigmented testa exhibited different degree of resistance to molding in the wet environment. Mansuetus (1990) correlated mold incidence with the presence of testa. Eighty percent of the selection were brown grained with testa and with TGMR of 2 or less. Twelve percent were red or white without testa and TGMR of 3 or less indicating the importance of testa in imparting grain mold resistance (Stenhouse *et al.*, 1990). The effect of both pigmented testa and a red pericarp were additive, mesocarp thickness did not play significant role in grain mold resistance.

2.15 Artificial inoculation of sorghum with fungi at different stages of grain development

Castor (1977) inoculated *F. moniliforme, F. semitectum, C. lunata C. protruberata, Alternaria* spp. and *Helminthosporium* spp. at various times after flowering. The *Fusarium* and *Curvularia* isolates were the principal pathogens causing discoloration and reduction in seed viability. Seeds from the heads inoculated with *Fusarium* at flowering had the highest proportion of split pericarps. Rao and Williams (1977) reported high levels of grain mold in sorghum, when heads inoculated at anthesis with conidial and mycelial suspensions of *F. moniliforme, F. semitectum* and *C. lunata.* Castor and Frederiksen (1980) reported that inoculation ($2.2x10^3$ conidia/ml) at anthesis or within 2 to 3 days of anthesis resulted in greatest damage, suggesting that floral tissues (glumes, stigmas, styles etc.) are most susceptible at flowering and becomes less susceptible thereafter. They inoculated sorghum lines with *C. lunata* at anthesis and noticed that infection occurs in glumes, lemma, palea and lodicules in 5 days after anthesis. Colonization of pedicel tissues resulted in kernel abortion or in reduced kernel filling. Narayana and Prasad (1982) inoculated *F. moniliforme* and *C. lunata* singly and in combination in equal proportion at preflowering and post flowering periods. *F. moniliforme* was observed to be more infective at flowering and *C. lunata* at soft dough stage. Combine inoculation was more effective from anthesis to dough stage. Deshpande *et al.* (1985) noticed that artificial inoculation with *C. lunata* not only reduced seed germination and seedling vigour index but increased abnormal seed germination than with *Fusarium*. Bandyopadhyay and Mughogho (1988a) inoculated *F. moniliforme, F. pallidoroseum* and *C. lunata* on flowering panicles of six genotypes which were watered with sprinkler on the days of no rainfall from flowering to grain maturity and harvest. They reported that TGMR of susceptible and resistant genotypes were significantly greater and germination of susceptible genotypes lower in plot with sprinkler irrigation than in plot receiving only rainfall.

Singh *et al.* (1993) inoculated with a mixed spore suspension of *F. moniliforme, F. pallidoroseum* and *C. lunata* at 50% anthesis on 14 accessions. Genotypes IS 7173, IS 23773, IS 23783 and IS 34219 were completely resistant to mold upto 55 days after inoculation and a further six (IS-7326, IS-4963, IS-5726, IS-4011, IS-5292 and IS-27761) developed moderate to low mold growth.

Somani (1992) inoculated *F. moniliforme* and *C. lunata* at 10, 20,30 and 40 DAF and observed that if the infection takes place at flowering, no grain development takes place and germination increases linearly with the advancement of grain development. *F. moniliforme* infection is usually at or earlier to soft dough stage where as that of *C. lunata* is from dough stage onwards.

2.16 Histopathology of infection by molding fungi

Mathur, *et al.* (1975) noticed embryonic infection by *F. moniliforme* and *F. semitectum*. They could locate deep seated infection of *Alternaria tenuis, C. lunata* and *Drechslera sorghicola.*

Castor (1977) observed that the scutellum was often partially degraded in seed from *Fusarium* inoculated heads and suggested that the fungus could destroy the embryo indirectly by interfering with translocation from the endosperm to the embryo during germination. All the grain from susceptible *Fusarium* – inoculated heads contained *Fusarium* in the endosperm and 78% of grain from *Curvularia* – inoculated heads had that fungus in the endosperm. Rao and Williams (1977) noticed that inoculations at anthesis or within 2-3 days of anthesis resulted in invasion in greatest tissues. That indicates that floral tissues (Glumes, stigmas style etc.) are most susceptible at flowering and becomes less susceptible there after. Abdullah and Dadhum (1978) observed embryonic infection by *Aspergillus fumigatus* and *Gibberella fujikuroi* in sorghum. Castor and Frederiksen (1980) compared seeds from heads inoculated with *F. moniliforme* , *F. semitectum* and *C. lunata* and observed that *F. semitectum* produced minimum discoloration and no degradation of endosperm and germ tissues. *C. lunata* resulted in partial degradation of the endosperm and appeared to progress slowly inward from the pericarp. *F. moniliforme* appeared to colonize the region where hilum, scutellum and endosperm fuses. They also reported that there are some evidences suggesting that *F. moniliforme* growth over the kernel surface occurs after complete colonization of the endosperm tissues. *F. moniliforme* was found initially beneath the glume, around the germ and hilum where as *Curvularia* produced mold on portions of the seed not covered by glumes. Blakely and Castor (1979) reported that fungi enter through hylar and stylar ends and they further stated that the embryo region which is under the hylar areas was damaged the most implying that the hylar area is the most readily accessible to fungi. Castor (1979) isolated fungi from different grain components and noticed that embryo contain less fungi than any other tissue.

Castor (1981) studied histopathology of grain mold and provided that infection take place by relatively few species of fungi during anthesis. Also a number of different tissues appear to be involved in resistance to colonization. Since the infection takes place at such an early stage the presence of a testa probably has little effect on initial colonization. Mesocarp provide an ideal environment for early colonization. Spikelet tissues, including sterile lemma, palea, lodicules, anthers, and filaments are sites of infection at anthesis with *C. lunata* and *F. moniliforme*. The ovary which develops into kernel, is not colonized until it expands between 5 and 10 days after anthesis. Forbes (1986) and Bandyopadhyay (1986) noticed initial infection by *F. moniliforme* on a susceptible cultivar at the apical end on spikelet tissues; lemma, palea, glumes, filaments and senescing styles. Fungus mycelium advances basipetally, either by colonizing spikelet tissues or by growing in voids between these tissue. Early colonization of glumes (3-4 days following inoculation) was found to be very heavy and caused little cellular disruption or pigmentation in the host. Within 5 days of inoculation, mycelium can be seen in all parts of spikelets, with the denser growth around the ovary base. Lodicules appears to be severe as an important source and always surrounded by dense fungal growth, but extensive colonization of lodicule tissue *per se* has been questioned.

In the next stages of invasion, a dense mycelial mat progresses acropetally between the aleurone layer and the pericarp. Subsequent invasion of the endosperm, embryonic tissues and pericarp originates from this peripheral mat. When environmental conditions are favourable, mycelial growth pushes through the pericarp, producting a white or pink fungal mass which can completely cover the grain.

Infection by *C. lunata* differs from that of *F. moniliforme, C. lunata* can infect the apical part of the ovary wall from the colonized lemma, palea, lodicules, filaments, pollen grains and decaying styles, within 5-10 days mycelium penetrates the pericarp and ramifies through the cross and tube cells. Colonization does not usually continue directly into the endosperm, but rather through the placental sac, which can also lead to invasion of the embryo. Gopinath *et al.* (1987) noticed 43% embryonic infection of *F. moniliforme* , while *F. semitectum* and *F. solani* colonized the embryonic tissue in 8 and 5% seed, respectiv-ely.

Singh *et al.* (1988) could detect infection by *F. moniliforme* and *C. lunata* after anthesis, while that of *Phoma sorghina*, 8 DAA. Singh and Agarwal (1989) detected *C. lunata* and *F. moniliforme* infection in embryonic tissue and *Phoma sorghina* in the aleurone layer only.

Deshmukh and Raut (1993) microscopically examined the seeds infected by *C. lunata (Cochliobolus lunatus*) showed a clear distribution of pathogen in pericarp, seed-coat, aleurone layer, endosperm and embryo. The scutellum showed heavy colonization by mycelium and mycelia were also present in coleoptile, coleorrhiza, and embryonic axis.

2.17 Inheritance/Genetics of resistance

The grain mold problem is so complex that it is almost certain that grain mold resistance is the results of the additive effects of many genes affecting several plant characteristics (Murty et al., 1980). Rana *et al.* (1978) found that water absorption capacity and seed hardness, two factors that have an effect on susceptibility are governed by additive genes. Glueck and

Rooney (1980) reported the inheritance of testa is controlled by complementary B_1 and B_2 testa genes. Dabholkar and Baghel (1980) made 7x7 diallel cross amongst sorghum lines resistant and susceptible to grain mold caused by *Curvularia* and observed both gca and sca components of variance were significant for reaction to grain mold. However, gca was larger in magnitude suggesting predominance of additive genetic variance. Dabholkar and Baghel (1982) reported additive gene action to be predominant in the inheritance of tannins in grain. Dabholkar and Baghel (1983) crossed two varieties of sorghum highly susceptible to grain mold, two moderately resistance and three less susceptible in a diallel fashion excluding reciprocals. Grain mold was developed by artificially inoculating earhead with spore suspension of *C. lunata*. Both additive and non-additive genetic components of variance determined the expression of mold reaction. Genes for resistance were recessive to genes for susceptibility. SPV-29 and 2219 B appeared to posses dominant genes for resistance. Narayana and Prasad (1983) studied a diallel set of crosses involving resistant and susceptible lines to mold for heterosis, combining ability and genetic variation. Additive gene action was found to be predominant in the inheritance of *Fusarium* molds.

Kataria *et al.* (1990) studied mode of resistance to grain molds, largely caused by *C. lunata (Cochliobolus lunatus)* and *F. moniliforme (Gibberella fujikuroi)* in F_1, F_2 and backcross generations from 3 crosses involving 2 resistant and 2 susceptible lines. Analysis of the results indicated that additive effects were significant in all crosses except IS402 x IS 10892, but were generally smaller in magnitude than the dominance effects. Duplicate type interaction were also important in most crosses.

Esele *et al.* (1993) used four parental cultivars with distinct characteristics and gene markers for caryopsis traits as a base population to generate F_1, F_2 and BC_1 populations. These populations were evaluated for resistance to grain mold. The presence of pigmented testa (B_1-B_2-), a red pericarp (R-Y-) a thin mesocarp (Z-) and an intensifier gene (I-) were all dominantly inherited. A pigmented testa was the single most important trait conferring grain mold resistance. The effect of red pericarp was enhanced by the presence of the intensifier gene. The effect of both a pigmented testa and a red pericarp were additive. Mesocarp thickness did not play a significant role in grain mold resistance. Shivanna *et al.* (1994) indicated that the genetic constitution of the susceptible genotypes is identical, while the resistant genotypes differ in their genetic constitution. Inheritance of grain mold resistance was governed by 4 independently segregating genes, 2 with complementary interactions and the other 2 with additive interactions. Ghorade (1995) reported predominant additive gene action for characters like 100 seed weight, hardness, grain density, water absorption rate, conductivity of grain leachate, germination, fungal load of *Fusarium* spp., *Curvularia* spp. and other mold spp. in F_1 and F_2 diallel progenies.

2.18 Heterosis

Hybrid vigour was first noticed by Kolreuter (1763) in the interspecies crosses of *Nicotiana* and was studied thereafter by numerous workers. The first clear approach to the concept of heterosis was made by Shull (1994) and he coined the term "Heterosis" to denote the increased vigour, size, fruit fullness, speed of development, resistance to disease and insect-pests or to the climatic adversities. Heterosis (H_1) is expressed over the mid parent value and heterobeltiosis (H_2) is expressed over the superior parents. Heterosis could also serve more practical purpose in providing the breeders a mean of increasing disease resistance in resistance breeding programs.

The terms "heterosis" and "hybrid vigour" are synonymous and it has been suggested by Whaley (1952) that a more precise usage would be to term the superiority of the hybrids as hybrid vigour and to refer the mechanisms by which the superiority is developed as heterosis. Heterosis is the genetic expression of the beneficial effects of hydridization. The presence of heterosis in sorghum has been reported by many workers (A gikar and Chavan, 1957; Quinby, 1963; Kambal and Webster, 1966; Rao, 1970a; Tripathi *et al.*1976; Goyal and Joshi, 1976; Laosuwan and Atkins, 1977).

Giriraj and Goud (1981) studied the diallel analysis of eight varieties and reported heterosis to the extent of 28.08% for total plant height. Saradaman (1981) studied the heterosis and found that, in general, all hybrids showed heterosis for plant height and panicle length.

Kanaka (1982) found that heterosis for grain yield ranged from -11.36 to 74.72% and 1000 grain weight from -16.47 to 69.25%.

Kulkarni and Shinde (1985) studied the F_1 generation of seven variety diallel of sorghum and heterosis was found to be very high (65.5%) for grain yield, high for plant height (40.4%) and low for days to 50% bloom (8.0%). Swarnlata and Rana (1988) studied six newly developed ms lines and crossed with few restores and they reported that heterosis over ms line varied from 109 to 147% for yield characters. Over restorers, heterosis was 84% for grain yield and 12% for biological yield.

Ghorade (1995) studied 11x11 diallel cross excluding reciprocals and observed highest estimates of percentage of heterobeltiosis upto - 10.38% for days to 50 % flowering, 64.70% for plant weight, -41.02% for glume coverage, 19.61% for 100 grain weight, 6.29% for grain hardness, 2.76% for germination, -5.44% for conductivity of grain leachates, -5.69% for fungal load of *Fusarium* spp., -12.88% for *Curuvularia* spp. and -8.91 for other fungal spp.

2.19 Combining ability

Combining ability can be defined as the relative ability of a biotype to transmit desirable performance to its crosses. It provides a means of understanding the nature of gene action in yield heterosis and is desirable tool to study and compare the performance of a line in hybrid combinations.

According to Sprague and Tatum (1942) the general combining ability denotes the average performance of line in a hybrid combination, while specific combining ability designates those cases in which certain combinations do relatively better or worst than would be expected on the basis of average performance of the lines involved. Srihari and Nagur (1980) observed that the variance due to general combining ability (gca) and specific combining ability (sca) were almost equal with respect to the character like grain weight of ear indicating the presence of both additive and non additive genetic variance of this character. Highest heterosis (121.34%) has been shown by combination (Swarna x CS-3541) associated with highest sca effects (26.38) even though its parents recorded low gca effects for grain weight of ear, indicating that non additive gene action is operating predominantly for expression of this character. Sanghi and Monapora (1981) observed predominance of non additive gene action for plant height. Bijapure *et al.* (1980) observed very high gca under rainfed condition. Indi and Goud (1981) found predominance of additive genetic effects for plant height and dominance effects predominated for most of the traits. Similarly, over dominance was observed for grain yield and panicle weight. Patidar and Dabholkar (1981) found influence of additive gene effects in inheritance of 1000 seed weight and grain yield in sorghum. However, sca effects were significant for grain yield and number of grains/ear.

Borikar and Bhale (1982) reported more pronounced estimates of sca variances for all characters indicating the preponderance of non additive gene action for yield and yield components. The gca was also considerable for days to flowering and plant height. Kanaka (1982) observed predominance of additive gene action for plant height. He also reported additive and non additive gene actions for days to 50% flowering and panicle length. Karale *et al.* (1984) recorded highly significant gca and sca values for all the characters in *Kharif* and *Rabi* seasons. The gca values were of higher magnitudes than sca variances for days to flowering, plant height, panicle length and 1000 seed weight indicating the importance of additive and additive x additive gene action.

Palaniswamy and Subramanian (1986) reported additive gene action for plant height, grain yield, whereas, non additive gene action for days to bloom and peduncle length. Patil and Thombre (1986) reported the characters plant height, days to 50% flowering, 1000 seed weight under the control of additive gene effects while panicle weight and grain yield under non additive gene action. Chandrashekharappa (1987) reported predominance of additive gene action for plant height, days to 50% flowering (DTF) while non additive gene action for 1000 seed weight. Nimbalkar and Bapat (1987) noticed additive and non additive gene action for DTF and plant height. Shekar *et al.* (1987) recorded 1000 grain weight, days to 50% flowering and plant height predominantly under the control of additive whereas grain yield under non additive gene action. Hugar *et al.* (1988) reported non additive gene action more important for DTF, plant height, grain yield and 1000 grain weight. Patil (1990) reported that the sca effects were more stable than gca for grain yield and 1000 seed weight. Amsalu and Bapat (1990) recorded the additive gene action for DTF.

2.20 Correlation studies

It is a known fact that some plant and grain characters are associated with yield and grain deterioration. If the association is assessed, it is possible to select plants based on yield and grain mold resistance traits. Several workers have found out the characters association in sorghum. Hardness and density correlated inversely with milling yield, and the endosperm texture was negatively correlated with hardness, test weight and kernel density (Maxson *et al.*, 1971). Gangadharan *et al.* (1978) reported a highly significant correlation between the per cent of mold grain in ear head and rainfall. Patel *et al.* (1980) observed positive significant correlation between DTF with 1000 seed weight. Similar results were found by Patil and Thombre (1985). They also observed that the plant height and DTF expressed positive strong correlation. However, Reddy and Nagur (1981) recorded negative correlation. The percentage for kernel floating was correlated with percentage vitreousness, grain hardness determined as a work required for grinding, breaking strength at individual kernel (Hallgren and Murty, 1983). Mansuetus *et al.* (1988) observed that disease incidence was negatively associated with glume cover, glume length and glume area at boot stage.

Forbes *et al.* (1989) reported highly significant correlation (r=0.94) amongst two estimates of severity (Ergosterol concentration and colony forming units of *F. moniliforme*). Also reported colony forming units of *F. moniliforme* was positively associated with electrolyte leachate (r=0.98), visual assessment as percentage of kernels moldy (r=0.93), negative associated with percent germination (r=-0.98) and negative association between electrolyte leachate and percentage germination (r=-0.95). Indira *et al.* (1991) reported high correlation (r=0.88) between September rainfall and mean disease score at four locations. Jambunathan *et al.* (1991) reported significant (P<0.01) correlation coefficient between ergosterol and flavan-4-ols concentration and negative in coloured mold-susceptible and mold-resistant accessions that did not have testa, but no significant correlation in white mold-resistant and mold susceptible sorghum. Jambunathan *et al.* (1992) reported negative correlation with ergosterol concentration and grain hardness (Stenvert method). Mukuru (1992) reported significant correlation (r=-0.66, P = 0.01) between flavan-4-ols and mold resistance. Ghorade (1995) reported that grain hardness exhibited significant positive association with grain density, germination, grain yield, 100 seed weight, and negative association with water absorption rate and fungal load of all types of fungi. Also reported that germination exhibited positive significant association with 100 grain weight, grain hardness, grain density and negative significant association with conductivity of grain leachate, water absorption rate and all three types of fungal load.

CHAPTER – III

MATERIALS AND METHODS

PAGES : 40 - 59

CHAPTER III

MATERIALS AND METHODS

3.1 Materials

The experimental materials comprised of 10 parental lines of sorghum (*Sorghum bicolor* (L.) Moench) with different characteristic viz., good grain quality, earliness, adaptation, yield, varying mold reactions, presence of testa, mesocarp thickness and grain hardness. These included three resistant (IS-2284, IS-6335 and IS-9471); five moderately resistant elite (SPV-946, SPV-1201, SRT-26B, GJ-35-15-15 and ICSB-101 B), and two susceptible (SPV-104 and AKms-14B) lines. The pedigree and characteristics of these lines are summarised below:

		Characteristics					
Line	Pedigree	DTF	Pl. ht cm	TGMR	Testa	Seed hardness kg/cm^2	Source
SPV-1201	PVK-400×IS-3443-12	73	244	3.0	A	8.67	Dr.PDKV
ICSB-101B	(Ind.Syn.89-1×RS/R 20-682)-5-1-3	72	167	3.0	A	6.94	ICRISAT
Akms-14B	(MR-807×BTX-678) ×AKms-2B	66	140	4.5	A	6.95	Dr.PDKV
SRT-26B	(M-211×ICSB-27)	70	179	3.0	A	6.56	Dr.PDKV
GJ-35-15-15	(2077A×M-25)× Marvan	78	237	3.0	A	8.11	Dr.PDKV
SPV-946	(SPV-475×SPV-462)	77	264	3.0	A	7.25	Dr.PDKV
SPV-104	(SPV-148×SPV-512)	80	179	4.5	A	6.08	Dr.PDKV
IS-2284	(Haak Doom) Q-2-2-37	70	283	2.0	P	5.91	ICRISAT
IS-6335	(purbi gooseneck banwar)	66	255	2.0	P	6.68	ICRISAT
IS-9471	(South Africa)	72	286	2.0	P	6.10	ICRISAT

A = absent, P = present.

3.2. Methods

3.2.1 Location

The experiments were conducted at two locations viz., Sorghum Research Unit, Dr. PDKV, Akola, latitude 20° 42' N and longitude 77° 02' E with an altitude of 281 m, soil vertisol medium to deep black and ICRISAT, Patancheru. latitude 17°32' N and longitude 78° 16' E with and altitude of 545 m soil-vertisol medium to deep black, 26 km northwest of Hyderabad.

3.2.2 Predisposition

The meteorological data on precipitation number of rainy days, relative humidity and temperature during rainy season 1995, 1996, were collected from Sorghum Research Unit, Dr. PDKV, Akola (Table 1). Since testing at ICRISAT was done under controlled conditions, the meteorological data were been considered Data from 23rd meteorological week to 45 meteorological week the period from flowering to maturity of sorghum crop at both the centres was taken in to consideration

3.2.3 Experimental layout

The experiments were conducted in a completely randomized block design with two replications. Fifty-five treatments (45 test crosses + 10 parents) were included in the experiment. The plot size was double row 3-m long, with row spaced at 45 cm and plants at 10 cm. The trial was sown on 27th June 1995 at Akola and harvested on 26th October 1995.

The experiment was repeated at Akola during the rainy season, 1996. It was sown on 22nd July and harvested on 20th November.

The experiment was also conducted at ICRISAT during the rainy season 1996. It was sown on 17th June and harvested on 21 Oct. The plot size was at double row 4 m long, row spaced at 75 cm and plants within row at 10 cm. At this location overhead sprinkler irrigation was provided from the onset of flowering to grain maturity i.e. black layer formation, to harvest about 2 week after physiological maturity. The plots were sprinkled for 1 hr in the morning if it did not rain the previous night and the same morning and for an additional 1 hr in the evening if it did not rain throughout day. Experimental field with sprinkler irrigation and aerial view of the experimental field at Patancheru (Plate 1). The seeds of all these trials were used for studying physical, pathological and biochemical characters.

3.2.4 Data recording

Five plants were randomly selected from each replication of a treatment for recording data in F_1 crosses and parents. Fifteen plants were randomly selected per replication in each treatment for recording data in F_2 progenies. Data were recorded on agronomic traits, physical, pathological and biochemical characters. All above characteristics of the kernel of parents and crosses obtained from 1995 trial at Akola and 1996 trials at both locations, whereas, biochemical characteristics could only be studied for 1995 harvest at Akola. All characters were studied using 10 × 10 diallel analysis, except protein fractions, grain color, glume color pre-treatment of seed and presence of testa.

3.2.4.1 100-seed weight

Hundred kernels weight (g) of each line under various experiments was always recorded after compositing the threshed grain and sun-drying to about 12% moisture, using 'ADCO' precision electronic balance (model AD 200 C) unless specifically mentioned otherwise. All the values reported are means of two observations.

3.2.4.2 Grain hardness

A manually operated 'Kiya' hardness tester (Kiya Seisakusho Ltd., Japan) with bar-type probe (0.5 cm diameter) was used with a maximum permissible load of 20 kg for the determination of hardness of single grain.

Grains were equilibrated to a moisture content 6.5 $\pm$ 1.0% before hardness determination was made. Twenty randomly selected grains from each replications were tested for hardness, mean was calculated and expressed in kg/cm^2.

3.2.4.3 Endosperm texture

Endosperm texture was determined by visual examination of longitudinal cut half kernels. The rating ranged from 1 to 5 (1=0-20% almost completely corneous and 5 = 81-100% floury). Ten seeds were soaked in water overnight and were cut into two halves to the long axis from the hilar region and endosperm texture was determined

Plate 1 : Experimental field at Patancheru

A. Sprinkler irrigation

B. Aerival view of experimental field

A. Sprinkler irrigation

B. Aerial view of experimental field

Plate 1. Experimental field at Patancheru

using hand lens. The observations were recorded for each replication and mean was calculated.

3.2.4.4 Electrical conductivity of grain leachates

Electrical conductivity of grain leachates was measured using the method of Hendricks and Taylorson (1976) with some modification. Three g seed sample of each line were washed twice with glass distilled water (gdw) and placed in clean 'Corning', glass test tubes and 12 ml of gdw was dispensed to each tube. After four hr of soaking at 25°C the supernatants were used for measuring the electrical conductivity separately. 'YSI model 32' conductance meter of scientific division, Yellow Spring Instrument Co. INC., was used. The electrical conductivity was expressed in dSm^{-1}. The test was run twice.

3.2.4.5 Day's to 50% flowering

The number of days required for flowering of 50% of the plants in a plot from the date of sowing was recorded.

3.2.4.6 Plant height

Plant height (cm) was measured from the ground to the tip of ear head at physiological maturity.

3.2.4.7 Cob length

Cob length (cm) was measured from base to the tip of ear head.

3.2.4.8 Glume (grain) covering

Observation on grain covering i.e. amount of grain covered by the glume for all the lines under study were recorded. The characters were described as follows and shown in (Plate 2A):

1=0 % grain covered

2=25% grain covered

3=50% grain covered

4=75% grain covered

5=Grain fully covered

6=Glume longer than grain.

Plate 2 : A. Glume covering

1. 0% grain covering
2. 25% grain covering
3. 50% grain covering
4. 75% grain covering
5. 100% grain covering
6. > 100% grain covering

Plate 2 : B. Infected earheads

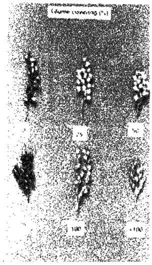
1. *F. moniliforme*
2. *F. pallidoroseum*
3. *C. lunata*
4. *Phoma sorghina*

Plate 2 : C. Infected seeds

1. *F. moniliforme*
2. *F. pallidoroseum*
3. *C. lunata*

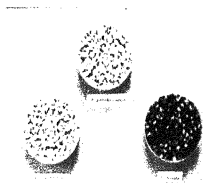
Plate 2 : D. Glume color

1. Tan
2. Red
3. Purple

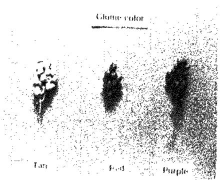


A

B



C



D

Plate 2. Glume covering, infected earhead, infected seed and glume color

3.2.4.9 Pericarp (Mesocarp)

Kernels were soaked in sterile water for 16 hr. The kernels were then removed and surfaces blot-dried. Free hand sections along the short axis with a new razor blade were taken. The sections of each line were selected and placed on clean glass slide separately. Two drop of stain (Mac Grunwald's) used by Scheuring and Rooney (1979) were placed over the sections. After 1 min, when the stain was evaporated the slide was held in slanting position and few drop of ethyl alcohol (95%) were added with the help of dropper for removing excess stain. After the evaporation of ethyl alcohol, the sections were mounted in glycerol with coverslip.

'Filar micrometer' was calibrated using slide micrometer. Sections were observed under low power (10 x objectives and 15 x Filar micrometer) and with help of screw drum, measurement of thickness, in micrometer (μm) of the pericarps were taken and the average of five observations was recorded. Observations for the presence of testa layer (dark brown/red layer adjacent to aleurone layer) were also recorded to confirm the results of bleach test.

3.2.4.10 Threshed grain mold rating (TGMR)

Panicles were harvested 14 days after physiological maturity, threshed and bulked was evaluated for grain mold severity. This is an estimate of the percentage of molded grain surface area and was recorded on a 1-5 scale, where :

1 = no mold visible on grain surface,

2 = scant superficial mold growth and 1-10% grain surface covered by mold,

3 = moderate mold growth and 11-25% of grain surface molded,

4 = considerable mold growth and 26-50% of grain surface molded, and

5 = extensive mold growth and >50% grain surface molded.

3.2.4.11 Seed germination

The Ragdoll's (rolled paper towel) method (ISTA, 1966) and standard blotter plate method of (ISTA, 1976) were used for germination studies. In rolled paper towel, 100 seeds were placed at equidistant on two layers of moist paper towel (48x25 cm; 55-58 sheet/kg). Seeded paper towel were incubated for 10 days at room temperature (i.e. 27°C ± 2°C). The rolled paper were then unrolled after removing rubber bands gently upper cover paper was removed and germinated seeds was counted. Unless otherwise mentioned the test was based on 400 seeds/ genotypes.

In standard blotter plate method grain germination was determined by incubating 100 grains from each genotypes in nine cm diameter Petri-plates (25 grains per dish) lined with wet filter paper for four days at 27°C ± 2.

3.2.4.12 Detection of grain mold fungi

To detect seed borne mycoflora, standard blotter plate method (SBM) of ISTA (1976) was used throughout the study. Twenty five seeds of each line was placed at equidistant on sterile three layer blotting paper discs presoaked in sterile water in each plate. The seeded plates were kept for incubation at 27°C ± 2°C under diurnal cycle for seven days. Fungi on incubated seeds were detected by stereoscopic binocular microscope with side illumination system. Research microscope was used for detailed observations species were identified by comparing the descriptions given in IMI description plates of fungi and bacteria and from book "Dematiaceous hyphomycetes" by Ellis (1971). Infected earhead and seeds by different mold fungi are shown in (Plate 2B and C).

Observations on colony count of *Fusarium moniliforme*, *Fusarium pallidoroseum* and *Curvularia lunata* separately and for other fungi were recorded in each plate on germinated and ungerminated seeds. The infection score were recorded on a 1-5 scale where:

1 = no infection

2 = up to 10% seed covered by fungal colony.

3 = up to 25% seed covered by fungal colony

4 = up to 50% seed covered by fungal colony.

5 = 50 % seed covered by fungal colony.

3.2.5 Biochemical characters

3.2.5.1 Proteins and protein fractions

Fifty five grain samples (10 parents and 45 F_1) grown during rainy season 1995 at Akola were used in the study. The grain samples were dried at 37°C for 48 hr and ground in Udy cyclone mill (UD Corporation, Boulder, Co.) to pass through a 0.4 mm

The meal was defatted in Soxhlet apparatus, using n-hexane and used for further analysis, All values reported are means of duplicate analysis.

3.2.5.1.1 Protein

The total nitrogen in the meal was determined by using Technicon auto analyser (TAA) described by Singh and Jambunathan (1980), which involves the conversion of organic nitrogen into ammonia by digesting the sample with sulphuric acid using block digestor (BD 40). Ammonical nitrogen reacts with sodium phenate in the presence of sodium hypochlorite to form indo-phenol blue complex. This color complex is measured at 660 nm.

Reagents :-

Acid mixture. Five parts (v/v) orthophosporic acid in 100 parts of sulphuric acid .

Kjel tabs auto. Each tablet contains 1.5 g K_2SO_4 and 7.5 mg selenium.

Alkaline sodium potassium tartrate. Dissolve 75 g sodium hydroxide and 50g sodium potassium tartrate in about 900ml distilled water, cool dilute to 1l.

Alkaline phenol. Mixed 138 ml of phenol (88%) with 500ml of 5N NaOH in an ice bath ; dilute to 1l with distilled water .

Sodium hypochlorite (NaOCl). Dilute, if necessary, commercially available bleach to get 5% NaOCl .

Ammonium sulphate standards. Dissolve 4.717g oven dried ammonium sulphate in 1000 ml distilled water (1000 ppm N stock solution). Take stock solution to give 10,20,30,40 and 50 ppm N into a 1000 ml volumetric flask and dilute to 1l by adding 4% sulphuric acid.

One hundred mg defatted flour was transferred to a Technicon digestion tube (75ml). In each set of 40 tubes one blank, one check, two random samples selected from preceding set, and 36 regular (unknown) samples were taken and 3 ml of acid mixture and 1 Kjel tab to each tube were added. Then the set was heated in Block digestor at 375°C, and maintained for 1 to 1.5 hr for digestion, digest were cooled and dissolved with minimum amount of water. Volume was made up to 75 ml, and the solution was mixed thoroughly after putting the stopper. The aliquot from each tube were transferred in to Technicon sample cup and analysed it using TAA.

Nitrogen in % was calculated by using formula

$$N\% = \frac{\text{Sample peak height} \times 75 \times 100}{1.8\ (\text{slope}) \times 1000 \times \text{sample weight (mg)}}$$

Where, 5 is the made up volume and 1.8 is the net division on chart paper for 10 ppm N. The crude protein was calculated by using the factor (N% × 6.25).

3.2.5.1.2 Protein fractionation

Protein fractionation of all the parents (10) and F_1 crosses (20) obtained at Akola during 1995 season was carried out. For protein fractionation, crosses were selected in such a way that each cross had one resistant (IS-9471), one elite (SPV-946) and one susceptible (SPV-104) line. Landry and Moreaux (1970) method was used to obtain fractions of protein. The residue after fraction V was treated with 0.1 N sodium hydroxide solution and protein soluble in the alkali was referred to as fraction VI or residual protein. The detailed protein fractions I-VI were as follows :

Fraction	Protein class	Solvent system (reagents)	Extraction time (min)
I	Albumin, globulin free peptide	0.5 M NaCl	60,30,30
II	Prolamin	70% isopropanol	30,30
III	Cross link prolamin	70% isopropanol with 0.6% 2 ME[a]	30,30
IV	Glutelinlike	Borate buffer (pH [10])	30,30,15
V	Glutelin	Borate buffer (pH [10]) 06% 2ME[a] with 0.5% SDS [b]	30,3015,
VI	Residual protein	0.1 N NaOH	30,30,15

a = 2 Mercapto-ethanol b = Sodium dodecyl sulphate.

Reagents :

0.5M Nacl , Dissolve 29.2 g Sodium chloride in water and make upto 1l, **70% isopropanol,** Mix 700 ml isopropanol with 300 ml water, **Isopropanol–2-mercapto-ethanol,** Mix 700 ml isopropanol and 6 ml 2-mercaptoethanol with 294 ml of water, **Borate buffer (pH [10]),** Dissolve 6.2 g boric acid, 29.2 g sodium chloride and 6 ml 2 mercapto ethanol in water, Adjust pH to 10.0 and finally make up to 1l, **Detergent-borate buffer (pH[10]),** Dissolve 62. g boric acid 29.2 g sodium chloride, 6 ml 2 - mercapto ethanol and 5 g sodium dedocyl sulphate in water. Adjust pH to 10 and make to 1 l with water, **0 1 N NaOH,** Dissolve 4 g NaOH in water make up to 1 l with water.

Extraction

- Defatted flour (1g) was put in to 50 ml screw cap centrifuge tube to which 20 ml 0.5 m sodium chloride solution were added and shaken for 1 hr. After centrifuge at 2500 rpm for 15 min the clear supernatant were collected in to 50 ml volumetric flask. Extraction repeated twice with 15 and 10 ml of the solvent for 30 min each, the aliquots were pooled and made upto 50 ml and filtered through Whatman No.1 filter paper (Fraction I). The extract were stored at 4°C.
- To the residue 20 ml 70% isopropanol were added and shaken for 30 min, the contents centrifuged, the extraction repeated twice of the residue with 15 and 10 ml solvent. The aliquots were pooled and made upto 50 ml and filter (Fraction II).
- Proceed similarly with the residue by using 70% isopropanol containing 0.6% ME (Fraction III).
- To the residue 20 ml borate buffer were added and shaken for 30 min, the contents centrifuged, and supernatant collected. Re-extracted the residue twice with borate buffer for 30 and 15 min and pooled the supernatant and volume were made upto 50 ml with borate buffer (Fraction IV).

- The residue were extracted with 20ml borate buffer containing 0.5% sodium dodecyl sulphate for 30 min and re-extracted twice referred above. The extract were pooled and volume made to 50 ml with borate buffer containing SDS (Fraction V).
- The residue were treated with 20 ml. 0.1 N sodium hydroxide solution (Fraction VI).

Estimation :

Ten ml of fraction (I to VI) were pipetted out in to Technicon digestion tube and few boiling chips were added to it. One hundred mg original flour (taken for protein fractionation) were added into Technicon digestion tube and 3 ml concentration sulphuric acid containing 5% orthophosphoric acid, digestion tablet containing 1.5g potassium sulphate and 7.5 mg selenium were added into each tube. Both flour sample and fractions were digested separately at 380°C for 1 hr. The digest were cooled for 5 min, then dissolved it in water (minimum quantity) and made upto 75 ml and mixed well.

Estimated N content as given in protein. Calculated mg nitrogen N in the 10 ml aliquot and expressed the 'N' at each fraction as % of the flour 'N'.

$$\text{Nitrogen in the fraction} = \begin{array}{c}\text{mg N in 50 ml}\\ \text{of the fraction}\end{array} \times \frac{100\%}{\text{mg N present in flour}}$$

3.2.5.2 Soluble sugars

Soluble sugars were extracted with hot aqueous – ethyl alcohol and the sugars on treatment with phenol sulphuric acid produces a stable and sensitive golden yellow color (Dubois, *et al.*, 1956).

80% ethyl alcohol (ethanol). 800 ml of ethanol in 1 l. volumetric flask and volume was make with distilled water.

5% phenol. Dissolved 5 g phenol in water and made up to 100 ml with water.

96% sulphuric acid (v/v). Use 96% sulphuric acid, specific gravity 1.84, diluted according to the purity.

Glucose (w/v) standard. (Stock = 1000 mg/ 1000 ml.) Dissolved 1000 mg of glucose in water and made up to I l.

Working standard. Pipette out 10 ml of stock standard in to a 100 ml volumetric flask and made up volume to 100 ml (the final concentration will be 100 μg/ml)

Defatted flour (100 mg) was placed in to a boiling tube to which 30 ml of hot 80% ethanol was added and shaken on a vortex mixture. After settling the material for 20-30 min, the supernatant was filtered through Whatman No. 41 filter paper in a beaker. For complete extraction of sugars the above step was repeated for 3-4 times. The extract was then placed on hot sand bath until the ethanol is evaporated.

Ten ml water were added to dissolve the contents and transferred in to a 100 ml volumetric flask, the contents in the beaker were washed 2-3 times and added to volumetric flask and volume was made to 100 ml with water one ml aliquot and 1 ml water as blank were taken into test tubes separately and 1 ml 5% phenol was added in each tube and shaken, then 5 ml 96% sulphuric acid was added and shaken vigorously on a vortex mixture and then test tubes were cooled in water.

The absorbance of the golden yellow were read at 490 nm against the blank. The standard were run with different concentration (i.e. 10,20, 30, 40 and 50 μg of glucose standard) from the working standard, keeping the volume to 1 ml with water, added reagents 1 ml 5% phenol and 5 ml 96% sulphuric acid.

Total soluble sugar (%)=

$$\frac{\text{Conc. of standard } (\mu g)}{\text{Absorbance of standard}} \times \begin{array}{c}\text{Absorbance}\\ \text{for 1 ml}\\ \text{sample}\\ \text{extract}\end{array} \times \frac{\text{1 (Conversion of g)}}{1{,}000{,}000} \times \frac{\text{100 ml (vol. make up)}}{\text{0.1g (Sample weight)}} \quad 100$$

3.2.5.3 Tannins

Price et al. (1978) Vanillin – HCL method was used for estimating tannins. Vanillin with tannin on acid catalyzation results in formation of an color complex which absorbs maximally at 500 nm. The reaction is specific for leucoanthocyanidins and catechins although, anthocynidin and dihydrochiones may interfere to some extent, expressed as catechin equivalents (CE).

Reagents

- **8% hydrochloric acid in methanol (v/v).** Mixed 8 ml. conc. HCL in methanol and made upto 100 ml.
- **1% Vanillin.** Dissolved 1 g vanillin (Sigma) in methanol and made upto 100 ml.
- **Vanillin – Hydrochloric acid reagent.** Mixed equal volume solution 1 and solution 2 before use.
- **Hydrochloric acid in methanol (4%) (v/v).** Mixed 4 ml conc. HCL in 100 ml. methanol.
- **1% Hydrochloric acid in methanol (v/v).** Mixed 1 ml conc. HCL with 99 ml. methanol.
- **Standard solution.** Stock solution, 1 mg/ml of catechin (Sigma) in methanol (0.1 ml) is equivalent to 10 μg catechin/ml). (stock solution can be stored for long time in stopper bottles in cold). Pipette out 0.1, 0.2, 0.4, 0.6, 0.8 and 1 ml. of catechin standard and made up the volume to 1 ml with methanol.

Extraction

Defatted flour (0.5g) was taken in centrifuge tube to which 10 ml acid methanol (1%) was added in each tube and shaken for 20 min in shaker and centrifuged for 10 min and aliquot was transferred to 20 ml volumetric flask. Again 5 ml acid methanol (1%) was added and shaken for 20 min and centrifuged for 10 min and aliquot was added to first extraction and the volume was made to 20 ml, and mixed well.

Estimation

One ml of extract was pipetted out in to test tubes, to which 5 ml freshly prepared Vanillin-HCL reagent was added slowly to the extract and to the catechin standard of different concentrations. Individual samples blank were prepared by adding 5 ml of 4% HCl in methanol to 1 ml aliquot. The absorbance were read at 500 nm against reagent blank.

Catechin equivalent (CE) in % were calculated by using formula.

$$CE\ \% = \frac{\text{(mg catechin/ml)}}{\text{vol. of extract taken (1ml)}} \times \frac{\text{Vol. made up (20 ml)}}{\text{wt. of sample (500 mg)}} \times 100$$

3.2.5.4 Flavan-4-ols

The anthocyanidins are determined by ionizing the middle ring of flavonoides by acid, yielding a pink color. The intensity of pink color is directly proportional to the concentration of flavan-4-ols. In case of catechin - like compounds the cyanidins are first obtained by boiling, which consequently get ionized to give pink color.

Grain samples were extracted with methanol and the phenolic compounds were then adsorbed in polyvinyl phyrrolidone (PVP) layers. The PVP was subsequently cleaned and treated with acid to ionize the flavanoid ring, if any. The results in all cases were expressed as $A_{550}g^{-1}$, (Butler, 1982).

Reagents

Butanol, Hydrochloric acid, Acetic acid, 0.1 N acetic acid, Diluted 5.71 ml acetic acid to 1 l with water, 300 ml butanol were taken in a 500 ml separating funnel to which 150 ml water were added shaken vigorously and kept overnight on stand. The top layer removed (water saturated butanol) and mixed with HCl in a bottle in 70 : 30 ratio, Water saturated butanol were mixed with methanol and N/10 acetic acid in ratio70:15:15, which is to be used for sample blank, Methanol, Methanol - HCL 1% : Mixed 1 ml concentrated HCL in methanol and make upto 100 ml with methanol.

Extraction

Defatted flour (200 mg) was taken in screw cap test tubes to which five ml methanol was added, then tubes were placed in Staurt tube rotator (TR-2) and mixed for 1 hr. The mix was centrifuged and the supernatant was collected in a vial. The above steps were repeated using the residue and all the extracts was pulled in the above vial. This is referred to as Methanol extract.

To the above residue five ml methanol HCL (reagent 8) was added and above steps were repeated; again residue was re-extracted with additional five ml. of methanol HCL and pool the extract which was used for the estimation of Acid methanol extract.

0.5 ml methanol and acid methanol extract was separately taken in test tubes to which seven ml (reagent, 5) water saturated butanol with HCL was added. Blank was prepared by using (reagent 6). All the test tubes were placed in tube rotator for one hr and absorbency was read at 550 nm. All the results were calculated as A $_{550}g^{-1}$ dry weight.

3.2.6.1 Glume color

Glume is the outer most protective covering of the developing kernels. Glume colors were described as below and shown in (Plate 2D).

W =white, S =sienna (yellow), M =mahogany (brown), R =red, P =purple, B =black, G =grey, O=other.

3.2.6.2 Grain color

Parental lines and F_1 crosses were screened for grain color. Which was visually assessed and designated as

W =white, Y=yellow, R=red, Br=brown, Bu= buff and O=other

3.2.6.3 Presence of testa layer

Bleach test. For studying presence of testa layer Kofoid *et al.* (1976) method was followed. Parental lines and hybrids (F_1's) were screened for the presence of testa.

Fifty kernels of individual line were placed separately in test tube to which 10 ml of reagent solution containing one part of KOH pellets and five parts of 6% sodium hypochlorite (a house hold bleach) was added. The tubes were swirled for few minutes and then placed on water bath maintained at 70°C for 10 min and shaken occasionally. After 10 min of bleaching the contents of the tubes were poured on to the strainer and rinsed thoroughly with running tap water separately. Excess of water was taken off and the sample damped in 2-3 folds of a paper towel. When the bulk of water was absorbed, kernels were transferred to fresh towel and examined. Kernels with testa layer turned black while without testa layer, remained light in color.

3.2.7 Pre-treatment of seed

Seed were pre-treated with 0.1% mercuric chloride solution for two min followed by washings in three changes of sterile water. Then these surface sterilized seeds were plated on pre-moistened three layered blotting paper in sterile petri-plates for detection of internally seed borne fungi. Pre-treated seeds were also tested for germination following the method described earlier.

Twenty five seeds pre-treated with 0.1% mercuric chloride were placed in each petri-plates, replicated three times and incubated at 27°C ± 2°C under diurnal cycle for seven days, for two replications and for two centres. Observations on fungal counts, infection score on germinated and ungerminated seeds were recorded as per method described earlier.

$$\text{Increased}(\%) = \frac{\text{count in treated} - \text{count in untreated}}{\text{count in treated}} \times 100$$

$$\text{Reduction}(\%) = \frac{\text{count in untreated} - \text{count in treated}}{\text{count in untreated}} \times 100$$

$$\text{Increased over location}(\%) = \frac{\text{maximum mean value- minimum mean value}}{\text{minimum mean value}} \times 100$$

3.2.8 Histopathology of infection

Histopathology of infection and colonization of major molding fungi *F. moniliforme*, *F. pallidoroseum* and *C. lunata*, at different stages of host maturity i.e. at anthesis, 10,20,30 and 40 DAF were investigated. An experiment was conducted during the rainy season 1996 at Akola.

Two susceptible lines AKms-14B and SPV-104 were selected for the purpose. Five plots (2.75 x 3 m) for each genotypes were randomly distributed. All recommended package of practices were followed.

The inoculum were separately multiplied on autoclave sorghum grains in 250 ml Erlenmeyer flasks incubated for 7-10 days at 30°C. Grain showing profuse sporulation of the pathogen were removed from the flasks, washed in a glass jar with distilled water, and strained through double layered cheese cloth. Spores and the mycelial fragments (cfu) in the resulting suspension were counted with a haemocytometer and appropriately diluted with distilled water so as to obtain $1 x 10^6$ cfu/ml.

Thirty cobs of each genotypes were selected randomly from individual plot at flowering of which 10 cobs were sprayed with inoculum of three major mold fungi, separately. Spraying was done carefully to cover the entire panicle to runoff taking due care to protect other cobs from spray. Inoculated cobs were tagged and covered with brown paper bags individually. The other plots were sprayed with fungicidal mixture of Thiram 0.2% + Carbendazim 0.07%.

Similarly, cobs were selected from 2^{nd} set and plots of these lines and inoculations were done following the methodology described above at 10 DAF. The inoculated cobs were covered with brown paper bags and the bags of previously inoculated cobs were replaced with perforated paper bags. Unbagged, uninoculated and other plots were sprayed with Thiram 0.2% + Carbendazim 0.07%. This way 3^{rd}, 4^{th} and 5^{th} set of plots were inoculated at 20,30, and 40 DAF, respectively.

Randomly 15 artificially inoculated kernels of each set for each pathogen were picked up and preserved in FAA (Formalin-acetic acid-alcohol) solution. Microtomy and microscopy were taken up at ICRISAT in 1997 to study the process of infection and histopathology.

3.2.9 Microtomy and microscopy

For microtomy of paraffin wax sectioning method described by Gopinath *et al.* (1987) was used on slight modifications. Different steps are as under.

Killing, Fixing and Hardening, Dehydration, Clearing, Embedding/section cutting, Staining.

Procedure

- As the samples were preserved in FAA solution, killing of host (grain) tissue is not necessary.
- Samples preserved in FAA were removed, thoroughly washed with water and soaked in water for 3-4 hr.
- The seeds were softened by boiling in water for 5 min and fixed in acetic acid-alcohol (1:3) solution for 24 hr. Then the seeds were washed in running water for 30 min-1 h before next procedure.
- All the samples were dehydrated with series of tertiary butyl alcohol i.e. 30,50, 60, 70,80,90 and 100% concentrations, for 30-45 min in each concentration
- The samples were then placed in xylene, a solvent of paraffin wax for 1 hr called clearing (dealcoholization).
- After clearing, the seed samples were infiltrated with paraffin wax, till it become free from xylene. This step was repeated 2-3 times, till all the xylene was removed from melted paraffin wax, Thereafter all the paraffin wax was replaced with fresh paraffin and kept for 24 hr at 57°C in oven. At this stage samples becomes ready for embedding.
- The samples were then embedded in paraffin wax in plastic mould, oriented as desired and labeled.
- The embedded blocks were removed from plastic mould and put in ice cold water for fine crystal texture and softened by immersing the blocks in 1% aqueous solution of sodium lauryl sulphate for 24 h.
- Then blocks were washed with water and transferred to a mixture of glycerin and acetic acid (1:1) for 7 days.
- Serial microtome sections were cut (15-20 μm thick), dewaxed and stained in Pianeze III b stain (Dhinara and Sinclair, 1995) and finally mounted in DPX mountant for observation under compound microscope.
- For fluorescence microscopy the sections were stained with fungiflour/celluliflour after dewaxing and observed under fluorescence microscope.

3.2.10 Statistical analyses

The data were analysed as per standard method suggested by Panse and Sukhatme **(1954)**. For 10x10 diallel, two sets of diallel viz. parents + F_1 crosses and parents + **F_2 progenies** were analysed for all characters as per the method 2, model I of Griffings **(1956 b)** as further extended by Singh (1973a, 1973 b).

3.2.10.1 Heterosis

Heterosis (H_1) expressed over mid parental values, heterobeltiosis (H_2) expressed over **better** parent; were estimated by using the following method of Laosuwan and Atkins **(1977)**.

$$\text{Heterosis } (H_1) = \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$$

$$\text{Where, } \overline{MP} = \frac{\overline{P_1} + \overline{P_2}}{2}$$

$$\text{eterobeltiosis } (H_2) = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$$

Where, $\overline{F_1}$ = Mean of hybrid (F_1)

$\overline{P_1}$ = Mean of parent 1

$\overline{P_2}$ = Mean of parent 2

$\overline{MP}$ = Mid parental value

$\overline{BP}$ = Mean of better parent

(Better parent changes as per the characters)

Test of significance, however, were calculated for the numerators of the expression i.e. $H_1 = \overline{F_1} - \overline{MP}$ and $H_2 = \overline{F_1} - \overline{BP}$.

3.2.10.2 Combining ability analysis

Combining ability analysis was based on plot means. It was carried out for all the characters, using method 2 model I of Griffings (1956 b) and further extended by Singh (1973 a, 1973 b).

The mathematical model for combining ability analysis (Model - I) was assumed as :

$$X_{ij} = \mu + g_i + g_j + S_{ij} + e_{ijk}$$

$$i,j = 1 \text{-----------------} p$$

$$k = 1 \text{-----------------} b$$

Where,

p = number of parents,

b = number of replications,

μ = population mean,

g = gca effect of i th parent,

gj = gca effect of j th parent,

Sij - sca effect of cross between i th and j th parents.

eijk = mean error effect.

The restrictions imposed to the model are :

$$\sum_{I} g_i = 0$$

and

$$\sum_{j} S_{ij} + S_{ii} = 0 \quad \text{(for each i).}$$

Computation of gca and sca effects

The various effects were estimated as follows :

Population mean $\mu = \dfrac{2}{p(p-1)} X..$

gca effects of i th parent =

$$\hat{g_i} = \frac{1}{P+2} \left[(X_{i.} + X_{ii.}) - \frac{2}{p} X..\right]$$

and sca effects of ij th cross =

$$\hat{S}_{ij} = x_{ij} - \frac{1}{p+2}(X_{ii}+X_{ii}+X_{.j}+X_{jj}) + \frac{2}{(p+1)(p+2)} X_{..}$$

Where,

p=number of parents,

Xi. =total of array involving i th parent,

Xii =mean of i th parent,

Xij =mean value of ij th cross,

X.. =total of all the treatments in the table without

reciprocals i.e. $\sum_i \sum_j X_{ij}$ such that $i \leq j$

3.2.10.3 Correlation coefficient

In order to study the degree of association between different characters contributing to **grain** mold development, simple correlation coefficients were worked out from the **respective** variances and co-variances as per the formulae suggested by Hays *et al.* **(1955).**

$$\text{Correlation between } ij = \frac{\text{covariance of } ij}{\sqrt{\text{variance of } i \times \text{variance of } j}}$$

Significance of correlation coefficient was determined from table of **correlation** coefficient of 5 and 1% level of significance (Fisher, 1958). The 'r' **values** were compared against n-2 degree of freedom.

CHAPTER – IV

RESULTS

PAGES : 60 - 128

CHAPTER – IV

RESULTS

4.1 Analysis of variance

4.1.1 Analysis of variance (Pooled F_1) for physical, agronomic, and pathological traits, Akola and Patancheru, 1996

The pooled analysis of variance over two locations for parents and F_1 crosses is presented in (Table 2). Data revealed that the two locations, were significantly different from each other for all the characters, except plant height and mesocarp thickness. This is indicative of the fact that the two locations were eco-edaphically different and genotypes were tested under sufficiently diverse environments.

The variance due to treatments-parents, crosses and parents vs crosses were highly significant for all the 15 characters studied, except infection by *F. pallidoroseum* and other fungi in parents and glume covering, and infection by *F. pallidoroseum* in parents vs. crosses. However, variances due to treatments × locations, parents × locations and crosses × locations interactions were significant for all characters except cob length and glume covering in treatments × locations, endosperm texture, cob length, glume covering, and infection by *F. moniliforme, F. pallidoroseum, C. lunata* and other fungi. in parents x locations and grain hardness, cob length and glume covering in crosses × locations interaction. Variance due to parents vs crosses × locations interaction was observed to be significant for the trait grain hardness, electrical conductivity, DTF, TGMR and germination.

4.1.2 Analysis of variance (Pooled F_2), for physical, agronomic and pathological traits, Akola and Patancheru, 1996

The pooled analysis of variance over two locations for parents and F_2 progenies for 11 characters is presented in (Table 3). Data revealed that the two locations significantly differ from each other for all the characters except cob length and glume covering.

The variance due to treatments, parents, crosses and parents vs. crosses were highly significant for all the 11 characters studied, except infection by *F. pallidoroseum* and other fungi for treatments, parents and crosses and plant height in parents vs. crosses. However variance due to treatments × locations interactions were significant for all characters except glume covering and infection by *F. moniliforme.* For parents × (locations) interactions only grain hardness, electrical conductivity TGMR were significant and for progenies x locations interactions grain hardness, electrical conductivity, plant height, cob length, TGMR and germination were significant. However, for parents vs progenies × locations interactions significantly differed from each other for all the characters except glume covering, and infection by *F. moniliforme* and *C. lunata.*

4.1.3 Analysis of variance for biochemical characters of parental lines and F_1 at Akola, 1995

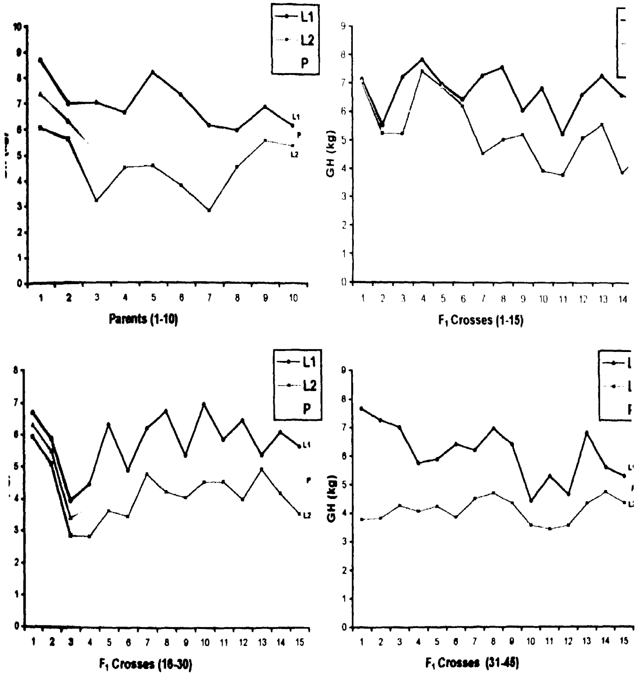
For biochemical characters viz. protein, soluble sugars, tannins and flavan-4-ols were studied from the samples collected at Akola (rainy season, 1995). The analysis of variance is presented in (Table 4).

The treatment differences were highly significant for all the traits studied. Further partitioning of treatment variance into components viz., parents, crosses and parents vs. crosses revealed that all the three components differed significantly among themselves for all the characters. Replication differences were non-significant for all the traits studied.

It may thus be concluded that the parental lines included in this investigation possessed sufficient variability for the characters studied.

4.2. Mean performance, heterosis and heterobeltiosis, Akola and Patancheru, 1996

The mean performance of parental lines, F_1 crosses, F_2 progenies, heterosis (H_1) and heterobeltiosis (H_2) were computed as per the procedure given in chapter III. The character wise results are presented in (Tables 5 to 20).



L1 = Akola L2 = ICRISAT P = Pooled

Figure 1. Grain hardness of parents and F$_1$ crosses at Akola and Patancheru,1996

1 SPV-1201
2 ICSB-101B
3 AKms-14B
4 SRT-26B
5 GJ-35-15-15
6 SPV-946
7 SPV-104
8 IS-2284
9 IS-6335
10 IS-9471

1 SPV-1201 x ICSB-101B
2 SPV-1201 x AKms-14B
3 SPV-1201 x SRT-26B
4 SPV-1201 x GJ-35-15-15
5 SPV-1201 x SPV-946
6 SPV-1201 x SPV-104
7 SPV-1201 x IS-2284
8 SPV-1201 x IS-6335
9 SPV-1201 x IS-9471
10 ICSB-101B x AKms-14B
11 ICSB-101B x SRT-26B
12 ICSB-101B x GJ-35-15-15
13 ICSB-101B x SPV-946
14 ICSB-101B x SPV-104
15 ICSB-101B x IS-2284
16 ICSB-101B x IS-6335
17 ICSB-101B x IS-9471
18 AKms-14B x SRT-26B
19 AKms-14B x GJ-35-15-15
20 AKms-14B x SPV-946
21 AKms-14B x SPV-104
22 AKms-14B x IS-2284
23 AKms-14B x IS-6335
24 AKms-14B x IS-9471
25 SRT-26B x GJ-35-15-15
26 SRT-26B x SPV-946
27 SRT-26B x SPV-104
28 SRT-26B x IS-2284
29 SRT-26B x IS-6335
30 SRT-26B x IS-9471
31 GJ-35-15-15 x SPV-946
32 GJ-35-15-15 x SPV-104
33 GJ-35-15-15 x IS-2284
34 GJ-35-15-15 x IS-6335
35 GJ-35-15-15 x IS-9471
36 SPV-946 x SPV-104
37 SPV-946 x IS-2284
38 SPV-946 x IS-6335
39 SPV-946 x IS-9471
40 SPV-104 x IS-2284
41 SPV-104 x IS-6335
42 SPV-104 x IS-9471
43 IS-2284 x IS-6335
44 IS-2284 x IS-9471
45 IS-6335 x IS-9471

4.2.1 100-grain weight

Data presented in (Table 5) revealed that for parental lines, the range of variation for 100-grain weight was from 1.69 to 2.90 g at Akola, whereas it was from 1.36 to 2.54 g at Patancheru. However, for crosses the range was from 1.76 to 3.41g and 1.52 to 2.98 g at Akola and Patancheru, respectively. Among the parental lines, SPV-104 recorded the highest 100-grain weight both at Akola (2.9 g) and Patancheru (2.54 g). Among the crosses, the highest grain weight at Akola and in pooled data exhibited by the cross SPV-1201 × SPV-104 (3.41 g) and (2.94 g), respectively, whereas at Patancheru ICSB-101B × SPV-104 (2.58 g) recorded the highest 100 grain weight. Among the crosses, SPV-1201 × SPV-104 was significantly superior at Akola. Across the two locations, SPV-104 recorded the highest 100-grain weight (2.72 g), followed by SPV-1201 (2.66 g) and ICSB-101 B(2.06 g).

Out of 45 crosses four exhibited significant positive heterosis (Table 12). The positive heterosis of highest magnitude (23.72%) was observed in AKms-14B × IS-6335 followed by SRT 26B × IS-6335 (22.94%) and AKms- 14 B × IS-9471 (20.95%)

As regards heterobeltiosis none of the crosses exhibited significant positive heterobeltiosis, however, the positive heterobeltiosis ranged between 18.75 (SRT-26B × IS-6335) to 0.18 % (ICSB 101B × SPV-104). Promising crosses exhibiting positive heterobeltiosis appear were SRT-26B × IS 6335 (18.35%). SRT-26B × IS-9471 (18.29%) and AKms-14B × IS-9471 (16.41%).

4.2.2 Grain hardness

That the range of variation for grain hardness for parental lines was from 5.91 to 8.67 kg/cm^2 at Akola, and 2.78 to 6.03 kg/cm^2 at Patancheru (Table 5, Fig. 1). However, in pooled data the range of variation was 4.43 to 7.35 kg/cm^2. The parental line SPV-1201 recorded the highest grain hardness at Akola 8.67 kg/cm^2 and Patancheru 6.03 kg/cm^2 as well as in pooled data 7.35 kg/cm^2. For crosses the range was from 3.96 to 8.71 kg/cm^2 and 2.82 to 7.43 kg/cm^2 at Akola and Patancheru, respectively. The highest (7.85, 7.43 and 7.64 kg/cm^2) grain hardness was recorded for cross SPV-1201 × GJ-35-15-15 at both locations and in pooled data, respectively.

In F_2 progenies (Table 8) the range of variation for grain hardness was from 3.25 to 7.31 kg/cm^2 and 2.13 to 6.26 kg/cm^2 at Akola and Patancheru, respectively. However, when pooled over locations, the grain hardness ranged between 3.26 and 5-93 kg/cm^2. Maximum grain hardness was recorded in F_2 progenies of SPV-1201 × IS 9471 (7.31kg/cm^2) at Akola , whereas F_2 progenies of SPV 946 × IS 2284 (6.26 kg/cm^2) and 5.93 kg/cm^2 exhibited maximum grain hardness at Patancheru and pooled data, respectively.

In F_1 diallel set, heterosis ranged from 0.40 to 11.84% over mid parental value (Table 12). The cross SPV 1201 × GJ 35-15-15 (11.84 %) recorded the highest heterosis, but the least heterosis was recorded in SPV 946 × IS 2284 (0.40%). None of the crosses exhibited significant positive heterosis, however, three crosses recorded significant negative heterosis.

Four crosses exhibited positive heterobeltiosis but it was not significant. The highest positive heterobeltiosis was exhibited in AKms-1201 × IS 2284 (5.49%) followed by SPV-1201 × GJ-35-15-15 (395%).

In F_2 diallel set only one F_2 progeny SPV-946 × IS-2284 (7.98 %) exhibited positive heterosis but, it was non-significant (Table 15).

4.2.3 Endosperm texture

It is seen from the (Table 5), that for parental lines the range of variation for endosperm texture was from 22.40 to 56.95 % at Akola, whereas, at Patancheru the same ranged between 25.90 to 59.15%. However, for crosses the range was from 21.15 to 74.00% and 25.55 to 66.60% at Akola and Patancheru respectively. The corneous endosperm texture at both locations and average over locations was exhibited by parental line GJ 35-15-15 (22.40, 25.9 and 24.15%), respectively. Among crosses corneous endosperm texture at Akola was exhibited by the cross SPV-1201 × GJ 35-15-15 (21.15 %), whereas, at Patancheru location ICSB-101 B × GJ 35-15-15 (25.55%) exhibited the corneous endosperm texture. Cross SPV-1201 × GJ 35-

15-15 (25.13%) exhibited lowest endosperm texture when pooled over locations. Corneus, intermediate and floury endosperm textures are depicted in Plate 3.

In F_1 diallel only three crosses exhibited negative heterosis (Table 12). Highest negative heterosis was noted by cross SPV-1201 × GJ 35-15-15 (-6.07%) followed by IS-2284 × IS-6335 (-3.07%). Sixteen crosses exhibited significant positive heterosis. Highest significant positive heterosis was recorded in cross AKms-14 B × SPV-946 (63.01%) followed by AKms-14B × SRT-26B (52.31%).

Whereas, 21 crosses indicated negative heterobeltiosis, none of them is significant. Highest negative heterobeltiosis was indicated by crosses SPV-946 × IS 6335 (-19.63%) followed by cross SPV-946 × IS 2284 (-19.43%). Only four crosses recorded significant positive heterobeltiosis. Cross AKms-14B × SPV-946 recorded highest significant positive heterobeltiosis (58.01%).

4.2.4 Electrical conductivity

It is observed from the (Table 5, Fig. 2) the range of variation for electrical conductivity for parental line was from 105.0 to 300.50 dSm^{-1} at Akola and 214.00 to 846.50 dSm^{-1} at Patancheru. However, in pooled data the range of variation was 167.25 to 553.25 dSm^{-1}. The parental line IS-9471 (105.00 dSm^{-1}) exhibited lowest electrical conductivity at Akola and IS-6335 (214.00 dSm^{-1}) at Patancheru, while in pooled data parental line IS-2284 (167.25 dSm^{-1}) exhibited lowest value. For crosses the range was 90.00 to 237.50 dSm^{-1} and 82.00 to 485 dSm^{-1}at Akola and Patancheru, respectively. Among crosses lowest electrical conductivity at Akola was exhibited by the cross IS-6335 × IS 9471 (90.00 dSm^{-1}) and at Patancheru and pooled over locations SPV 946 × IS 9471 exhibited lowest electrical conductivity (82.00 and 102.25 dSm^{-1}, respectively).

In F_2 progenies (Table 8) the mean values ranged from 155.00 dSm^{-1} (IS 6335 × IS-9471) to 553.00 dSm^{-1} (SRT-26B × SPV-104) at Akola; whereas, it was 158.00 dSm^{-1} (SRT-26B × IS -9471) to 685.00 dSm^{-1} (SPV-1201 × GJ 35-15-15) at Patancheru. However, when pooled over locations, the electrical conductivity ranged

Plate : 3 Endosperm texture of sorghum midian longitudinal half kernels of sorghum showing corneous, intermediate and floury endosperm

The rating for the kernels are

A-1,B-2,C-3,D-3,E-3,F-4,G-5 and H-5 (3.3X)

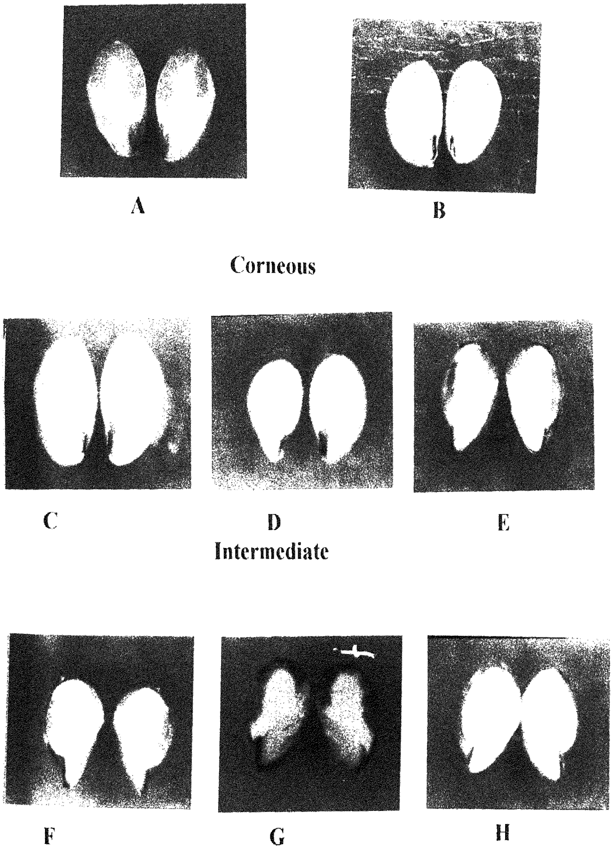
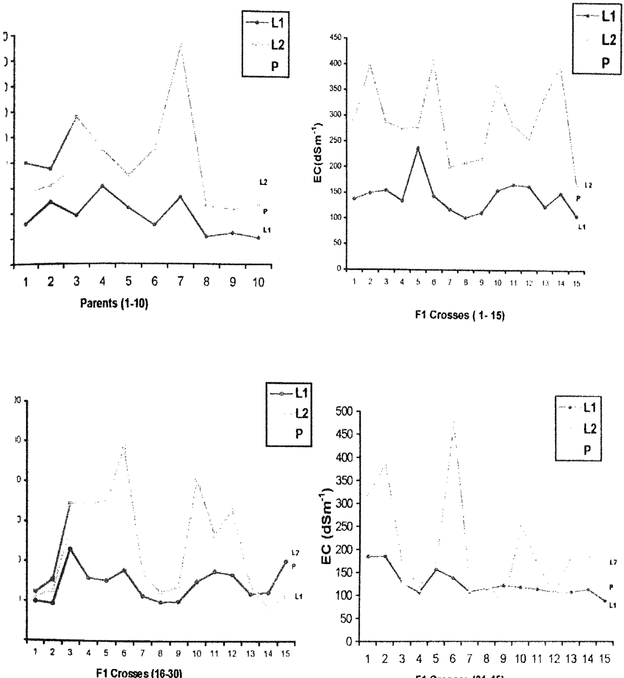


Plate 3. Endosperm texture



L1 = Akola   L2 = Patancheru,   P = Pooled

Figure 2. Electrical conductivity of parents and F_1 crosses at Akola and Patancheru, 1996

PV-1201
'SB-101B
Kms-14B
RT-26B
J-35-15-15
'V-946
'V-104
-2284
-6335
-9471

1 SPV-1201 x ICSB-101B
2 SPV-1201 x AKms-14B
3 SPV-1201 x SRT-26B
4 SPV-1201 x GJ-35-15-15
5 SPV-1201 x SPV-946
6 SPV-1201 x SPV-104
7 SPV-1201 x IS-2284
8 SPV-1201 x IS-6335
9 SPV-1201 x IS-9471
10 ICSB-101B x AKms-14B
11 ICSB-101B x SRT-26B
12 ICSB-101B x GJ-35-15-15
13 ICSB-101B x SPV-946
14 ICSB-101B x SPV-104
15 ICSB-101B x IS-2284

16 ICSB-101B x IS-6335
17 ICSB-101B x IS-9471
18 AKms-14B x SRT-26B
19 AKms-14B x GJ-35-15-15
20 AKms-14B x SPV-946
21 AKms-14B x SPV-104
22 AKms-14B x IS-2284
23 AKms-14B x IS-6335
24 AKms-14B x IS-9471
25 SRT-26B x GJ-35-15-15
26 SRT-26B x SPV-946
27 SRT-26B x SPV-104
28 SRT-26B x IS-2284
29 SRT-26B x IS-6335
30 SRT-26B x IS-9471

31 GJ-35-15-15 x SPV-946
32 GJ-35-15-15 x SPV-104
33 GJ-35-15-15 x IS-2284
34 GJ-35-15-15 x IS-6335
35 GJ-35-15-15 x IS-9471
36 SPV-946 x SPV-104
37 SPV-946 x IS-2284
38 SPV-946 x IS-6335
39 SPV-946 x IS-9471
40 SPV-104 x IS-2284
41 SPV-104 x IS-6335
42 SPV-104 x IS-9471
43 IS-2284 x IS-6335
44 IS-2284 x IS-9471
45 IS-6335 x IS-9471

between 165.50 and 589.50 dSm^{-1} and minimum electrical conductivity recorded in progeny IS-6335 × IS 9471 (165.50 dSm^{-1})

All 45 crosses indicated negative heterosis out of which 30 crosses exhibited significant negative heterosis (Table 12). Highest significant negative heterosis was recorded by cross SPV-104 × IS 9471 (-70.69 %) followed by cross SRT-26B × IS 6335 (-61.63 %).

As regards heterobeltiosis all 45 crosses exhibited negative heterobeltiosis, of which 38 indicated significant negative heterobeltiosis. The range in negative direction varied from –10.55 to –80.89%. The highest significant negative heterobeltiosis was exhibited by cross SPV–104 × IS–9471 (-80.89 %) followed by cross SPV-104 × IS 6335 (-74.33 %).

In F_2 diallel set (Table 15) nine progenies exhibited negative heterosis, of which three progenies exhibited significant negative heterosis. The highest negative heterosis exhibited by progeny SRT-26B × IS-9471 (-33.09 %) followed by AKms- 14 B × IS-6335 (-30.99 %) and SPV-104 × IS-9471 (-19.68%). Whereas, 29 progenies exhibited negative heterobeltiosis of which 13 progenies exhibited significant negative heterobeltiosis. The highest negative heterobeltiosis was exhibited by SRT- 26B × IS-9471 (-51.44 %) followed by AKms-14 B × IS 6335 (-50.23 %).

4.2.5 Days to 50% flowering

The range for days to 50% flowering, among parental lines was from 66.00 to 80.00 and 59.00 to 79.00 days at Akola and Patancheru, respectively (Table 5). The early flowering was exhibited by IS-6335 (66.00 days) at Akola, (59.00 days) Patancheru and (62.50 days) in pooled data. The crosses ranged between 59.50 and 76.00 days and 59.00 and 85.50 days at Akola and Patancheru, respectively. The earliest flowering crosses was SRT-26B x IS-6335 (59.00 and 59.75 days) at Patancheru and in pooled data, respectively.

The range of desirable heterosis was from - 0.17 to- 17.59 % (Table 12) 18 out of 45 crosses exhibited significant negative heterosis, highest recorded by cross SPV-104 × IS 9471 (-17.59 %) followed by SPV-104 × IS-6335 (-13.32%). Only five crosses exhibited significant positive heterosis.

Heterobeltiosis in desired direction was exhibited by 36 crosses, while positive and significant heterobeltiosis was exhibited by only one cross. The cross SPV-104 × IS 6335 recorded highest magnitude of heterobeltiosis (-22.04 %) followed by cross SPV-104 × IS -9471 (-21.41 %). Both crosses were also significantly superior to other crosses for heterosis in negative direction.

4.2.6 Plant height

It is observed from the (Table 6), that the range of variation was from 136 cm to 283 cm at Akola, and 140 cm to 285.50 cm at Patancheru , however, in pooled data the range of variation was 138 cm to 273.75 cm. The parental line AKms-14B exhibited least height (136, 140,138 cm) at Akola, Patancheru and in pooled data, respectively. For cross the dwarfs cross was ICSB-101B × AKms-14B (183 cm) at both locations and pooled data, however tallest cross was SPV-1201 × IS-9471 (343m 340 and 341.50 cm) at Akola, Patancheru and in pooled data, respectively.

In F_2 progenies (Table 8) the range was from 157.90 to 260.00 cm at Akola and from 184.15 to 318.25 cm at Patancheru. The least height was exhibited by progeny ICSB-101B × AKms-14 B (157.90, 184.15 and 171.02 cm) at Akola, Patancheru and pooled data, respectively.

Significant positive heterosis was observed in (Table 13) 41 crosses and maximum heterosis (56.81 %) was observed in SPV-1201 × AKms-14B followed by SPV-1201 × ICSB 101B (54.40 %). Only three crosses exhibited negative heterosis but, none of the crosses exhibited significant. Highest negative heterosis was observed in SPV-1201 × SPV-946 (-3.93 %).

Only seven crosses exhibited heterobeltiosis in negative direction and out of them, only three crosses were significant. They were SRT-26 × GJ 35-15-15 (-19.04 %), AKms- 14B × GJ-35-15-15 (-12.02 %) and SPV-1201 × SPV-946 (-10.78 %).

In F_2 diallel set (Table 15) 18 progenies exhibited heterosis in negative direction and none of them was significant. The highest negative heterosis was exhibited by SPV-1201 × SPV-104 (-12.55 %) followed by SPV-1201 × ICSB-101B (-10.06 %).

As regards to heterobeltiosis, 35 progenies exhibited negative heterobeltiosis and seven progenies exhibited significant negative heterobeltiosis. The range was from –23.32 to –1.21 %. The highest negative heterobeltiosis was exhibited in SPV-1201 × ICSB-101B (-23.32 %) followed by SRT –26B × GJ-35-15-15 (-21.61 %).

4.2.7 Cob length

Mean values for this character varied from 21.20 cm to 26.20 cm and from 17.00 to 28.90 cm in case of parental lines at Akola and Patancheru, respectively. (Table 6), whereas in pooled data the range was 19.10 cm to 27.55 cm. Parental line ICSB-101B recorded maximum ear head length (26.20, 28.90 and 27.55 cm) at Akola, Patancheru and pooled data, respectively. Among crosses the range was 20.40. (SPV-1201 × SP 104) to 29.70 cm (GJ-35-15-15 × IS-6335) at Akola, 21.00 (AKms-14 B × SRT-26B) to 32.10 cm (ICSB 101B × IS-9471) at Patancheru and 20.95 cm (SPV-1201 × SPV-104) to 30.80 cm (ICSB-101B × IS-9471) in pooled data.

In F_2 progenies (Table 8) mean values ranged from 18.95 (SPV-1201 × SPV-104) to 30.05 cm (ICSB-101 B × AKms-14 B) at Akola, whereas, it was 20.00 (SPV-946 × SPV-104) to 29.85 cm in (SPV-946 × IS-6335) at Patancheru. However, in pooled data, the cob length ranged between 21.25 to 28.90 cm and the maximum cob length recorded in progeny (ICSB –101 B × AKms-14 B).

In F_1 diallel set (Table 13) the estimates for heterosis ranged from 0.10 to 22.40% in positive direction and from –2.42 to –4.23 % in negative direction. Five crosses were significant in positive direction. The highest heterosis % in positive direction was recorded by cross SPV-104 × IS-6335 (22.40 %) followed by AKms-14B × GJ-35-15-15 (19.79 %).

Only one cross AKms-14B × GJ-35-15-15 (19.54%) exhibited significant heterobeltiosis in positive direction. This cross was also significantly superior to other crosses for heterosis in positive direction.

In F_2 diallel set (Table 15) 42 progenies exhibited positive heterosis of which only three progenies exhibited significant positive heterosis, the highest positive heterosis was exhibited in GJ-35-15-15 × IS 2284 (27.54 %) followed by SPV-946 × IS-6335 (17.26%) and GJ-35-15-15 × IS-9471 (14.92%). Whereas, 25 progenies exhibited positive heterobeltiosis, of which only one progeny GJ-35-15-15 × IS-2284 (25.60 %) exhibited significant positive heterobeltiosis.

4.2.8 Glume covering

The range for glume covering for parental lines was exhibited from 50 to 75% at Akola, Patancheru and in pooled data (Table 6). Parental lines ICSB-101B and IS-6335 recorded maximum 75% glume covering at Akola, Patancheru and pooled data. Minimum 50% was recorded by SPV-1201, AKms-14B, SPV-946, SRT-26B at Akola, Patancheru and in pooled data.

Among crosses ICSB-101 B × IS-6375, SPV-104 × IS-6335 and IS-2284 × IS-6335 recorded maximum 75% glume covering at Akola, Patancheru and pooled data. AKms-14B × GJ-35-15-15 and AKms-14B × SPV-946 recorded maximum glume covering at Patancheru.

In F_2 progenies (Table 9) maximum 66.50, 75.00 and 70.75 % glume covering was exhibited in SPV-946 × IS–6335 at Akola, Patancheru and pooled data, respectively. However, minimum 37.50% was recorded in SPV-1201 × SPV-946 and AKms- 14B × IS-946 at Akola. Whereas, SPV-1201 × SPV-104 recorded minimum 37.50 and 41.25% glume covering at Patancheru and in pooled data, respectively.

In F_1 diallel set (Table 13) none of the crosses recorded significant positive heterosis. However, 23 crosses recorded positive heterosis, the highest (25%) exhibited by AKms- 14 B × GJ 35-15-15 and AKms- 14 B × SPV –946. None of crosses exhibited significant positive heterobeltiosis. However, above crosses exhibited highest 25% heterobeltiosis in positive direction.

In F_2 diallel set (Table 15) 18 progenies exhibited positive heterosis, but it was not significant. The highest positive heterosis was exhibited in progenies SPV-104 × IS 2284 (20.47%) followed by GJ-35-15-15 × IS 2284 (16.71%). Whereas, 16 progenies exhibited positive heterobeltiosis, the range was 0.00 to 13.78%. The highest positive heterobeltiosis was exhibited in SPV 104 × IS 2284 (13.78%) followed by GJ-35-15-15 × IS-2284 (10.22 %).

4.2.9 Mesocarp thickness

The parental lines ranged was from 45.45 to 97.52 μm at Akola 59.91 to 96.57 μm at Patancheru and 54.02 μm to 97.05 μm in pooled data. Lowest mesocarp thickness was recorded in parental line SPV-946 (45.45 μm) at Akola and pooled data and IS-9471 (59.91 μm) at Patancheru. Among crosses the mean values ranged from 32.03 μm, 31.32 μm and 31.68 μm (SPV-104 × IS-6335) to 96.79 μm, 99.56 μm and 98.13 μm (AKms–14B × SRT-26B) at Akola, Patancheru and in pooled data, respectively (Table 6). Mesocarp thickness of susceptible, elite (moderately resistant), resistant parental lines and red and while cross are shown in Plate 4.

The ranged for desirable heterosis was from -3.03 to -61.14% (Table 13). Out of 45 crosses in F_1 generation 29 exhibited significant negative heterosis, the highest (-61.14%) recorded by SPV-104 × IS-6335 followed by SPV-104 × IS-2284 (-57.19%) and ICSB-101 B × IS -6365 (-56.61%).

Heterobeltiosis in desired direction (negative and significant) were exhibited by 32 crosses. The ranged of heterobeltiosis was from 13.74 to -64.39%. The highest heterobeltiosis (-64.39%) was indicated by SPV-104 × IS-6335 followed by ICSB-101 B × IS- 6335 (-61.74%). Both crosses were significantly superior to other crosses for heterosis in negative direction.

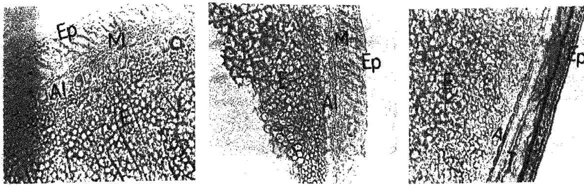
4.2.10 Threshed grain mold rating

At Akola, the range of variation for parental lines was form 2.00 to 4.00, whereas it was 1.50 to 5.00 and 1.75 to 4.50 at Patancheru and in pooled data, respectively. (Table 6). The parental lines IS-9471, IS- 6335 and IS-2284 exhibited lowest (2.0) TGMR at Akola, whereas, IS-9471 exhibited (1.5) TGMR at Patancheru and (1.75)

Plate : 4 : Mesocarp thickness (Transverse section, 66.6 X)

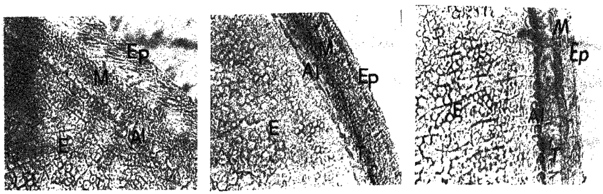
I		**Parental Lines**	
	A	Akms 14-B	White (S)
	B	SPV-946	White (MR)
	C	IS 9471	Red (R)
II		**F_1 Cross (red)**	
	D	SPV-104	White (Parental line)
	E	IS-6335	Red (Parental line)
	F	SPV-104 x IS-6335	Red (Cross)
III		**F_1 (Cross (white)**	
	G	SPV-1201	White (Parental line)
	H	ICSB-101B	White (Parental line)
	I	SPV-1201 x ICSB-101B	White (Cross)

(Ep Epicarp, M=Mesocarp, Al-Aleurone layer, E-Endosperm and T-testa)



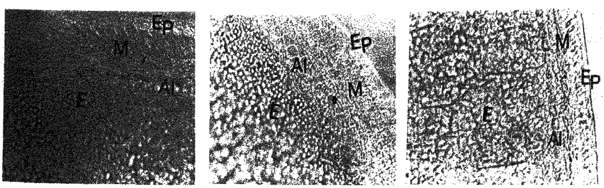
A **B** **C**

I Parental lines



D **E** **F**

II F_1 cross (red)



G **H** **I**

III F_1 cross (white)

Plate 4. Mesocarp thickness

TGMR in pooled data. Among crosses the range was from (2.0 to 3.50), cross SPV-946 × IS-6335 exhibited the lowest and AKms-14B × SRT-26B exhibited the highest TGMR at Akola, at Patancheru TGMR varied between (1.50 and 5.00) cross GJ 35-15-15 × IS-9471, IS-2284 × IS-6335 and IS-6353 × IS -9471 exhibited lowest (1.50) TGMR and SPV-946 × SPV-104 and SRT 26 B × GJ 35-15-15 exhibited highest (5.0) TGMR. However, in pooled data IS-6335 × IS-9471 and IS 2284 × IS-6335 recorded lowest (1.75) TGMR.

In F_2 diallel (Table 9) lowest TGMR was exhibited by progeny IS-2284 × IS-9471 (1.70, 2.0 and 1.85) at Akola, Patancheru and pooled data respectively. However highest TGMR was exhibited by AKms-14B × SPV-104 (3.05) and (3.28) at Akola and pooled data, respectively. Whereas at Patancheru progeny AKms-14B × SRT-26B (4.00) exhibited highest TGMR.

In F_1 diallel set (Table 13) the range for desirable heterosis was from 2.86 to -46.15% Out of 45 crosses 22 crosses exhibited significant negative heterosis, the highest (-46.15%) recorded by AKms-14 B × IS-6335 followed by (44.00 %) by AKms-14 B × IS-9471.

Heterobeltiosis in negative direction (negative and significant) were exhibited by 25 crosses. The range of heterobeltiosis was from 5.56 to 61.11%. The highest heterobeltiosis was exhibited (-61.11 %) in AKms-14B × IS-6335 and AKms-14B × IS-9471 followed by AKms-14 B × IS-2284 (-55.56%). First two crosses were significantly superior to other crosses for heterosis in negative direction.

In F_2 diallel set (Table 15) 44 progenies exhibited negative heterosis, of which 25 exhibited significant negative heterosis, the highest negative heterosis exhibited by AKms-14B × IS-6335 (-30.00%) followed by AKms-14 B × GJ 35-15-15 (-29.70%) and AKms-14 B × IS-9471 (-29.60 %). Whereas, all 45 progenies exhibited negative heterobeltiosis of which 41 exhibited significant negative heterobeltiosis. The range was from - 51.11% to - 2.50%. The highest negative heterobeltiosis was exhibited in AKms-14B × IS-9471 (-51.11%) followed by AKms-14 B × IS-6335 (-49.44%) and AKms-14B × IS-2284 (-46.67%).

4.2.11 Seed germination

It is seen form the (Table 7), that for parental lines the range of variation for seed germination was from 29.00 to 86.00% at Akola, whereas, at Patancheru it ranged between 2.50 and 61.00%. However, when pooled over locations parental lines ranged between 15.75 to 71.75%. Among crosses the range of variation for germination was from 32.50 to 98.00%, and 14.00 to 88.50% at Akola and Patancheru, respectively. Whereas, pooled data the crosses ranged between 25.25 to 90.00%. The highest seed germination at Akola was exhibited by parental line IS 6335 (86.00%), whereas, at Patancheru and pooled data parental line IS-2284 exhibited highest germination 61.00 and 71.75%, respectively.

Among crosses SPV-1201 × IS-2284 exhibited highest 98.00% seed germination at Akola, ICSB-101B × IS-6335 exhibit highest 88.50% germination at Patancheru, whereas, cross ICSB-101B × IS-2284 exhibited highest germination (90.00%) in pooled data.

In F_2 progenies (Table 9) the mean values for germination ranged from 53.00 to 87.90% at Akola, 9.75 to 83.50% at Patancheru and 38.00 to 84.70% in pooled data. At Akola progeny IS-2284 × IS-6335 exhibited highest germination (87.90%) followed by IS-6335 x IS-9471 (86.40%) and SPV-946 × IS-6335 (86.15 %), while progeny IS-2284 × IS-9471 exhibited highest seed germination (83.50 and 84.70%) at Patancheru and pooled data, respectively.

The range of heterosis in positive direction was from 4.14 to 76.76% (Table 14). All crosses exhibit positive heterosis, however 37 crosses exhibit significant. The highest heterosis (76.76%) was indicated in cross AKms-14B × IS-6335, followed by cross AKms-14 B × IS-9471 (71.44%).

Regarding heterobeltiosis the range was 1.20 to 40 56% in positive direction, whereas, 17 crosses out of 45 exhibits significant positive heterobeltiosis. The highest (40.56%) was indicated by SPV-1201 × SRT-26B followed by ICSB-101B × SPV-946 (33.89%) and ICSB-101B × IS-9471 (33.45 %).

In F_2 diallel set (Table 16) all the progenies exhibited positive heterosis, of which 23 progenies exhibited significant positive heterosis. The highest positive heterosis was exhibited by progeny ICSB-101B × AKms-14B (78.73%) followed by AKms-14B × GJ-35-15-15 (62.84%) and AKms-14B × IS-6335 (57.66%). However, 36 progenies exhibited positive heterobeltiosis, of which only four progenies exhibited significant positive heterobeltiosis. The highest positive heterobeltiosis was exhibited by, ICSB-101B × AKms-14B (38.93%) followed by SPV-1201 × SRT-26B (37.20%).

4.2.12 Infection by *F. moniliforme*

It is seen from the (Table 7) that, the range of variation for parental lines in F_1 diallel set, was from 5.33 to 38.67% at Akola, whereas, at Patancheru the same ranged between 34.00 to 71.34%. However, in crosses the range was from 5.99 to 35.99 and 21.34 to 70.67% at Akola and Patancheru, respectively. The lowest fungal load of *F. moniliforme* at Akola, Patancheru and in pooled data was exhibited by IS-9471, (5.33, 34.00 and 19.67%), respectively. Among crosses lowest fungal load of *F. moniliforme* at Akola was exhibited by cross SPV-104 × IS-6335 (5.99%), whereas, at Patancheru and pooled data, cross ICSB-101B × IS-6335 exhibited lowest infection by *F. moniliforme* (21.34 and 15.66%), respectively.

In F_2 diallel progenies (Table 10) mean values ranged from 18.50 (ICSB-101B × IS-6335) to 52.52% (SPV-104 × IS-9471) at Akola, where as it was 25.34 (IS-6335 × IS-9471) to 67.50% (AKms-14B × SPV-104) at Patancheru. However, in pooled data infection by *F. moniliforme* ranged between 26.88 to 54.25%, lowest 26.88% *F. moniliforme* load was recorded in progeny (SPV- 946 × IS-6335).

In F_1 diallel set 40 crosses exhibited negative heterosis of which only five crosses exhibited significant. The range was 53.47% to 0.02% in negative direction. However, the highest negative heterosis was in cross ICSB-101B × IS-6335 (-53.47%) followed by AKms-14B × IS-6335 (-50.81 %) and SPV-104 × IS-6335 (-48.39%) (Table 14).

However, 43 progenies exhibited negative heterobeltiosis of which 13 progenies exhibited significant. The range was -62.41 to -0.83 % in negative direction. The highest negative heterobeltiosis was observed in AKms-14B × IS-6335 (-62.41%) followed by SPV-104 × IS-6335 (-61.22%) and ICSB-101B × IS- 6335 (-60.51%).

In F_2 diallel set (Table 16) only three progenies exhibited negative heterosis, but it was not significant. The highest negative heterosis was exhibited in progenies SRT-26B × SPV-946 (-12.50%) followed by ICSB-101B × AKms-14 B (-7.59%) and SRT -26B × SPV-104 (-1.93%). Three progenies recorded significant positive heterosis.

However, 13 progenies exhibited negative heterobeltiosis, but it was not significant. The range was -17.43 to 0.04%. The highest negative heterobeltiosis exhibited in SRT-26B × SPV-946 (-17.43%) followed by AKms-14 B × IS-9471 (-16.13%) and SPV-946 × IS-6335 (-16.00 %), but it was not significant. Only one progeny IS-2284 × IS-6335 exhibited (104.41%) significant positive heterobeltiosis.

4.2.13 Infection by *F. pallidoroseum*

The range of variation for parental lines for *F. pallidoroseum* was exhibited from 0.71 to 2.67% at Akola, 7.34 to 19.34% at Patancheru and 4.02 to 10.51% in pooled data. Lowest (0.71%) *F. pallidoroseum* load was exhibited by parental lines SPV-1201, ICSB-101B, AKms-14B and GJ-35-15-15 at Akola, whereas, AKms-14B exhibited lowest 7.34 and 4.02% *F. pallidoroseum* load at Patancheru and in pooled data, respectively. In crosses lowest (0.71, 5.34 and 3.02%) *F. pallidoroseum* load was exhibited in cross ICSB-101 B × IS 2284 at Akola, Patancheru and pooled data, respectively (Table 7).

In F_2 progeny lowest (0.77%) fungal load of *F. pallidoroseum* was exhibited in GJ-35-15-15 × SPV-946 at Akola, however, progeny AKms-14B × GJ-35-15-15 exhibited lowest (1.50 and 1.53%) fungal load at Patancheru and pooled data, respectively (Table 10).

Out of 45 crosses, 13 crosses exhibited negative heterosis out of which only one cross ICSB-101 B × IS-2284 (-64.85%) exhibited significant heterosis in F_1 diallel set (Table 14).

The range of heterobeltiosis was from –71.25 % to -0.04%, 22 crosses exhibited negative heterobeltiosis, out of which only one cross ICSB-101 B × IS-2284 (-71.25%) exhibited significant heterobeltiosis. The same cross was found significantly superior to other crosses for heterosis in negative direction.

In F_2 diallel 37 progenies exhibited negative heterosis of which only one progeny GJ 35-15-15 × SPV–946 (-74.43%) exhibited significant negative heterosis. The range was –74.43 to –1.71% in negative direction. Thirty eight progenies exhibited heterobeltiosis in negative direction and out of them, only one progeny GJ-35-15-15 × SPV-946 (-79.88%) was significant. The same progeny was found significantly superior to other crosses for heterosis in negative direction (Table16).

4.2.14 Infection by *C. lunata*

At Akola location, the range of variation for parental lines was from 24 (IS-9471) to 60% (GJ-35-15-15), whereas, at Patancheru and in pooled data the range of variation for parental lines was from 15.33 and 20.67 (IS-6335) to 37.33 and 46.67% (SRT 26B), respectively. Among crosses the range was from 18.00 (SPV-1201 × IS-6335 and SPV-1201 × IS-9471) to 68% (ICSB-101B × SRT-26B) at Akola, whereas, at Patancheru 8.0 (ICSB-101B × SPV-104) to 37.33% (SPV-1201 × SPV-104) and in pooled data the range was from 20.33 (ICSB-101B × IS-6335) to 46.33% (SPV-1201 × SPV-104) (Table 7).

In F_2 progenies lowest (19.26%) fungal load of *C. lunata* was exhibited in IS-6335 × IS-9471 at Akola, whereas, IS 2284 × IS 9471 exhibited lowest values (18.50 and 19.71%) at Patancheru and in pooled data, respectively (Table 10).

In F_1 diallel set (Table 14), 36 crosses exhibited negative heterosis, but it was not significant. The range was –36.13 to –0.55%, highest negative heterosis was exhibited in ICSB-101 B × IS-6335 (-36.13 %) followed by SRT- 26B × IS-9471 (-34.29 %) and SPV-1201 × IS-9471 (-33.01 %) The range of heterobeltiosis was from –52.72 to –2.87%, 41 crosses exhibited negative heterobeltiosis, out of which 11 crosses were exhibited significant. The highest negative heterobeltiosis was exhibited by cross ICSB-101 B × IS-6335 (-52.72%) followed by SRT-26B × IS-9471 (-50.71%) and SPV-1201 × IS-9471 (-49.26 %).

In F_2 diallel set (Table 16), 34 progenies exhibited negative heterosis The range was from –38.72 (IS-2284 × IS-9471) to 1.17% (SRT-26B × IS-2284), none of them was significant. However, 41 progenies exhibited negative heterobeltiosis but it was not significant. The range was from 45.25 to 3.94%. Highest negative heterobeltiosis was exhibited in progeny IS-2284 × IS-9471 (-45.25%) followed by IS-2284 × IS-6335 (-41 39%).

4.2.15 Infection by other fungi

At Akola location the range of variation for parental lines was from 9 34 (AKms-14B) to 24 67 % (IS-2284), whereas, at Patancheru the range of variations was from 0 71 (SPV-104) to 6.00% (ICSB-101B), however in poled data the range of variation was from 5.18 (AKms-14B) to 15.00% (IS-2284) Among crosses lowest (12 00, 0.71 and 9.00%) fungal load of other fungi was exhibited in AKms-14B × SPV-104, ICSB-101B × SPV-104, and AKms-14B × SPV-104 at Akola, Patancheru and pooled data, respectively (Table 7).

In F_2 progenies lowest (27.00 20.52 and 8.45%) fungal load of other fungi was exhibited in ICSB-101 B × SRT–26B, SPV-1201 × IS-2284 and AKms-14B × SRT-26B at Akola, Patancheru and pooled data, respective (Table 10).

In F_1 diallel four crosses exhibited negative heterosis but it was not significant. The highest negative heterosis exhibited by GJ-35-15-15 × IS-2284 (-15.66%) followed by IS-6335 × IS-9471 (-13.94%) and ICSB 101B × SPV-104 (-5.14%). However, 11 crosses exhibited negative heterobeltiosis, the range was from

0.02 to -22.22%. The highest negative heterobeltiosis exhibited in GJ-35-15-15 × IS 2284 (-22.22%) followed by SRT-26 B × IS 9471 (-19.52). None of them exhibited significant negative heterobeltiosis (Table 14).

In F_2 diallel set 14 progenies exhibited negative heterosis, but it was not significant. The highest negative heterosis was exhibited in progeny GJ-35-15-15 × SPV-104 (-29.64%) followed by SPV-946 × SPV-104 (-21.40 %) and AKms-14B x GJ-35-15-15 (-18.18 %), whereas, 20 progenies exhibited negative heterobeltiosis. The range was -40.00 to -4.15%. The highest negative heterobeltiosis exhibited in progeny AKms-14B × GJ-35-15-15 (-40.00%) followed by GJ-35-15-15 × SPV-104 (-39.80%). None of the progeny exhibited significant negative heterobeltiosis (Table 16).

Biochemical characters

4.2.16 Proteins

The data relative to mean performance of parental lines and crosses for biochemical parameters is presented in (Table 11).

Data revealed, that the range of variation in parental lines for proteins in sorghum grains varied from 8.93 to 12.94%, however, for crosses the range was 5.23 to 10.56%. The highest proteins was exhibited by parental lines ICSB-101B (12.94 %) followed by SRT-26 B (12.41%) and SPV-1201 (12.35%). Among crosses the highest proteins was exhibited by cross SPV-104 × IS-6335 (10.56%) followed by SPV-1201 × IS-9471 (10.11%).

Among 45 crosses none of cross exhibited the heterosis in positive direction, a negative heterosis exhibited in all 45 crosses (Table 17) The highest negative heterosis was exhibited by cross AKms-14B × SRT 26 B (-27.43%), followed by AKms-14 B × SPV-946 (-27.27%).

Significant heterobeltiosis was reported in all 45 crosses in negative direction, and none of crosses exhibited positive heterobeltiosis The highest heterobeltiosis in negative direction was exhibited by cross SRT-26B × IS-9471 (-30.36%) followed by SRT-26 B × IS-2284 (-29.15 %).

4.2.17 Soluble sugars

The mean performance of parental lines and crosses for soluble sugars content is presented in (Table 11).

Data revealed that parental lines mean values for this character ranged from 1.2 (SPV-104) to 2.3% (AKms-14B). Among crosses SPV-1201 × IS-6335 and SRT- 26B × IS-2284 (1.8%) exhibited highest and SPV-946 × SPV-104 and SPV-104 × IS-6335. (0.8%) recorded lowest value.

Among 45 crosses (Table 17), only four exhibited the heterosis in positive direction, the highest being 2.53% (GJ-35-15-15 × IS-9471) followed by 2.29% (SPV-1201 × IS-6335). Negative heterosis exhibited in 41 crosses. The highest significant negative heterosis was exhibited by cross AKms-14B × SRT-26B (-28.67%).

None of crosses exhibited significant and positive heterobeltiosis. Only one cross SPV-1201 × IS-6335 (2.29%) exhibited positive heterobeltiosis. Significant heterobeltiosis was reported in 34 crosses in negative direction.

4.2.18 Tannins

The mean performance of parental lines and crosses for tannins content is presented in (Table-11).

Parental lines range for tannins content was varied from 0.02 (ICSB-101B) to 5.84 CE % (IS-2284). However, crosses range was varied from 0.01 (ICSB-101B × GJ-35-15-15) to 3.41 CE % (AKms 14B × IS 2284).

Among 45 crosses 20 exhibited positive heterosis (Table 17), of which 16 were significant. Cross (SRT-26B × IS-9471) recorded highest 38.64 CE % followed by (AKms-14B × IS-9471) 36.84 CE %.

Only one cross (SRT-26B × SPV-104) exhibited positive heterobeltiosis (0.07%). Twenty seven crosses exhibited significant negative heterobeltiosis.

4.2.19 Flavan-4-ols

The data relative to mean performance on flavan-4-ols both extract (methanol + H+/methanol) content is presented in (Table 11 and Fig. 3).

The range for parental lines for this characters varied from 0.00 to **18.00** $A_{550/g}^{-1}$, however, for crosses the range was 0.00 to 12.00 $A_{550/g}^{-1}$. The highest **flavan-4-ols** content was exhibited by parental lines IS-9471 (18.0) followed by IS-**2284** (7.9) and IS-6335 (7.6 $A_{550\,g}^{-1}$). Among crosses the highest flavan-4-ols content **was exhibited** by IS-6335 × IS-9471 (12.00) followed by IS-2284 × IS-9471 (11 90 $A_{550/g}^{-1}$).

Among 45 crosses 25 exhibited positive and significant heterosis, the **range** was 52.10 to 5.67% in positive direction (Table 17). Cross SRT-26B × IS-6335 **exhibited** the highest positive heterosis (52.10 %) followed by SPV-946 × IS-6335 **(52.07%)**. However, only one crosses recorded negative significant heterosis, IS-2284 × **IS-6335** (-14.01%).

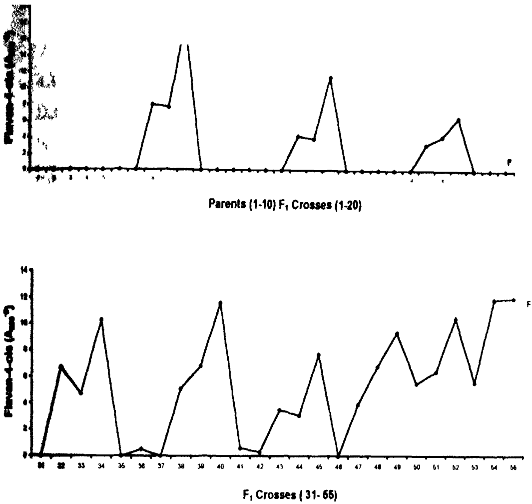
Out of 45 crosses 21 crosses exhibited positive heterobeltiosis of which **four** were significant. The highest positive heterobeltiosis was observed in GJ-35-15-**15** × SPV-946 (48 37 %) followed by SRT-26B × SPV-946 (41 30%)

Mean performance at Akola, 1995 and 1996

4.3.1 100-grain weight

Data presented in (Table 18) revealed that, parental line SPV-1201 exhibited highest **100-grain** weight (3.04, 2.80, and 2.92 g) in both season and in pooled data. However, **lowest** (1.61 g) value was recorded in parental line IS-2284 in Akola 95 season, **whereas**, parental line IS-6335 exhibited lowest (1 69 and 1.66 g) grain weight in **Akola** 96 season and in pooled data, respectively.

Among crosses maximum 100-grain weight was recorded in SPV-946 × **SPV**-104 (3.17 g) in Akola 1995. whereas, cross SPV-1201 × SPV-104 recorded **maximum** (3.40 and 3.28 g) grain weight in Akola 1996 and in pooled data, **respectively**. Cross IS-2294 × IS-6335 recorded minimum (1 62, 1.76 and 1 69 g) **grain** weight in Akola 1995, Akola 1996 and in pooled data, respectively.



F – Flavan-4-ols

Figures 3. Flavan-4-ols of parents and F_1 crosses at Akola 1995

1 **SPV**-1201
2 **ICSB**-101B
3 **AKms**-14B
4 **SRT**-26B
5 **GJ**-35-15-15
6 **SPV**-946
7 **SPV**-104
8 **IS**-2284
9 **IS**-6335
10 **IS**-9471

11 SPV 1201 x ICSB 101B
12 SPV 1201 x AKms 14B
13 SPV 1201 x SRT 26B
14 SPV 1201 x GJ 35 15 15
15 SPV 1201 x SPV 946
16 SPV 1201 x SPV 104
17 SPV 1201 x IS 2284
18 SPV 1201 x IS-6335
19 SPV 1201 x IS 9471
20 ICSB 101B x AKms 14B
21 ICSB 101B x SRT 26B
22 ICSB 101B x GJ 35 15 15
23 ICSB 101B x SPV 946
24 ICSB 101B x SPV 104
25 ICSB 101B x IS 2284

26 ICSB 101B x IS-6335
27 ICSB 101B x IS 9471
28 AKms 14B x SRT 26B
29 AKms 14B x GJ 35 15 15
30 AKms 14B x SPV 946
31 AKms 14B x SPV 104
32 AKms 14B x IS 2284
33 AKms 14B x IS-6335
34 AKms 14B x IS 9471
35 SRT 26B x GJ 35 15 15
36 SRT 26B x SPV 946
37 SRT 26B x SPV 104
38 SRT 26B x IS 2284
39 SRT 26B x IS-6335
40 SRT 26B x IS 9471

41 GJ 35 15 15 x SPV 946
42 GJ 35 15 15 x SPV 104
43 GJ 35 15 15 x IS 2284
44 GJ 35 15 15 x IS-6335
45 GJ 35 15 15 x IS 9471
46 SPV 946 x SPV 104
47 SPV 946 x IS 2284
48 SPV 946 x IS-6335
49 SPV 946 x IS 9471
50 SPV 104 x IS 2284
51 SPV 104 x IS-6335
52 SPV 104 x IS 9471
53 IS 2284 x IS-6335
54 IS 2284 x IS 9471
55 IS-6335 x IS 9471

4.3.2 Grain hardness

Data presented in (Table 18) revealed that parental line SPV-1201 exhibited highest (9.09, 8.67 and 8.88 kg) grain hardness in Akola 1995, Akola 1996 and in pooled data, respectively. Cross GJ-35-15-15 × SPV-946 exhibited highest (8.47, 8.70, 8.59 kg) grain hardness in Akola 1995, Akola 1996 and in pooled data, respectively.

4.3.3 Endosperm texture

It is observed from (Table 18), that parental line SPV-946 recorded (24.10 and 22.00%) corneous endosperm texture in Akola 1995 and in pooled data, respectively, however, parental line GJ-35-15-15 exhibited (18.00 %) corneous endosperm texture in Akola 1996. Whereas, floury endosperm texture (66.95 and 61.40%) recorded in parental line IS-6335 in Akola 1995 and in pooled data, respectively, and (56.95%) in IS-2284 in Akola 1996. Cross SPV-1201 × GJ-35-15-15 exhibited (27.25, 21.15 and 24.00%) corneous endosperm texture in Akola 1995, Akola 1996 and in pooled data, respectively, however, cross SPV-104 × IS-9471 recorded (73.85 and 71.20%) floury endosperm texture in Akola 1995 and in pooled data, respectively and in SPV-104 × IS-6335 (74.00 %) in Akola 1996.

4.3.4 Electrical conductivity

It is observed from the (Table 18), that lowest electrical conductivity (97.00, 105.00 and 101.00 dSm^{-1}) was exhibited in parental line IS-9471 in Akola 1995, Akola 1996 and in pooled data, respectively. However, highest electrical conductivity was exhibited by parental line SPV-104 (350.00 and 305.00 dSm^{-1}) in Akola 1995 and in pooled data, respectively and SRT-26B (300.50 dSm^{-1}) in Akola 1996.

4.3.5 Days to 50% flowering

It is seen from (Table 18), that parental line IS-6335 exhibited minimum (60.00, 66.00 and 63.00 days) flowering and maximum (80.50, 80.00 and 80.25 days) flowering was observed in SPV-104 at Akola 1995, Akola 1996 and in pooled data, respectively. Cross SPV-1201 × SRT-26 indicated maximum value (89.00 and 82.50 days) in Akola 1995 and in pooled data respectively. However, cross SPV-946 × IS-9471 recorded maximum flowering 79 00 days in Akola 1996 season and minimum flowering was recorded in ICSB-101B × IS-2284, ICSB-101 B IS-6335, and AKms-14B × IS-6335 (57 days) in Akola 1995 However, in Akola 1996 and in pooled data cross SRT-26B x IS-6335 exhibited minimum (59 50 and 58 7 days) flowering, respectively

4.3.6 Plant height

Data presented in (Table 19) revealed that parental line AKms-14B recorded minimum plant height (142 50, 136 00 and 139 25 cm) in both season and in pooled data, respectively However, maximum (265 00 cm) was recorded in parental line IS-2284 in Akola 1995 and (251 00 and 252 25 cm) in parental line IS-9471 in Akola 1996 and in pooled data, respectively Cross ICSB-101B × SPV-104 recorded minimum (150 50 cm) plant height in Akola 1995, however, cross ICSB-101 B × AKms-14B recorded minimum plant height (183 00 and 171 50 cm) in Akola 1996 and in pooled data, respectively

4.3.7 Cob length

It is observed from (Table 19), that parental line ICSB-101B indicated maximum (26.60, 26 20 and 26 40 cm) and cross GJ-35-15-15 IS-6335 recorded maximum (30.90, 30 60 and 30 75 cm) cob length in both seasons and in pooled data, respectively

4.3.8 TGMR

Data presented in (Table 19) revealed that parental line IS 9471 recorded lowest (1 50 2.00 and 1 75) and parent AKms-14B recorded highest (4 00 4 00 and 4 00) TGMR in both seasons and in pooled data, respectively Among crosses 25 23 and 22 cross recorded minimum (2 00) TGMR at both locations and in pooled data respectively

4.3.9 Seed germination

In F_1 diallel set (Table 19) the range of variation for parental line was exhibited from 51.00 to 97 00, 29 00 to 86 00 and 40 00 to 90 00 % in Akola 1995, Akola 1996 and in pooled data, respectively Parental line GJ-35-15-15 exhibited highest (97 00 %) seed germination in Akola 1995, Akola 1996 and in pooled data, parental line IS-6335 recorded highest 86 00 and 90 00% germination, respectively Parental line AKms-

14B recorded lowest 51 00, 29 00 and 40 00% seed germination in both seasons and in pooled data, respectively

Among crosses, the highest germination was recorded in GJ-35-15-15 × IS-6335 and SPV-946 × IS-6335 (93 00%) in Akola 1995 season In Akola 1996 and in pooled data, cross SPV-1201 × IS-2284 recorded highest seed germination 98.00 and 94 50%, respectively

4.3.10 Infection by *F moniliforme*

It is seen from (Table 20), that the range of variation in F_1 diallel set was from 0 21 (IS-2284 and GJ-35-15-15) to 34 45% (SRT-26B) in Akola 1995, whereas, in Akola 1996 the range was 5 33 (IS-9471) to 46 00% (AKms-14B) However, in pooled data the range was 4 51 (IS-9471) to 30 23% (SRT-26B)

Among crosses minimum (3 34, 6 00 and 4 67%) *F moniliforme* load was exhibited in IS-6335 × IS-9471 at both locations and in pooled data, respectively However, maximum (73 50, and 51 08%) load was recorded in cross AKms-14B SRT-26B in Akola 1995 and in pooled data respectively Whereas cross SPV-1201 SPV-946 indicated maximum (35 99%) load in Akola 96 season

4.3.11 Infection by *F pallidoroseum*

It is observed from (Table 20) that, all the parental lines in Akola 1995 recorded minimum (0 71%) load, however, five parents viz SPV-1201, ICSB-101B, AKms-14B, GJ-35-15-15 and SPV-104 recorded minimum load in Akola 1996, and in pooled data.

Among crosses, all the crosses except SPV-1201 IS-2284 recorded minimum (0 71 %) *F pallidoroseum* load in Akola 1995, 12 crosses each in Akola 1996 and in pooled data

4.3.12 Infection by *C lunata*

It is observed from (Table 20), that in Akola 1995 the range of variation for parental lines was from 1 46 (SPV-1201) to 45 55% (SPV-104), whereas in Akola 1996 it was from 24 00 (IS-9471) to 60 00% in (GJ-35-15-15), however in pooled data the range was 15 89 (IS-9471) to 50 66 % (SPV-1201)

Among crosses minimum (12.34%) *C. lunata* load was exhibited in cross SPV-946 × IS-9471 in Akola 1995 season, however, cross SPV-1201 × IS-9471 exhibited minimum (18.00 and 19.00%) load in Akola 1996 and in pooled data. Whereas, cross ICSB-101B × SRT-26B indicated maximum (58.90, 68.00 and 63.45%) load in Akola 1995, Akola 1996 and in pooled data, respectively.

4.3.13 Infection by other fungi

Data presented in (Table 20) revealed that in Akola 1995 the range of variation for parental lines was from 16.67 (SPV-1201) to 88.89% in (GJ-35-15-15), in Akola 1996, 9.33 (AKms-14B) to 26.00% (SPV-946) and in pooled data 18.55 (SRT-26B) to 55.11% in (GJ-35-15-15). Among crosses the range of variation was from 8.88 (AKms-14B × SRT-26B) to 46.67% (GJ-35-15-15 × SPV-946) in Akola 1995, however, it was from 12.00 (AKms-14B × SPV-104) to 37.34% (AKms-14B × IS-6335) in Akola 1996 and 14.11 (AKms-14B × SRT-26B) to 36.66% (ICSB-101B × IS-2284) in pooled data.

4.4 Combining ability analysis

Combining ability analysis was carried out for 15 characters of F_1 and 11 characters of F_2 diallel progenies and results are presented in (Tables 21 and 22) respectively.

The variance due to treatments too further partitioned using appropriate expectations of the observed mean squares, into components of variation attributable to general combining ability (gca) variance and specific combining ability (sca) variance. The characteristic results of the above aspects are presented here with.

4.4.1 100-grain weight

In F_1 diallel set, significant variance due to gca and sca indicated role of additive as well as non-additive gene action. The ratio of additive to non-additive variance was more (1.936) than unity indicating predominance of additive gene action (Table 21).

4.4.2 Grain hardness

In F_1 diallel set, variance due to gca and sca were significant indicating that additive as well as non- additive gene actions were important in expression of this character.

The ratio of additive to non-additive variance was more (1 700) than unity indicating predominance of additive gene action (Table 21)

Variance due to gca and sca were significant and thus additive as well as non-additive gene action for this character was important in F_2 progenies (Table 22). Lower ratio of δ^2 gca / δ^2 sca than unity (0 378) proved predominance of non-additive gene action

4.4.4 Electrical conductivity

In F_1 diallel set variance components due to gca and sca were significant indicating presence of additive as well as non additive gene action in the inheritance of this character Lower ratio of δ^2gca δ^2sca (0 728) revealed that the character is predominantly controlled by non-additive gene action (Table 21)

In F_2 diallel progenies the variance of gca and sca were significant proving the importance of additive and non-additive gene action for the control of this character But higher ratio of δ^2gca / δ^2 sca (1 716) indicated that the additive gene action is more predominant than non-additive gene action (Table 22)

4.4.5 Days to 50% flowering

Variance due to gca and sca were significant and thus additive as well as non-additive gene action for this character was important in F_1 diallel set (Table 21) Lower ratio of δ^2 gca/ δ^2 sca than unity (0 974) proved predominance of non-additive gene action

4.4.6 Plant height

In F_1 diallel set, variance due to gca and sca were significant indicating that additive and non-additive gene action were important in expression of this character However, lower ratio of δ^2gca/ δ^2 sca (0 443) indicated that non-additive gene action was important than additive (Table 21)

In F_2 diallel progenies, the variance of gca and sca were significant proving the importance of additive as well as non-additive gene action for the control of this character But higher ratio of δ^2gca/δ^2sca (1 227) indicated that the additive gene action is more predominant than non additive gene action (Table 22)

4.4.7 Cob length

In F_1 diallel analysis, significant variance component for gca and sca indicated additive and non-additive gene action. Higher ratio of δ^2gca/δ^2sca (1.256) than unity proved that the character is primarily governed by additive gene action (Table 21).

In F_2 diallel set the variance components due to gca and sca were significant. This indicated the existence of additive and non-additive gene action. Higher ratio of δ^2gca/δ^2sca (1.967) than unity showed the importance of additive genetic variance than non-additive genetic variance (Table 22).

4.4.8 Glume covering

In F_1 diallel set variance due to gca was significant, whereas sca was non-significant. It is there-fore concluded that the character is predominantly controlled by additive gene action only. This is further proved by higher ratio (1.293) of δ^2gca/δ^2sca (Table 21).

Variance due to gca and sca were significant in F_2 diallel set (Table 22). It is therefore, proved that the character is governed by additive as well as non additive gene action. In inheritance of this character, lower ratio of δ^2gca/δ^2sca (0.480) revealed that the character is predominantly controlled by non additive gene action.

4.4.9 Mesocarp thickness

In F_1 diallel set, significant variance due to gca and sca indicated role of additive as well as non additive gene action. Lower ratio of δ^2gca/δ^2sca than unit (0.376) proved predominance of non additive gene action. (Table 21)

4.4.10 Threshed grain mold rating

In F_1 diallel set, significant variance due to gca and sca indicated role of additive and non-additive gene action. Higher ratio of δ^2gca/δ^2sca (1.961) than unity proved that the character is primary governed by additive gene action (Table 21).

In F_2 diallel progenies the variance of gca and sca were significant proving the importance of additive as well as non-additive gene action for the control of this character But higher ratio of δ^2gca δ^2sca (1 187) indicated that the additive gene action is more predominant than non-additive gene action (Table 22)

4.4.11 Seed germination

In F_1 diallel set, variance due to gca and sca were significant indicating presence of additive as well as non-additive gene action in inheritance of this character Lower ratio of δ^2gca/δ^2sca (0 646) revealed that the character is predominantly controlled by non additive gene action (Table 21)

In F_2 diallel progenies variance components due to gca and sca were significant This proved the presence of additive and non-additive gene action for control of germination and there was a lot of useful variability for the character also Similarly from the ratio of δ^2gca δ^2sca (0 772) it was clear that additive as well as non-additive gene action was equally operating (Table 22)

4.4.12 Infection by *F moniliforme*

In F_1 diallel set, variance due to gca and sca were observed significant indicating that additive as well as non-additive gene actions were important in expression of this character The ratio of additive to non-additive variance was more (1 573) than unity indicating predominance of additive gene action (Table 21)

In F_2 diallel set variance due to gca was significant, whereas sca was non-significant It is therefore concluded that the character is predominantly controlled by additive gene action only However lower ratio (0 725) of δ^2gca δ^2sca revealed that the character is predominantly controlled by non-additive gene action also (Table 22)

4.4.13 Infection by *F pallidoroseum*

In F_1 diallel set variance due to gca was non-significant and sca was significant It is therefore, appears that the character is controlled by non-additive gene action only This is further proved by lower ratio (0 043) of δ^2gca δ^2sca (Table 21)

In F_2 diallel set variance due to gca and sca was non-significant However, the ratio of δ^2gca/δ^2sca was observed to be (0 045) which is indicative of non additive gene action (Table 22)

4.4 14 Infection by *C lunata*

The variance due to gca was significant and sca was non-significant in F_1 diallel set (Table 21) It is therefore concluded that the character is predominantly controlled by additive gene action only This is further proved by higher ratio (4 068) of δ^2gca/δ^2sca

In F_2 diallel set variance due to gca and sca was significant and non significant respectively (Table 22) It is therefore concluded that the character is predominantly controlled by additive gene action only This is further proved by very high ratio (49 780) of δ^2gca δ^2sca

4.4.15 Infection by other fungi

In F_1 diallel set variance due to gca was non significant and sca was significant The ratio of δ^2gca/δ^2sca was also observed to be less than unity (0 082) which indicated that this character is predominantly governed by non additive gene action (Table 21)

Variance due to gca was significant however sca was non significant in F_2 diallel set (Table 22) The ratio of δ^2gca δ^2sca was higher (1 845) which indicated the predominant of additive gene action in the inheritance of this trait It is therefore concluded that the character is predominantly controlled by additive gene action only

Biochemical characters

4.4.16 Proteins

In F_1 diallel set significant variance due to gca and sca indicated role of additive as well as non additive gene action in the inheritance of this character The ratio of additive to non-additive variance was (0 101) lower than unity revealed that the character is predominantly controlled by non additive gene action (Table 23)

4.4.17 Soluble sugars

Variance due to gca and sca were significant and thus additive as well as non-additive gene action for this trait was important in F_1 diallel set (Table 23) However, ratio of δ^2gca/δ^2sca than unity (0 313) proved predominance of non-additive gene action

4.4.18 Tannins

In F_1 diallel set, variance due to gca and sca were to be significant indicating that, additive as well as non-additive gene actions were important in expression of this character The ratio of additive to non-additive variance was more (3 192) than unity indicating predominance of additive gene action (Table 23)

4.4.19 Flavan-4-ols

In F_1 diallel set variance components due to gca and sca were significant indicating presence of additive and non-additive gene action in inheritance of this character But higher ratio of δ^2gca/δ^2sca (4 821) indicated that the additive gene action is more predominant than non-additive gene action (Table 23)

4.5 Estimates of general combining ability effects

The general combining ability effects were calculated for all the 15 characters in F_1 and 11 characters in F_2 for pooled over locations The character wise results are presented below

4.5.1 100 grain weight

The data relative to gca effects for 100-grain weight are presented in (Table 24)

Among 10 parental lines in F_1 diallel set only one parental line GJ-35 15-15 (0 132) exhibited significant gca in positive direction Remaining parental lines, exhibited either non-significant gca or significant gca in negative direction Thus, they may not be of any use in breeding program as far as 100-grain weight is concerned

4.5.2 Grain hardness

Hard grain is a desirable character for grain mold resistance In F_1 diallel set, five parental lines recorded significant positive gca effects Parental line IS-9471 exhibited higher (0 843) significant gca estimates, followed by AKms-14B (0 784), SRT-26B

(0.677), IS-6335 (0 464) and GJ-35-15-15(0 429) These parental lines can be said as good general combiners (Table 24)

Rest of parents have exhibited non significant gca or significant gca in negative direction and hence, may not be useful in breeding program for this trait

In F_2 (Table 25) progenies all the parental lines showed significant positive gca effects SRT-26B recorded highest gca (1 568), followed by IS 9471 (1.388), SPV-1201 (1 301) and IS-6335 (1 295)

4.5 3 Endosperm texture

Corneous endosperm texture is desirable character for grain mold resistance Therefore, negative and significant gca effects are desirable It is revealed from the data (Table 24) that, all the 10 parental lines exhibited significant negative gca effects Higher significant negative gca effects was exhibited by parental lines AKms 14B (17.316) followed by SPV-104 (-8 400) SRT 26B (7 858) and GJ-35-15-15 (6 212) Thus these parental lines can be identified as best general combiners for endosperm texture

4.5.4 Electrical conductivity

Low electrical conductivity is desirable character for grain mold resistance Therefore negative and significant gca effects are desirable It is revealed from the data (Table 24), that none of the parental lines exhibited significant negative gca effects in F_1 crosses However minimum significant positive effect was observed in GJ 35 15 15 (44 042) and SPV-946 (65 792)

However, in F_2 diallel (Table 25) seven parents exhibited significant negative gca effects The highest significant negative gca effects exhibited by GJ 35 15-15 (-121 617) followed by SPV-1201 (-101 451) SPV 946 (78 284) and IS 2284 (-59 117) all are significantly superior to last parental line SPV 104 (21 992)

4.5.5 Days to 50% flowering

In sorghum breeding program, earliness is one of the objective for selection of genotypes and negative gca effects of higher magnitude are always favoured In F_1 diallel set parental line SPV-1201 (-8 375) appeared to be the best general combiner for earliness exhibiting highly significant and negative gca effects (Table 24)

4 5 6 Plant height

Dwarf to mid dwarf plant type is a desirable character Therefore negative gca effects are appreciated The gca estimates for plant height for F_1 diallel set is presented in (Table 24) It is revealed from the data that all the parental lines exhibited significant negative gca effects The highest significant negative gca effects was exhibited by SPV-1201 (-68 667) followed by ICSB-101B (-66 042) IS 2284 (-59 167) and AKms-14B (-57 167) Thus these parental lines can be identified as the best general combiners for introducing dwarfness In F_2 diallel set four parental lines SRT -26 B (-41 734), AKms- 14 B (-34 722) ICSB-101 B (-15 434) and IS 2284 (-14 005) exhibited significant negative gca effects (Table 25)

4 5 7 Cob length

In F_1 diallel set general combining ability effects the range for the character cob length was 0 446 to 2 774 in all the parental lines None of the parental line exhibited significant positive gca effects (Table 24)

In F_2 diallel set (Table 25) only one parental line SPV-1201 (0 072) exhibited positive gca effects while all others recorded significant negative gca effects except SRT-26 B (-0 349)

4.5 8 Glume covering

Maximum glume covering is a desirable characters for grain mold resistance therefore positive gca effects of higher magnitude are desirable In F_1 diallel (Table 24) four parental lines exhibited significant positive gca effects the highest being recorded by ICSB-101 B (10 511) followed by IS-2284 (8 428) IS 9471 (7 386) and SPV 1201 (3 220) Thus these parental lines can be identified as best general combiners for glume covering In F_2 diallel set (Table 25) five parental lines recorded significant gca effects in positive direction viz IS-6335 (11 701) SPV-1201 (5 576) ICSB-101 B (4.451) AKms- 14 B (2 742) and SRT 26 B (1 742)

4.5.9 Mesocarp thickness

Thin mesocarp thickness is desirable character for grain mold resistance. Therefore, **negative gca effects are** appreciated. The gca estimates for mesocarp thickness for F_1 **diallel set is presented in** (Table 24). It is revealed from the data that, four parental **lines exhibited significant** negative gca effects SRT – 26 B (-6.767), AKms-14B (-3.499), **SPV-946** (-3.475) and SPV-1201 (-2.605). Thus these parental lines can be **identified as the best** general combiners for introducing thin mesocarp.

4.5.10 Threshed grain mold rating

Low thresh grain mold rating is desirable character, negative gca effect of higher **magnitude are desirable.** In F_1 diallel (Table 24) none of the parental line exhibited **significant negative** gca effects. However, parental line SPV-946 exhibited negative **gca effects (-0.038).** In F_2 diallel set (Table 25) none of parental line exhibited **significant negative** gca effects.

4.5.11 Seed germination

In F_1 **diallel set** (Table 24) all the parental lines exhibited significant negative gca **effects. The range** was from (-3.858) in SPV- 946 to (-17.589) in ICSB-101 B. The **maximum significant** gca effects was exhibited parental lines by ICSB-101B (-17.589) **followed** by IS-6335 (-15.505). In F_2 diallel set (Table 25) all the parental **lines recorded significant** negative gca effects. The range varies from (-5.933) in IS-2284 **to (-16.271)** in AKms-14 B.

4.5.12 Infection by *F. moniliforme*

In F_1 **diallel set** only two parental lines GJ-35-15-15 (-0.934) and SPV 946 (-0.708) **exhibited negative** gca effects and can be considered as good general combiners for **this traits (Table** 24).

In F_2 diallel set (Table 25) seven parental lines viz. IS-9471 (-**15.954), IS 6335** (-14.268), IS-2284 (-13.818), SPV-104 (-10.343), GJ-35-15-15 (-**7.828), SPV-1201** (-3.558) and SPV-946 (-2.989) exhibited negative significant gca **effects. Thus these** parents can be identified as good general combiners for grain mold **resistance against** the infection *F. moniliforme* . Parental lines IS-9471 (-15.954), IS-

6335 (-14.268) and IS-2284 (-13.818) exhibited highest significant gca effects proving **its significance** over other parental lines and hence can be considered as best general **combiners for** this traits.

4.5.13 Infection by *F. pallidoroseum*

In F_1 diallel set, five parental lines AKms- 14 B (-3.555), SPV-104 (-2.195), IS-2284) **(-1.164), IS-9471** (-1.002) and SPV-946 (-0.985) exhibited significant negative gca **estimates and** hence can be identified as good general combiners (Table 24). In F_2 **diallel set (Table** 25) only two parental lines IS-2284 (-0.493) and IS-6335 (-0.329) **were the good** general combiners giving highest negative gca effects.

4.5.14 Infection by *C. lunata*

In F_1 diallel set, only one parental line SPV-104 (-2.941) exhibited significant negative **sca effects, and** hence can be considered as best general combiner for this trait (Table **24). In F_2 diallel** set two parental lines SRT -26 B(-1.061) and IS-6335 (-0.505) **exhibited negative** gca effects, hence can be considered good general combiners for **this trait** (Table 25).

4.5.15 Infection by other fungi

In F_1 diallel set, nine parental lines exhibited significant negative gca effects. First **three higher** magnitude parents were SPV-1201 (-6.727), AKms-14B (-6.336) and **SRT-26B (-4.896).** Thus these can be used for best combines for this trait (Table 24). **In F_2 diallel** set, among 10 parental lines five ICSB-101B (-5.706), SRT-26B (-3.696), **AKms-** -14 B (-3.168), SPV-1201 (-2.463) and IS-6335 (-1.619) exhibited **negative and** significant gca effects and thus can be identified as a best general **combiners for** this trait (Table 25).

Biochemical characters

The general combining effects estimates were computed for biochemical characters **viz. proteins,** soluble sugars, tannins and flavan-4-ols for Akola 1995 location and are **presented in** (Table 26).

4.5.16 Protein

It is observed from (Table 26), .that all the parental lines exhibited highly significant **gca in desirable** direction however, parental lines AKms-14B exhibited the highest

(0.801) significant gca in desirable direction followed by SRT-26 B (0.787), ICSB-101B (0.637), GJ-35-15-15 (0.619), and SPV-946 (0.616) and thus they can be identified as good general combiners for proteins content.

4.5.17 Soluble sugars

All parental lines except two exhibited highly significant gca in desirable direction however, highest (0.280) significant gca in desirable direction was exhibited by parental lines AKms-14B, followed by SRT-26B (0.197), SPV-104 (0.167), SPV-946 (0.112) and ICSB 101 B (0.109) indicating that they are best general combiners for this character (Table 26).

4.5.18 Tannins

Out of 10 parents only three parental lines IS-2284 (0.815), IS-6335 (0.790), and IS-9471 (0.590) exhibited significant gca in desirable direction, indicating thereby, that they are best general combiners. Remaining parents exhibited significant or non significant gca effects in negative direction. Hence they can be said as poor general combiners (Table 26).

4.5.19 Flavan-4-ols

Out of 10 parental lines, only three parental line viz. IS-9471 (1.851), IS-6335 (0.578) and IS-2284 (0.469), exhibited significant gca effects in desirable direction and hence considered as good combiners. However, all others seven parental lines exhibited significant gca effects in negative direction and hence can be said as poor general combiners (Table 26).

4.6 Estimates of specific combining ability effects

The specific combining effects were calculated for 11 characters in F_1 and seven characters in F_2 for pooled over locations. The character wise results are presented below.

4.6.1 100-grain weight

The relative estimate due to sca effects for 100 grain weight is presented in (Table 27). In F_1 diallel set four crosses exhibited significant positive sca effects for 100-grain weight. The highest significant positive sca effects was exhibited by SPV-1201x SRT-26 B (0.336) followed by AKms-14B x IS-6335 (0.296), ICSB-101B x SPV-104

(0.227) and SPV-1201x SPV-104(0.207) and hence these crosses can be identified as a **best specific** combinations for 100-grain weight. Negative and significant sca **estimates were** exhibited by three crosses SPV-1201x SPV-946 (-0.326), ICSB-101 B **x AKms-14** B (-0.227) and ICSB-101B x SRT-26B (-0.224) which proved poorer. **Rest crosses** recorded non significant sca effects.

4.6.2 Grain hardness

Specific combining ability effects with positive and significant values were exhibited **by two crosses** (Table 27) out of 45 crosses in F_1 diallel set. The highest positive sca **effects was** observed in SPV-1201 x GJ-35-15-15 (0.948) followed by AKms-14B x **IS-2284 (0.760)** hence, these two crosses appeared to be best specific combinations **for grain hardness**. On the contrary three crosses exhibited negative and significant sca **effects and hence** these are the poorer for grain hardness. In F_2 diallel set (Table 29) **only one progeny** SPV-946 x IS-2284 (1.098) exhibited significant and positive sca **effects, hence** can be observed as best specific combination for grain hardness.

4.6.3 Endosperm texture

Corneous endosperm texture is considered as a desirable character for grain mold **resistance.** Significant and negative sca effects are therefore considered for assessing **crosses.** In F_1 diallel set three crosses exhibited significant negative sca effect for **endosperm** texture. The highest significant negative sca effect was exhibited by cross **IS-6335** × IS-9471 (-7.604) followed by IS-2284 × IS-6335 (-7.354) and SPV-1201 × **GJ-35-15-15** (-6.283). These three crosses appeared to be best specific combinations **for this trait** (Table 27).

4.6.4 Electrical conductivity

Lower electrical conductivity grain leachates is considered as a desirable character for **grain mold** resistance. Significant and negative sca effects are therefore considered for **assessing** crosses. In F_1 diallel set 11 crosses exhibited significant and negative sca **effects** (Table 27). The cross SPV-104 × IS-9471 (-120.063) was found most **promising** and significantly superior to remaining 10 crosses. Some of these ten **showing better** combinations were SPV-104 × IS-6335 (-76.813), AKms-14B × IS-**6335 (-68.00)** AKms- 14B × IS-9471 (-68.00), SRT 26-B × SPV-104 (-66.917) and

SRT-26B × IS-6335 (61.146). Three crosses yielded positive and significant sca effects. Rest of crosses did not show any significance in their sca effects for this trait.

In F_2 diallel set (Table 29) seven crosses exhibited significant and negative sca effects. These crosses were AKms- 14 B × IS-6335 (-76.284), followed by SRT-26 × IS-9471 (-66.722), SRT-26B × GJ-35-15-15 (-50.451), SPV-1201 × IS-6335 (-49.909), SPV-104 × IS-9471 (-46.576), GJ-35-15-15 × IS-2284 (-45.867) and SPV-946 × IS-9471 (-38.347). As against this nine crosses exhibited significant positive sca effects and hence appears poor combinations for this trait.

4.6.5 Days to 50% flowering

Since selection of genotype towards early maturity is desirable in sorghum, negative and significant sca effects are therefore considered for assessing crosses. In F_1 diallel set 11 crosses exhibited significant and negative sca effects (Table 27). The highest significant negative sca effects for first five crosses were exhibited by SPV-104 × IS-9471 (-7.813) followed by SPV-104 × IS-6335 (-4.750), SPV-946 × IS-2284 (-4.646), SPV-946 × IS-9471 (-4.646) and SRT-26-B × IS-6335 (-4.542) hence, these crosses may be good for earliness. Seven crosses exhibited significant and positive sca effects, while remaining crosses exhibited non-significant sca effect.

4.6.6 Plant height

Among 45 crosses, negative and significant sca effects were found in 10 crosses (Table 27) in F_1 diallel set. The highest negative and significant sca effects was exhibited in SPV-1201 × SPV - 946 (-54.208) followed by SRT-26B × GJ-35-15-15 (-34.000) and ICSB-101 B × AKms-14B (-30.359) exhibited significantly superior negative sca effects over seven crosses. Considering higher magnitude of negative sca effects these crosses proved to be best specific combinations.

Twenty two crosses exhibited significant and positive sca effects, the highest recorded by SRT-26B × IS-2284 (49.688) and lowest by SPV-104 × IS-6335 (14.333). Rest parents have exhibited non-significant sca effects. In F_2 diallel set (Table 29) only two progenies exhibited significant and negative sca effects SRT 26 × GJ-35-15-15 (-31.463) and SPV-946 × IS-2284 (-21.617) which proved best specific

combinations. However, eight progenies recorded significant and positive sca effects, **which appears** poor combinations for this trait. The highest significant positive sca **effects was** recorded in SPV-946 × IS-6335 (50.985) and lowest by SPV-1201 × GJ-**35-15-15**(20.222).

4.6.7 Cob length

In F_1 diallel set the range for sca effects was from -0.037 (GJ-35-15-15 × SPV-104) to **2.455 (SPV-104** × IS-6335). Four crosses exhibited significant and positive sca **effects** **SPV-104** × IS-6335 (2.455), AKms-14B × GJ-35-15-15 (2.316), SPV-1201 × **IS-9471 (2.280)** and ICSB 101 B × SRT -26B (2.103) which appeared best specific **combinations**. Three crosses exhibited significant and negative sca effects GJ-35-15-**15 × SPV-946** (-2.972), IS-2284 × IS-9471 (-2.166) and SPV-1201 × ICSB-101B (-**2.161), categorised** as undesirable for sca effects combinations. Rest of parents have **exhibited non** significant positive or negative sca effects (Table 27).

In F_2 diallel set (Table 29) three progenies exhibited significant and **positive sca** effects GJ-35-15-15 × IS-2284 (3.722), SPV-946 × IS-6335 (2.645) and **ICSB-101B** × AKms-14B, (1.872) all these crosses may be considered as better **specific** combinations for this trait. Only one progeny exhibited significant and **negative sca** combination SRT-26B × IS-2284 (-2.628).

4.6.8 Glume covering

Maximum glume covering is considered as desirable character. Significant and **positive sca** effects. The highest significant positive sca effects was exhibited ICSB-**101B × IS**-6335 (11.553) followed by AKms- 14 B × SPV-946 (11.032) and AKms-**14B × GJ**-35-15-15 (10.511) thus these crosses appeared best combinations for glume **covering trait**. Four crosses exhibited significant negative sca effects. While rest did **not exhibited** any significant sca effects.(Table 27).

Among 45 progenies in F_2 diallel set three exhibited significant sca **effects in** positive direction. The highest was exhibited by SPV-946 × IS-6335 **(11.617) followed** by SPV-104 × IS-2284 (10.180) and GJ-35-15-15 × IS-2284 **(8.388). Four** progenies recorded significant negative sca effects. (Table 29)

4.6.9 Mesocarp thickness

Thin mesocarp thickness is desirable character for grain mold resistance. Therefore, **negative gca** effects are appreciated. The sca effects for mesocarp thickness for F_1 **diallel set is** presented in (Table 28). It is revealed from the data that, 22 crosses **exhibited significant** and negative sca effects. Few of these higher magnitude crosses **were SPV-104** × IS-2284 (-26.604), ICSB-101B × IS-6335 (-22.195), ICSB-101B × **IS-2284 (-22.031)** and SPV-104 × IS-6335 (-21.485). Thus these crosses appeared **best combinations** for mesocarp thickness. Twelve crosses exhibited significant and **positive sca** effects, cross SPV-1201 × AKms--14B exhibited highest (19.318) while, **cross GJ-35-15-15** × SPV-104 exhibited lowest (6.334) value. Thus these crosses are **of no use for** this trait. Rest did not exhibited any significant sca effects.

4.6.10 Threshed grain mold rating

Low TGMR is a desirable character, negative sca effect of higher magnitude are **desirable.** In F_1 diallel set Among 45 crosses, 11 crosses exhibited significant and **negative sca** effects which range from -0.913 in (AKms- 14B × IS-6335) to 0.319 **(SPV-1201** × GJ-35-15-15). Crosses, AKms-14B × IS-6335 (-0.913), AKms- 14 × IS-**9471 (-0.871)** and AKms-14B × IS-2284 (-0.767) of higher magnitude appeared best **specific** combinations for this trait. Eight crosses exhibited significant and positive **sca effects** which range from 0.733 in (IS-2284 × IS-9471) to 0.420 in (GJ-35-15-15 × **SPV-946).** Hence these crosses can be grouped under poor specific combinations for **this trait** (Table 28).

In F_2 diallel set, only four progenies exhibited significant and negative **sca effects** the highest exhibited by SPV-1201 × ICSB-101B (-0.388) followed by **AKms-14B** × IS-9471(-0.381), ICSB-101 B × SPV-104 (-0.367) and AKms- 14 B × **IS-6335** (-0.346) hence proved to be best specific combinations for this trait (Table **29). Rest all** others have exhibited negative and positive non-significant sca effects, **hence these** progenies appear undesirable.

4.6.11 Seed germination

Positive and significant sca effects for germination percentage was exhibited in 15 **crosses in F_1** diallel set (Table 28). The highest being 15.185 (AKms-14B × IS-6335), **followed by** AKms-14B × IS-9471 (12.769), IS-2284 × IS-6335 (10.839), ICSB-101B × **IS-9471** (10.526) and SPV-104 × IS-9471 (10.111) ranked 1st to 5th and exhibited **the highest** positive and significant sca estimates, hence these crosses can therefore be **identified** as best specific combintions for improving germination. Negative and **significant** sca effects were exhibited by four crosses which appear to be poor **combinations** for this trait.

In F_2 diallel set eight progenies exhibited positive and significant sca **effects** (Table 29). Highest significant sca effects were exhibited by AKms-14B × IS-**6335 (9.286)** followed by AKms-14B × GJ-35-15-15 (8.175), SPV-1201 × SRT-26B **(8.170), SPV-946** × IS-6335 (8.017), ICSB-101B × AKms-14B (7.184), SPV-946 × **SPV-104** (7.053), AKms-14B × IS-9471 (6.604) and SPV-1201 × SPV-104 (6.478). **Hence these** crosses proved best specific combinations for improving germination. **All others** have exhibited non significant positive and negative sca effects.

4.6.12 Infection by *F. moniliforme*

Minimum fungal load is a desirable character for grain mold resistance. Significant **and negative** sca effects are therefore, considered for assessing crosses.

In F_1 diallel set, four crosses ICSB-101B × IS-6335 (-10.017), SPV-104 × **IS-6335** (-9.795), AKms-14B × IS-6335 (-9.259) and SPV-104 × IS-2284 (-8.392) **exhibited** significant negative sca effects hence considered as best specific **combinations** for introducing resistance against *F. moniliforme*. Rest crosses **exhibited** non-significant and negative sca effects or positive sca effects, hence cannot **be considered** for this trait (Table 28).

In F_2 diallel set sixteen progenies exhibited negative sca effects. **Considering** higher magnitude of negative sca effects, first three good sca

combinations for this trait were SRT-26B × SPV-104 (-6.582), SRT-26B × SPV-946 **(-6.425) and** SPV-1201 × IS-2284 (-5.028) (Table 29).

4.6.13 Infection by *F. pallidoroseum*

Negative and significant sca effects are considered for evaluating the crosses in **respect of fungal** load of *F. pallidoroseum*. In F_1 diallel set, three crosses ICSB-101B × **IS-2284,** SPV-946 × SPV-104 and GJ-35-15-15 × SPV-946 exhibited negative and **significant** sca effects, hence these can be considered, good for specific combinations **for introducing** resistance against *F. pallidoroseum* (Table 28). In F_1 diallel set only **one progeny** (ICSB-101 B × IS-6335) exhibited negative and significant sca effects (-2.567) **and** hence this can be considered the best specific combinations (Table 29).

4.6.14 Infection by *C. lunata*

Thirty crosses exhibited negative sca effect in F_1 diallel set (Table 28) considering **higher magnitude** of negative sca effects, first three good sca crosses considers for **this trait** were, ICSB-101B × SPV-104, SPV-946 × IS-2284) and SPV-1201 × IS-9471 **(Table** 29.) In F_2 diallel set, two progenies SRT-26B × GJ-35-15-15 and **AKms-14B** × SPV-104 exhibited significant negative sca effects, which can be **considered** as good sca combinations for introducing resistance against *C. lunata* **(Table 29)**

4.6.15 Infection by other fungi

Twenty crosses exhibited negative sca effects in F_1 diallel set (Table 28) considering **higher magnitude** of negative sca effects, first three good combinations for this trait **were GJ-35-15-15** × IS-2284, ICSB-101B × SPV-104 and IS-6335 × IS-9471. Three **crosses** SPV-1201 × SRT-26B, AKms- 14 B × IS-6335 and SPV-1201 × SPV-946 **exhibited** significant positive sca effects, hence were poor combinations. In F_2 diallel **set 21 progenies** exhibited negative sca effects. Considering higher magnitude of **negative sca** effects, first three good combinations for this trait were AKms-14B × **SRT-26 B,** AKms-14B × GJ-35-15-15 and AKms-14B × SPV-946. One progeny **AKms-14B** × IS-9471 exhibited significant positive sca effects (Table 29).

Biochemical characters

The specific combining ability effect were calculated for 4 biochemical characters viz. Proteins, soluble sugars, tannins and flavan-4-ols for Akola 1995 location and are presented in (Table 30).

4.6.16 Proteins

Data (Table 30), revealed that the highest positive sca effect was observed in SPV-1201 × IS-9471 whereas, lowest was observed in SPV-1201 × GJ-35-15-15. Among 45 crosses eight crosses exhibited positive and significant sca effect. SPV-1201 × IS-9471 exhibited highest (0.278) sca effect followed by IS-6335 × IS-9471(0.240), SPV-1201 × IS-2284) (0.181), AKms-14B × IS-6335 (0.175), SPV-104 × IS-6335 (0.175), SPV-104 × IS-2284 (0.119), IS-2284 × IS-9471 (0.106) and SPV-946 × SPV-104 (0.070). Therefore these crosses can be identified as a best specific combines can be identified as best specific combinations for protein content. On the contrary 31 crosses exhibited negative and significant sca effects, hence these can be treated as poor specific combinations for protein content.

4.6.17 Soluble sugars

Twenty crosses exhibited significant sca effects. Out of which only three exhibited significant positive sca effects GJ-35-15-15 × SPV-104 (0.095), SPV-1201 × IS-6335 (0.089) and AKms- 14B × IS-9471 (0.080), hence these crosses can be identified as good specific combinations for soluble sugars (Table 30). On the contrary 11 crosses exhibited negative and significant sca effects, the highest being observed in AKms-14B × SRT-26B followed by AKms-14B × GJ-35-15-15 and SPV-104 × IS-6335, hence these crosses can be treated as poor specific combinations for soluble sugars content.

4.6.18 Tannins

Out of 45 crosses, 20 crosses exhibited significant and positive sca effects and 20 crosses exhibited significant sca effect n negative direction. Crosses IS-2284 × IS-6335 exhibited highest positive and significant sca effects (0.763) followed by AKms-14B × IS-2284 (0.344), SRT-26 × IS-9471 (0.302) SRT-26 × IS-6335 (0.299), AKms-

14B × IS-9471 (0.283), SPV-1201 × IS-9471 (0.244), SPV-104 × IS-6335 (0.234) and SPV-104 × IS-9471 (0.233). Therefore these crosses can be identified as a best specific combinations for tannin content (Table 30). On the other hand out of 20 crosses which exhibited negative and significant sca effects, the highest being observed in IS-2284 × IS-9471 (-0.408) followed by IS-6335 × IS-9471(-0.291), AKms-14B × SRT-26B (-0.146), and SPV-1201 × ICSB-101B (-0.125) can be treated as poor specific combinations for tannins content.

4.6.19 Flavan-4-ols

Significant sca effect in positive direction were exhibited by 17 crosses (Table 30). These crosses exhibited the range of 0.072 to 0.635 sca effects, the highest being exhibited by AKms-14B × IS-2284 (0.635), followed by SRT-26B × IS-6335 (0.596), SPV-946 × IS-6335 (0.586), SPV-104 × IS-6335 (0.530), SPV-104 × IS-9471 (0.426), AKms-14B × IS-9471 (0.405) and SPV-104 × IS-2284 (0.391), hence these crosses can be identified as best specific combinations for flavan-4-ols content.

However, 16 crosses exhibited significant negative sca effects. These crosses exhibits the range of -0.075 to -0.749 sca effects, the highest being indicated by IS-2284 × IS-6335 and lowest by ICSB 101B × SPV-104. Hence these can be treated as poor specific combinations for flavan-4-ols content.

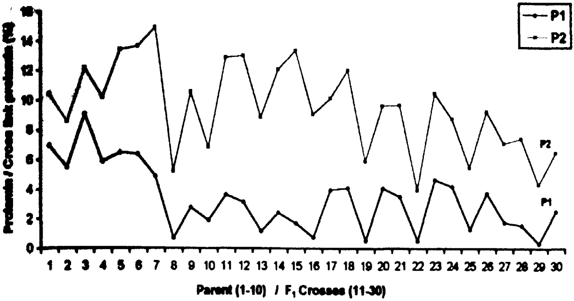
4.7 Protein fractions

4.7.1 Albumin and Globulin

Protein fractionation was carried out for all the parental lines and F_1 crosses (20) of Akola 1995 season. Results are presented in (Table 31). It is observed from the data that, the range of variation for albumin and globulin for parental lines was from 1.81 (IS-2284) to 20.63% in SRT-26B. For crosses, the range was from 7.90 (IS-2284 × IS-9471) to 16.74% (SPV-946 × SPV-104).

4.7.2 Prolamin

It is observed from (Table 31and Fig. 4), that maximum (9.09 %) prolamin was recorded in parental lines AKms-14B followed by SPV-1201 (6.96 %) and GJ-35-15-15 (6.47 %), however, minimum prolamin was observed in IS-2284 (0.70 %).



P1 = Prolamin P2 = Cross link prolamin

Figure 4. Prolamin and Cross link prolamin of parents and F_1 crosses at Akola 1995

1 SPV-1201	11 SPV-1201 x SPV-946	21 SRT-26B x SPV-104
2 ICSB-101B	12 SPV-1201 x SPV-104	22 SRT26B x IS 9471
3 AKms-14B	13 SPV-1201 x IS-9471	23 GJ-35-15-15 x SPV-946
4 SRT-26B	14 ICSB-101B x SPV-946	24 GJ-35-15-15 x SPV-104
5 GJ-35-15-15	15 ICSB-101B x SPV-104	25 GJ-35-15-15 x IS-9471
6 SPV-946	16 ICSB-101B x IS-9471	26 SPV-946 x SPV-104
7 SPV-104	17 AKms-14B x SPV-946	27 SPV-946 x IS-9471
8 IS-2284	18 AKms-14B x SPV-104	28 SPV-104 x IS-9471
9 IS-6335	19 AKms-14B x IS-9471	29 IS-2284 x IS-9471
10 IS-9471	20 SRT-26B x SPV-946	30 IS-6335 x IS-9471

Among crosses, cross (GJ-35-15-15 × SPV-946) exhibited maximum prolamin (4.72 %), however, minimum prolamin was recorded in (IS-2284 × IS-9471) 0.38 %.

4.7.3 Cross-link prolamin

It is observed (Table-31, Fig. 4), that parental lines SPV-104 exhibited maximum (14.92 %) cross-link prolamin followed by SPV-946 (13.62 %) and GJ-35-15-15 (13.39 %), minimum was observed in IS-2284 (5.24 %). Among crosses, maximum (13.09 %) cross-link prolamin was recorded in SPV-1201 × SPV-104 followed by SPV-1201 × SPV-946 (12.89 %), minimum (3.99 %) was recorded in SRT-26B × IS-9471.

4.7.4 Glutelin-like

It is observed (Table 31) that parental lines IS-6335 exhibited maximum (12.69%) glutelin-like, followed by IS-2284 (12.39%), minimum value (2.46%) was recorded in AKms-14B. Among crosses, maximum (10.88%) glutelin-like was indicated in SPV-1201 × IS-9471 and minimum (0.96 %) in IS-6335 × IS-9471.

4.7.5 Glutelin

It is observed form the data (Table 31),that, the range of variation for parental lines was from 27.90 (ICSB-101 B) to 68.27% (IS-2284). Among crosses, the range of variation was from 26.62 (SRT-26B × IS-104) to 51.96% (SPV-946 × IS-9471).

4.7.6 Residues

It is indicated (Table 31) that the range of variation for parental lines was from 7.26 (IS-2284) to 11.46% (AKms-14B). Among crosses, the range of variation was from 2.70 (SPV-1201 × SPV-104) to 11.46% (SRT-26B × IS-9471).

4.8 Glume color, grain color and testa

It is observed from data (Table 32) that three parental lines IS-2284, IS-6335 and IS-9471 with colored grain had a testa layer or sub-coat, whereas, seven parental lines with white grain did not show black reaction with bleach test indicating absence of testa. Among F_1 crosses, 24 (crosses with colored parental lines) out of 45 crosses observed colored grain and exhibited black reaction with bleach test indicating presence of testa. Remaining 21 crosses with white grain did not show black reaction with bleach test thus confirm the absence of testa layer. The above observations were confirmed by section cutting, where colored grain observed to have testa layer or sub-coat and white grain did not have the testa layer. Observations on glume cover were recorded just to provide additional information to the breeder.

4.9 Fungal load on germinated and ungerminated seeds (pre-treated and untreated)

Effect of seed pre-treatment (0.1% $HgCl_2$) on germination and seed mycoflora of both germinated and ungerminated seed of parental lines, F_1 crosses and F_2 progenies from Akola and Patancheru centres during 1996 were studied. Comparison of two seasons at Akola centre of parental lines and F_1crosses during 1995 and 1996 were also studied. The details of observations have been narrated under following subheads.

- Fungal load on germinated seeds, Akola and Patancheru, 1996
- Fungal load on ungerminated seeds, Akola and Patancheru, 1996
- Fungal load on germinated seeds, Akola, 1995 and 1996
- Fungal load on ungerminated seeds, Akola, 1995 and 1996

4.9.1 Fungal load on germinated seed, Akola and Patancheru, 1996

.4.9.1.1 Seed germination

Higher germination of the seed is the desired trait for the breeders as well as farmers. Grain mold is an important factor in reduction in germination in sorghum. Many molding fungi remain confined to the surface and hence effect of pre treatment of seed was studied. Method of pre-treatment of seed is described in materials and methods.

Germination percent recorded on standard blotter tests method on treated and untreated seed. In F_1 diallel set (Table 33), the range of variation for parental lines was exhibited from 59.57 to 93.67, 5.00 to 80.67 and 33.00 to 87.00% at Akola, Patancheru and in pooled data, respectively. Parental line IS-9471 exhibited highest 93.67 % germination followed by IS-6335 (93.33%) at Akola location, at Patancheru parental line IS-6335 recorded highest (80.67%) germination followed by IS-2284 (74.33%). In pooled data, parental IS-6335 recorded highest germination (87.00%) followed by IS-9471 (83.83%).

Among crosses the highest seed germination was recorded in AKms 14B × IS-6335, IS-6335 × IS-9471 (95.33%) followed by SPV-1201 × IS-6335 (94.67%) at Akola location. At Patancheru cross ICSB-101B × IS-6335 recorded highest seed germination (92.00%) followed by SRT-26B × IS-6335 (91.00%) and ICSB-101B × IS-9471 (89.67%). However, in pooled data ICSB 101B × IS-6335 recorded highest seed germination (91.83%) followed by AKms-14B × IS-6335 (91.67%) and ICSB-101B × IS-9471 (91.34%). Over all, there was significant increase in germination 2.28, 5.51 and 3.64% at Akola, Patancheru and in pooled data, respectively, in treated seed with mercuric chloride over untreated control, and there was 27.39 % increased in germination at Akola over Patancheru.

In F_2 diallel (Table 45) at Akola, progeny IS-2284 × IS-6335 recorded highest germination (92.13%) followed by ICSB-101 B × IS-9471 (91.90 %) and IS-6335 × IS-9471 (91.79%). At Patancheru, progeny GJ-35-15-15 × IS-2284 recorded highest seed germination (91.50%) and SPV-946 × IS-6335 (89.50%). However, in pooled data IS-2284 × IS-9471 recorded highest seed germination (90.53%) followed by SPV-946 × IS-6335 (90.45 %) and GJ-35-15-15 × IS-2284 (89.35%). Over all, there was significant increase in germination 4.45, 6.56 and 5.35 % at Akola, Patancheru and in pooled data, respectively, in treated seed with mercuric chloride over untreated control and there was 24.69 % reduction in germination at Patancheru over Akola.

4.9.1.2 Infection by *F. moniliforme*

In grain mold of sorghum low fungal load is considered as a desirable characters. It is seen from the data (Table-34), that the range of variation for parental lines was exhibited from 3.33 in (IS-9471) to 23.67 % in (SPV-104) at Akola, 2.67 in (AKms-14B) to 22.33% (IS-6335) at Patancheru and 10.7 (IS-9471) to 17.17% (IS-2284) in pooled data. Among crosses the lowest fungal load of *F. moniliforme* was noticed in SPV-104 × IS-6335 (3.33%) followed by IS-6335 × IS-9471 (4.01%) and IS-2284 × IS-6335 (4.34%) at Akola, whereas, at Patancheru AKms 14 B × SPV-104 (9.33)

exhibited lowest *F. moniliforme* load followed by AKms 14 B × SPV-946 (11.33 %) **in pooled data** IS-6335 × IS-9471 (9.84%) recorded lowest *F. moniliforme* load.

Over all, there was significant reduction in *F. moniliforme* load 14.75, **44.75 and 35.06** % at Akola, Patancheru and in pooled data, respectively in treated **seed with mercuric** chloride over untreated control and there was 86.28% increased *F. moniliforme* load at Patancheru over Akola location.

In F_2 diallel (Table 46) progeny SRT-26B × SPV-946 exhibited **(10.93)** ***F. moniliforme*** load followed by ICSB-101 B × IS-6335 (11.43%) at Akola, **whereas, at Patancheru** IS-6335 × IS-9471 recorded lowest (14.50%) *F. moniliforme* **count followed** by ICSB-101 B × SPV-104 (15.50%), in pooled data AKms 14 B × **SRT-26 B** recorded lowest (16.2%) *F. moniliforme* load followed by SRT-26 B × **SPV-104** (16.70%).

Over all, there was significant reduction in *F. moniliforme* load 27.10, **17.98 and** 22.98% at Akola, Patancheru and in pooled data, respectively in treated **seed over untreated** control and in general there was 28.32 % increase in load at **Patancheru** over Akola.

4.9.1.3 Infection by *F. pallidoroseum*

In F_1 diallel it is observed from data (Table 35), that the range of variation for parental **lines was from** 0.33% to 3.33% at Akola, 0.0 to 9.00% at Patancheru. However in **pooled data** the range of variation was 1.33 to 5.50%. Parental line SPV-1201 **exhibited lowest** *F. pallidoroseum* load at Akola (0.33%) and AKms 14B (1.33%) in **pooled data.** For crosses the lowest *F. pallidoroseum* load was recorded in cross **ICSB 101B** × GJ-35-15-15 and SRT-26B × GJ-35-15-15 (0.00%) at Akola and AKms-**14 B** × **SPV-946** (2.67%) at Patancheru. Cross AKms 14 B × SPV-946 (1.50%) also **exhibited lowest** *F. pallidoroseum* load in pooled data.

Over all, there was significant reduction in *F. pallidoroseum* load 3.64, **36.28 and** 21.75% at Akola, Patancheru and in pooled data, respectively in treated **seed with mercuric** chloride over untreated control and there was 165.27 % increase *F.* ***pallidoroseum*** load at Patancheru over Akola.

In F_2 diallel (Table 47) progeny GJ-35-15-15 × SPV-946 exhibited lowest *F. pallidoroseum* load (0.34%) followed by SPV-1201 × SPV-946 and AKms 14 B × SPV-946 (0.60%) at Akola whereas, at Patancheru AKms 14 B × SRT 26B exhibited lowest *F. pallidoroseum* load (0.50%) followed by ICSB 101 B × SPV-104 (0.75%) and AKms 14 B × GJ-35-15-15 (0.92%). Progeny GJ-35-15-15 × SPV-946 exhibited lowest *F. pallidoroseum* load (0.80%) followed by SPV-1201 × AKms-14B (0.99%) and AKms 14 B × GJ-35-15-15 (1.06%) in pooled data.

Over all, at Akola, Patancheru and pooled data exhibited 4.80, 35.48 and 21.30% reduction in fungal load of *F. pallidoroseum*, respectively in treated seed with mercuric chloride over untreated control and in general, there was 36.60% increase in *F. pallidoroseum* load at Patancheru over Akola.

4.9.1.4 Infection by *C. lunata*

In F_1 diallel set, it is seen from data (Table 36), that the range of variation for *C. lunata* in parental lines was exhibited from 18.00 to 45.35% at Akola, whereas, it was 1.33 to 18.00 and 12.00 to 31.17% at Patancheru and in pooled data, respectively. Parental line IS-6335 exhibited lowest *C. lunata* load (18.00%) at Akola, however parental line SPV-104 recorded lowest (1.33 and 12.00%) load at Patancheru and in pooled data. Among crosses the lowest *C. lunata* load was exhibited by SPV- 1201 × IS 6335 (12.67%) and SPV-1201 × IS-9471 (12.68%) at Akola. Crosses AKms-14B × GJ 35-15-15 and AKms-14B × SPV-104 exhibited lowest (8.67%) followed by ICSB-101B × SPV-104 (9.33%) at Patancheru. Whereas, SPV-1201 × IS-9471 exhibited lowest (14.01%) *C. lunata* load followed by SPV-1201 × IS-6335 (14.67 %) in pooled data.

Over all, there was 20.69 and 7.44% reduction in *C. lunata* load at Akola and in pooled data, respectively in treated seed with mercuric chloride over untreated control. However, at Patancheru there was 21.73 increased in *C. lunata* load and there was 108.95% increase in *C. lunata* load at Akola over Patancheru.

In F_2 diallel set (Table 48) the range was from 15.17 to 47.03%, progeny IS-6335 × IS-9471 exhibited lowest (15.17%) *C. lunata* load followed by IS-2284 × IS-9471 (17.71%) at Akola. At Patancheru the range varied from 4.00 to 29.76%, lowest (4.00%) *C. lunata* load was exhibited in AKms 14 B × SRT 26B. However, progeny IS-6335 × IS-9471 exhibited lowest *C. lunata* load (15.50 %) in pooled data.

Over all, there was reduction in *C. lunata* load 19.36, 2.44 and 13.81 % at Akola, Patancheru and in pooled data, respectively in treated seed over untreated control and in general there was 46.43 % increase in *C. lunata* load at Akola over Patancheru.

4.9.1.5 Infection by other fungi

In F_1 diallel set it is observed from (Table 37) that the range of variation for parental lines was from 6.33 to 19.33% at Akola, 0.00 to 5.33% at Patancheru and 3.17 to 11.00% in pooled data. Parental line AKms - 14 B recorded lowest other fungi load (6.33, 0.00 and 3.17%) at both locations and in pooled data, respectively. Among crosses lowest other fungi load was exhibited by AKms- 14B × SPV-104(10.33 and 5.83%) at Akola and in pooled data. However, cross ICSB-101B × SPV-104 exhibited lowest (0.00%) followed by AKms 14 B × SRT-16B (0.33%) at Patancheru.

Over all, there was significant reduction in other fungi load 39.16, 22.89 and 36.09 % at Akola, Patancheru and in pooled data, respectively in treated seed with mercuric chloride over untreated control. and there was 283.44% increase in other fungi load at Akola over Patancheru. In F_2 diallel (Table 49), progeny IS-6335 × IS- 9471 exhibited lowest other fungi load (9.17%) followed by SPV-104 × IS-9471 (9.73 %) and IS- 2284 × IS- 6335 (9.94%) at Akola. Whereas, progeny AKms - 14 B × SRT -26B exhibited lowest other fungi load (0.50%) and (6.85%) at Patancheru and in pooled data, respectively. In treated seed with mercuric chloride over untreated control, over all, there was 6.37, 4.91 and 14.44% reduction in other fungi load at Akola, Patancheru and in pooled data, respectively and there was 46.50% reduction in other fungi load at Patancheru over Akola.

4.9.1.6 Score (Germinated seed)

It is observed from data (Table 38), that parental lines IS- 9471 and IS- 6335 recorded minimum (1.00 score) at both locations and in pooled data, however, parental line AKms -14 B exhibited maximum (4.25 and 3.96 score) at Akola and in pooled data and parental lines SPV -1201 and ICSB -101 B (4.00 score) at Patancheru. Thirteen crosses recorded minimum (1.00 score) and seven recorded more than (3.00 score) at Akola, at Patancheru nine crosses recorded minimum (1.00 score) and 19 crosses recorded more than (3.00) score at Patancheru, however in pooled data only four crosses recorded minimum (1.00 score) and more than (3.0 score) recorded in 14 crosses.

Over all, there was reduction in score 13.27 , 0.83 and 6.83% at Akola, Patancheru and in pooled data, respectively, in treated seed over untreated control. and there was 12.74 % increase in score at Patancheru over Akola.

In F_2 diallel set (Table 50) 27 progenies recorded more than (3.00 score) maximum (3.70 score) recorded by AKms -14 B × SPV- 104, SRT -26 B × SPV- 104 and SPV- 946 × SPV -104 and progeny IS- 2284 × IS- 9471 exhibited minimum (2.10 score) at Akola, at Patancheru, however 36 progenies exhibited more than (3.00 score), maximum (3.94 score) and minimum (1.75 score) recorded by AKms- 14 B × SPV 104 and IS -6335 × IS-9471 at Patancheru, respectively.

Over all, there was reduction in score 17.71, 11.14 and 14.41 % in treated over untreated control at Akola, Patancheru and in pooled data, respectively. However there was 3.63 % increase in score at Patancheru over Akola.

4.9.2 Fungal load on ungerminated seed.

4.9.2.1 Ungerminated Seed

It is observed from data (Table 39) in F_1 diallel for ungerminated seed, the range of variation for parental lines was from 6.33 to 40.33% at Akola, 19.33 to 95.33% at Patancheru and 13.00 to 67.00% in pooled data. Parental line IS-9471 exhibited minimum (6.33%) and SPV-104 exhibited maximum (40.33%) ungerminated seed at Akola. At Patancheru, parental line IS-6335 exhibited minimum (19.33%) and

AKms-14B maximum (95.33 %) ungerminated seed. In pooled data parental line IS-6335 recorded minimum (13.00%) and SPV-104 and AKms-14 B recorded (67%) ungerminated seed.

For crosses the range for ungerminated seed was from (4.67%) in AKms-14B × IS-6335 and IS-6335 × IS-9471 to (40.00%) in AKms-14B × SPV-104 at Akola and (8.00%) in ICSB 101B × IS-9471 to (72.67%) in Akms-14B × SRT-26 B at Patancheru.

Over all, there was 12.77, 9.06 and 10.09% decrease in ungerminated seed in treated over untreated control at Akola, Patancheru and in pooled data, respectively, and 165.24% increase in ungerminated seed at Patancheru over Akola.

4.9.2.2 Infection by *F. moniliforme*

In F_1 diallel set, load of *F. moniliforme* on ungerminated seed for parental lines ranged from 2.33 to 18.67%, 11.67 to 54.00 and 7.17 to 35.33% at Akola, Patancheru and in pooled data. (Table 40). Parental line (IS-9471) recorded lowest 2.33 and 7.17% fungal load at Akola and in pooled data, however, (IS-6335) recorded lowest 11.67% at Patancheru. Highest fungal load was indicated by (AKms-14B) 18.67 % at Akola, whereas, parental line (SPV-104) recorded highest fungal load 54.00 and 35.33 % at Patancheru and in pooled data, respectively. Among crosses lowest fungal load was recorded by AKms-14B × IS-6335 and IS-6335 × IS-9471 (1.67 %) at Akola, ICSB-101 B × IS-9471 (5.00 %) at Patancheru and ICSB 101B × IS-6335 (4.17%) in pooled data.

Over all, there was reduction in *F. moniliforme* load 13.77, 25.66 and 28.05% at Akola, Patancheru and in pooled data, respectively in treated seed with mercuric chloride over untreated control, and 241.04% more *F. moniliforme* fungal load was recorded at Patancheru over Akola. In F_2 diallel (Table 52) progeny ICSB-101B × IS-6335 recorded lowest load (2.73%) at Akola, GJ-35-15-15 × IS-2284 (5.50%) at Patancheru and SPV-946 × IS-6335 (5.31%) in pooled data. In treated seed with mercuric chloride over untreated control, over all, there was 18.36, 4.45 and 6.67% reduction in *F. moniliforme* load at Akola, Patancheru and in pooled data, respectively. In general 165.56% more *F. moniliforme* load on ungerminated seed was recorded at Patancheru over Akola.

4.9.2.3 Infection by *F. pallidoroseum*

In F_1 diallel (Table 41) six parental lines out of 10 parental lines recorded lowest (0.00%) fungal load IS-6335, IS-2284, SPV-946, GJ-35-15-15, SRT-26B and ICSB-101B at Akola. At Patancheru and in pooled data parental lines IS-6335 recorded lowest (2.00 and 1.00%) and SPV-104 recorded highest (10.33 and 7.17%) *F. pallidoroseum* load respectively. Among crosses 21 recorded lowest (0.00%) load, at Akola, however only one cross SRT-26B × IS-6335 exhibited lowest fungal load (0.00 and 0.17%) at Patancheru and in pooled data, respectively. Over all, there was 58.33% increase, 33.09 and 27.68% significant decrease in fungal load at Akola, Patancheru and in pooled data, respectively in treated seed with mercuric chloride over untreated control, and there was 918.89 % increase in fungal load at Patancheru over Akola.

In F_2 diallel (Table 53) 22 progenies exhibited lowest fungal load (0.00%) at Akola, however, at Patancheru and in pooled data four and three progenies recorded lowest (0.00%) *F. pallidoroseum* load, respectively. Over all, there was 87.50 and 26.52% increase in fungal load at Akola and in pooled data, respectively and 88.15% decrease in fungal load at Patancheru in treated seed with mercuric chloride over untreated control and 882.60% more fungal load was exhibited at Patancheru over Akola.

4.9.2.4 *C. lunata*

In F_1 diallel (Table 42) at Akola parental lines IS-9471 and IS-6335 exhibited lowest fungal load (3.33%) and highest in AKms-14B and SPV-104 (16.00%). At Patancheru and in pooled data parental line IS-6335 exhibited lowest (5.00 and 4.17%) and parental lines AKms-14B exhibited highest (43.00 and 29.50 %) respectively. Among crosses the lowest *C. lunata* load was exhibited by crosses SPV-1201 × IS-6335 (1.67 %) at Akola, whereas, at Patancheru and in pooled data cross ICSB-101 B × IS-6335 exhibited lowest fungal load (2.33 and 2.67%), respectively.

Over all, there was 8.27 % reduction in fungal load in treated seed over untreated control at Akola, However, at Patancheru and in pooled data exhibited 43.44 and 21.09% increase in fungal load in treated over untreated control, respectively, Patancheru exhibited 66.91% increase in fungal load over Akola. In F_2 diallel (Table 54) progeny IS-6335 × IS-9471 exhibited lowest (1.68%) *C. lunata* load at Akola, however, IS-2284 × IS-9471 recorded lowest *C. lunata* load (1.75 and 1.76%) at Patancheru and in pooled data. All the treatment exhibited 17.59, 19.93 and 15.58% reduction in fungal load at Akola, Patancheru and in pooled data, respectively in treated over untreated control and exhibited 27.92% reduction fungal load at Patancheru over Akola.

4.9.2.5 Other fungi

In F_1 diallel (Table 43) parental lines IS-2284 and IS-6335 exhibited lowest other fungi load i.e. 0.00, 0.67 and 0.33% at Akola, Patancheru and in pooled data. respectively. Among crosses AKms-14B × IS-6335 indicated lowest (0.00%) fungal load at both locations and in pooled data.

Over all, the treatments exhibited 60.00 and 22.30% reduction in fungal load at Akola and in pooled data, respectively, however, at Patancheru location exhibited 26.89% increase in fungal load in treated over untreated control. In general Patancheru exhibited 20.53% increase in fungal load over Akola.

In F_2 diallel (Table 55) progeny ICSB-101B × IS-9471 exhibited lowest fungal load (0.00%) at Akola, GJ-35-15-15 × IS-2284 and SRT 26B × IS-2284 (0.00%) at Patancheru and SPV-946 × IS-6335 and IS-2284 × IS 9471 (0.15%) in pooled data, over all, the treatments exhibited 19.93, 21.05 and 20.62% reduction in other fungi load in treated over untreated control. Patancheru location exhibited 26.78 % more other fungi load over Akola.

4.9.2.6 Score (Ungerminated seed)

In F_1 diallel set. (Table 44) parental lines IS-9471 exhibited minimum 1.17, 2.50 and 1.84 score and AKms-14B exhibited maximum 4.75, 5.00 and 4.88 score at Akola, Patancheru and in pooled data, respectively. Among crosses the range of variation was from 0.92 to 4.58 at Akola, 1.42 to 5.00 at Patancheru and 1.38 to 4.71 in pooled data

Over all, there was 3.97 and 0.63 % reduction in score at Akola and in pooled data, respectively and 3.38 % increase in score at Patancheru in treated over untreated control and there was 23.32% increase score at Patancheru over Akola.

In F_2 diallel, (Table 56) all the progenies at Akola and Patancheru except one each IS-2284 × IS-9471 (2.91) and IS-6335 × IS-9471 (2.92), respectively recorded more than 3.00 score. However, all the progenies in pooled data recorded more than 3.00 score. Over all there was, 13.22, 6.96 and 9.72% significant reduction in score at Akola, Patancheru and in pooled data, respectively, in treated seed over untreated control and there was 11.31% increase in score at Patancheru over Akola.

4.9.3 Fungal load on germinated seed, Akola 1995 and 1996

4.9.3.1 Seed germination

Seed germination (%) recorded on standard blotter test method on treated and untreated seed were used for study. In F_1 diallel set (Table 57) parental line IS-6335 and IS-9471 exhibited highest germination (97.23%) followed by SPV-1201 (96.67 %) and lowest in parental line AKms-14B (53.34%) in Akola 1995 and Akola 1996 parental line IS-9471 recorded highest (93.67%) and lowest in parent SPV-104 (59.67%) however, in pooled data parental lines IS-9471 recorded highest (95.45%) and lowest in AKms-14B (57.33%) seed germination.

Among crosses the highest seed germination (%) were recorded in crosses SPV-946 × IS-2284, SPV-946 × IS-6335 and GJ-35-15-15 × IS-6335 (97.78 %) and lowest in GJ-35-15-15 × SPV-104 (50.00%) in Akola 1995. In Akola 1996, crosses AKms-14B × IS-6335 and IS-6335 × IS-9471 recorded highest (95.33%) seed germination and lowest in AKms-14B x SPV-104 (59.67%), however, in pooled data highest % seed germination was recorded in cross SPV-946 × IS-6335 (96.06%) followed by IS-6335 × IS-9471 (95.45%) and lowest in GJ-35-15-15 × SPV-104 and SPV-946 × SPV-104 (67.33%).

Over all, there was significant increase in seed germination 7.07, 2.33 and 4.63% at Akola 1995, Akola 1996 and in pooled data, respectively, in treated seed with mercuric chloride over untreated control and there was 3.52% increase in % germination at Akola 1996 over Akola 1995.

4.9.3.2 Infection by *F. moniliforme*

In sorghum grain mold low fungal load is considered as desirable characters. In F_1 diallel set, (Table 58) parental lines GJ-35-15-15 and IS-6335 recorded lowest (1.11%) *F. moniliforme* load and highest in ICSB-101B (23.33%) in Akola 1995. In Akola 1996 the lowest load was recorded in IS-9471 (3.33%) and highest in SPV-104 (23.67%), however, in pooled data parental lines IS-9471 recorded lowest (2.50%) and ICSB-101B recorded highest (20.34%) *F. moniliforme* load.

Among crosses lowest load was exhibited by GJ-35-15-15 × IS-6335 (1.11%) followed by ICSB-101 B × IS-9471 (1.67%) in Akola 1995. In Akola 1996 crosses SPV-104 × IS-9471 (3.33%) followed by IS-6335 × IS-9471 (4.01%), however, crosses ICSB-101B × IS-9471 exhibited lowest (3.34%) *F. moniliforme* load followed by SPV-104 × IS-9471 (3.61 %) in pooled data.

Over all, there was significant reduction in *F. moniliforme* load 26.51, 78.49 and 54.87% in Akola 1995 , Akola 1996 and in pooled data, respectively in treated seed over untreated control. However, there was 19.80 % decrease in fungal load in Akola 1996 over Akola 1995.

4.9.3.3 Infection by *F. pallidoroseum*

There was no occurrence of *F. pallidoroseum* at Akola during 1995 in all the entries except one tested (Table 59), hence no conclusion could be drawn.

4.9.3.4 *C. lunata*

It is observed from (Table 60) that the range of variation for parental lines was from 4.44% (SPV-1201) to 34.45% (SPV-104) in Akola 1995. In Akola 1996 the same was observed to be 18.00% (IS-6335) to 45.35% (SPV-1201), whereas, in pooled data range was 14.73% (IS-9471) to 35.33% (ICSB-101B). Among crosses in Akola 1995 the range was 10.00% in (SPV 946 × IS-6335) and (SPV-104 × IS-9471) to 38.34 %

in (ICSB-101 B × GJ-35-15-15), however in Akola 1996 and in pooled data the range was 12 67% to (SPV-1201 × IS-6335) to 53 33% (ICSB-101B × GJ-35-15-15) Over all, there was 13 34, 22 36 and 17 82% reduction in fungal load in Akola 1996 in treated over untreated control and 46 85% increase in *C lunata* load Akola 1996 over Akola 1995

4.9.3.5 Infection by other fungi

In F_1 diallel (Table 61) in Akola 1995 season the range for parental line was from **15.00%** (SPV-1201) to 64 65% (GJ-35-15-15) in Akola 1996 the range was from **6.33%** (AKms-14B) to 19 33% (SPV-1201), however, in pooled data the range was **15.95%** (AKms-14B) to 40 89% in (GJ-35-15-15)

Among crosses in Akola 1995 cross AKms-14B SRT-26B recorded **lowest** (10 00%) other fungi fungal load and highest in SPV-104 IS-2284 (32 78%) **in Akola** 1996 the lowest fungal load recorded in AKms-14B SPV-104 (10 33%) **and highest** in SPV-1201 SRT-26 B (27 33%), however, in pooled data cross ICSB-**101B** × SRT-26B recorded lowest (12 28%) fungal load and highest in SPV-104 IS-**2284** (25 89%)

4.9.3.6 Score (GS)

In F_1 diallel (Table 62) it is observed from data that the range of variation for parental **lines** was from 1 50 (SPV-1201) to 3 83 (ICSB-101B) in Akola 1995 from 1 00 (IS-**9471 and** IS-6335) to 4 25 (AKms-14B) in Akola 1996 and from 1 50 (IS-9471 and **IS-6335**) to 3 71 (AKms-14B) in pooled data Among crosses the range was from 1 25 **(SPV-946** IS-6335) to 4 24 (ICSB-101B SPV-104) in Akola 1995 from 1 00 **(ICSB**-101 B × IS-6335) to 3 75 (AKms-14B SPV-104) in Akola 1996 and 1 25 (IS-**6335** × IS-9471) to 3 63 (AKms-14B SPV-104) in pooled data Over all there was **14.26,** 13 27 and 13 75% reduction in score in Akola 1995 Akola 1996 and in pooled **data,** respectively in treated over untreated control and there was 11 84% increase in **score** over Akola 1996

4.9.4 Fungal load on ungerminated seed, Akola, 1995 and 1996

4.9.4.1 Ungerminated seed

In parental line minimum ungerminated seed were recorded in IS-9471 (2.22, 6.33, 4.28%) in Akola 1995, Akola 1996 season and in pooled data, respectively. However maximum ungerminated seed were recorded in AKms-14B (45.00%) in Akola 1995, SPV-104 (40.33%) in Akola 1996 and AKms-14B (41.83%) in pooled data (Table 63).

Among crosses minimum ungerminated seed was recorded in SPV-1201 × GJ-35-15-15 (2.78%) and maximum in ICSB 101 SR1-26B (51.11%) in Akola 1995. In Akola 1996 minimum ungerminated was recorded in AKms-14B IS-6335 and IS-6335 × IS-9471 (4.67%) and maximum in SPV-1201 SPV-946 (30.00%), however, in pooled data cross IS-6335 IS-9471 recorded minimum (4.28%) and GJ-35-15-15 SPV-104 recorded maximum (32.67%) ungerminated seed.

Over all there was 28.47, 12.83 and 21.71% reduction in ungerminated seed in Akola 1995, 1996 and in pooled data respectively in treated seed over untreated control and 16.74% reduction in ungerminated seed in Akola 1996 over Akola 1995.

4.9.4.2 Infection by *F. moniliforme*

Four parental lines GJ-35-15-15, IS-2284, IS-6335 and IS-9471 recorded lowest (1.11%) and highest in SR1-26B (14.45%) in Akola 1995 (Table 64) however parental lines IS-9471 recorded lowest 2.33 and 1.72% and highest in AKms-14B 18.67 and 12.67% *F. moniliforme* load at Akola 1996 and in pooled data respectively.

Among crosses four crosses recorded lowest *F. moniliforme* load (1.11%) in Akola 1995, cross IS-6335 IS-9471 also recorded lowest load 1.67 and 1.39 % in Akola 1996 season and in pooled data respectively. Highest load was recorded in GJ-35-15-15 SPV-104 (30.56%) and (17.95%) in Akola 1995 and in pooled data, respectively and SPV-1201 SPV-946 (17.00%) in Akola 1996.

Over all, there was significant decrease *F. moniliforme* load 19.76, 13.64 and 16.95% in Akola 1995, Akola 1996 and in pooled data, respectively in treated seed over untreated control and 14.88% increase in fungal load in Akola 1995 over Akola 1996.

4.9.4.3 Infection by *F. pallidoroseum*

The fungal load of *F. pallidoroseum* in Akola 1995 and Akola 1996 season were recorded nil in most of entries (Table 65), hence conclusion could not be drawn. There was no occurrence of *F. pallidoroseum* at Akola during 1995. In all the entries and in majority entries tested during 1996 season, hence no conclusion could be drawn (Table 65).

4.9.4.4 Infection by *C. lunata*

Table 66, revealed that parental line IS-9471 recorded lowest 0..00, 3.33 and 1.67% *C. lunata* load in Akola 1995, Akola 1996 and in pooled data, respectively. SPV-946 recorded highest 16.67% in Akola 1995 and AKms-14B exhibited highest 16.00 and 13.00% load in Akola 1996 and in pooled data, respectively. Among crosses lowest (0.00 %) load were recorded in GJ-35-15-15 × IS-6335 and SPV-946 × IS-6335 in Akola 1995 cross SPV-1201 × IS-6335 (1.67%) in Akola 1996 and cross SPV-946 × IS-6335 (1.17%) in pooled data. Over all, there was 27.55, 8.27 and 17.99% reduction in fungal load in Akola 1995, Akola 1996 and in pooled data, respectively in treated over untreated control and 4.26% reduction in *C. lunata* load in Akola 1996 over Akola 1995.

4.9.4.5 Infection by other fungi

Data presented in Table 67 revealed that, the range for parental lines was from 0.00 (SPV-1201) to 26.11% (AKms-14B) in Akola 1995 season however, in Akola 1996 was from 0.00% in (IS-9471 and IS-2284) to 3.67% in (SPV-104) and in pooled data 0.28 % (IS-9471) to 14.72% (AKms-14B).

Among crosses SPV-946 x IS-2284 recorded lowest (0.00%) other fungi load at both locations and in pooled data, however, crosses SPV-946 × SPV-104 recorded highest (7.78%) fungal load in Akola 1995, cross AKms-14B × SRT-26B and SPV-1201 × SPV-104 (3.00 %) on Akola 1996 and cross SPV-1201 × Akms-14B (5.28%) in pooled data, respectively.

Over all, there was 49.52, 60.00 and 52.41% significant reduction of other fungi load in Akola 1995, Akola 1996 and in pooled data, respectively in treated over untreated control and 64.55% reduction in fungal load in Akola 1996 over Akola 1995.

4.9.4.6 Score

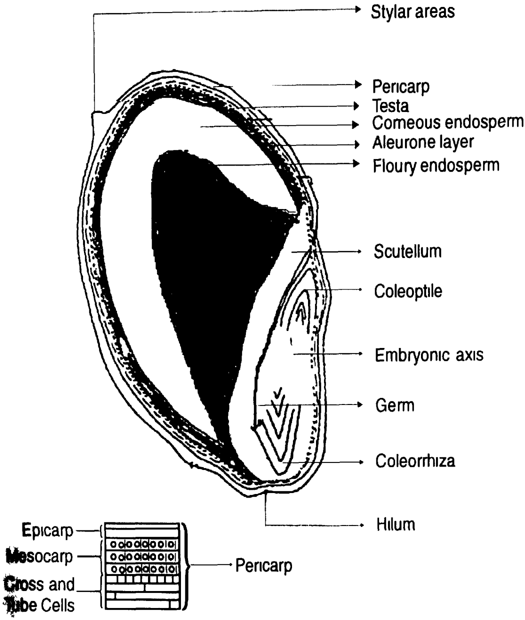
It is observed from data (Table 68), that the score range in parental lines was from 0.83 (SPV-1201) to 4.08 (ICSB-101B) in Akola 1995, from 1.17 (IS-9471) to 4.75 (AKms-14B) in Akola 1996 and from 1.04 (IS-9471) to 4.21 (ICSB-101B) in pooled data. Among crosses the range was from 0.58 (SPV-946 × IS-6335) to 4.75 (AKms-14B × SRT-26B) in Akola 1995 from 0.92 (SPV-1201 × IS-2284) to 4.58 (AKms-14B × SPV-104) in Akola 1996 and from 1.13 (SPV-946 to IS-6335) to 4.54 (AKms-14B SPV-104) in pooled data. AKms-14B × SPV-104 exhibited maximum score in both locations and in pooled data.

4.10. Histopathology of infection of molding fungi (Microtomy)

Histopathology of infection and colonization of major molding fungi viz. *F. moniliforme* and *F. pallidoroseum* and *C. lunata* at different stages of grain development i.e., at anthesis, 10, 20,30 and 40 DAF were investigated.

Histologically sorghum seed consist of outer covering pericarp (seed coat), the storage tissue endosperm and embryo (germ). Pericarp is sub-divided into outer epicarp, two to three cells layers, middle mesocarp contains starch granules, usually thickest opposite embryo; innermost layer of pericarp is endocarp consist of cross and tube cells (Plate 5).

Just beneath the pericarp, some sorghum kernels have highly pigmented layer called testa or sub-coat, testa usually thickest at the crown of the kernel and thinnest over embryo. The endosperm of sorghum seed consist of aleurone layer and peripheral (earlier so called stele layer), corneous and floury portions. Aleurone cell layer located beneath the pericarp or testa if it is present, block-like



edian longitudinal section of sorghum grain showing its parts

rectangular cells. The peripheral endosperm is beneath the aleurone layer, consisting of first two to six endosperm cell. The corneous endosperm (hard/ horney) located beneath the peripheral endosperm made up of starch and proteins. The floury endosperm area has loose packed endosperm cells. The starch granules are sphericals and they are held together by protein matrix.

Embryo or germ lies at the base of the kernel and consist of scutellum, plumule and radicle, plumule, radicle and a part between is known as embryonic axis. Coleoptile and coleorrhiza are the fused parts around the plumule and radicle toward embryonic leaf and root cap respectively.

4.10.1. Infection by *F. moniliforme*

Small size shriveled grains and in some cases no grain formed in the earhead, infection in all parts when the inoculations were made at anthesis (Plate 6A). When the earhead were inoculated at 10 DAF infection observed in all parts except in some parts of endosperm (Plate 6B). The grain from the earhead inoculated 20 DAF colonization observed in endosperm scutellum, embryonic region and at hilar areas (Place 6C). Earhead inoculated at 30 DAF fungus colonizing in embryonic region involving coleoptile, coleorrhiza and embryonic axis (Plate D). When the earhead were inoculated at 40 DAF fungus colonizing in pericarp, aleurone and peripherals region fungus mycelium and spores were observed on pericarp (Plate 6E).

2. Infection by *F. pallidoroseum*

Shriveled grain and infection in all parts when the inoculations were made at anthesis (Plate 7A). Infection in all parts except some parts of endosperm, when the inoculations were made at 10 DAF (Plate 7B). At 20 DAF infection observed in hilar areas, embryonic region and pericarp (Plate 7C). Pericarp and embryonic region colonized when inoculations were made at 30 DAF (Plate 7D). At 40 DAF colonization were observed in endosperm, pericarp and aleurone layer (Plate 7E).

4.10.3. Infection by *C. lunata*

Shriveled grain formed and infection observed in embryonic region when the inoculations were made at anthesis (Plate 8A). At 10 DAF infection noticed in embryonic region, this infection takes place through hilar region (Plate 8B). Infection

Plate : 6 Infection by *F. moniliforme*

A Anthesis - (LS)Shriveled grain
Infection in all parts (13.2 x)

B 10 DAA - (LS) Infection in all parts (13.2 x)
Except endosperm

C 20 DAA - (LS) Hilar, pericarp, embryonic
Region (33.3 x)

D 30 DAA - (LS) Embryonic infection (66.6 x)

E 40 DAA - Aleurone layer and pericarp (66.6 x)

(Pe-Pericarp, E-Endosperm, Al-Aleurone layer,
Er-Embryonic region, Ea-Embryonic axis, Hi-Hilar
F-Fungus mycelium, Fs-Fungus mycelium and spores)

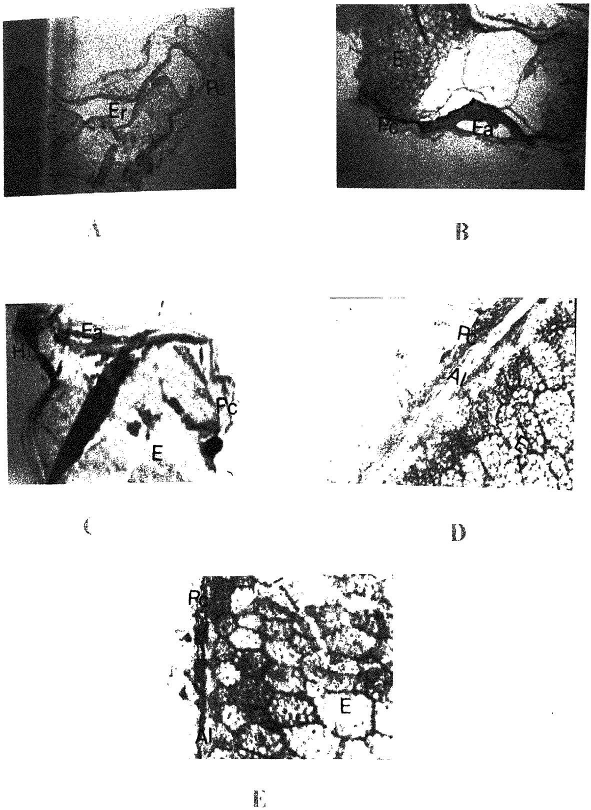


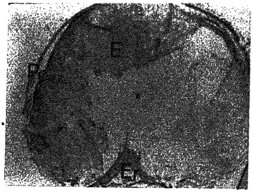
Plate 6. Infection by *F. moniliforme*

Plate : 7 Infection by *F. pallidoroseum*

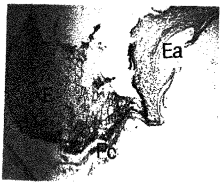
A- Anthesis	(LS) Shriveled grain infection in all parts (13.2 x)
B-10 DAA	(LS) Infection in all parts (33.3 x)
C-20DAA	(LS) Hilar, pericarp, endosperm and embryonic region (33.3 x)
D-30 DAA	(TS) Pericarp and embryo (33.3 x)
E-40DAA	(LS) Infection in endosperm and pericarp (66.6 x)

(Pe- Pericarp, E-Endosperm, Er-Embryonic region, Ea-Embryonic axis, Al-Aleurone layer, F-fungus mycelium)

A

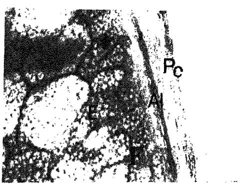


B



C

D



E

Plate 7. Infection by *F. pallidoroseum*

was observed in embryonic axis, scutellum near hilar voids, when inoculations were made at 20 DAF (Plate 8C). At 30 DAF, infection were observed in pericarp with spores and mycelium, aleurone layer and endosperm intercellular mycelium was observed (Plate 8D). Infection observed in pericarp and aleurone layer only with spores and mycelium on pericarp when inoculation were made at 40 DAF (Plate 8E).

4.10.4. Infection by different fungi (Fluorescence microscopy)

Shriveled grain was formed when the inoculation were made at anthesis and infection was observed in all region except endosperm (Plate 9A). Infection was observed in hilar areas when the inoculations were made at 10 DAF (Plate 9B). Infection observed in embryonic axis with coleoptile and coleorrhiza infection at 20 DAF (Plate 9C). Infection in pericarp, aleurone layer and endosperm with mycelium. Infection A to D by *F. moniliforme* (Plate 9D). Embryonic infection was observed when the inoculations were made at 20 DAF (Plate 9E). Pericarp infection when inoculated at 40 DAF by *C. lunata* (Plate 9F). E and F infection by *C. lunata.*

4.11 Correlation studies

Correlation describes the inter relationship between the variables. In any biological entity the variables are generally associated with each other. With a view to find out the association between grain molding contributing physical and biochemical characters. Simple correlation coefficient have been worked out on following aspects.

- Correlation between fungal load on germinated and ungerminated F_1 seed (Untreated), Akola and Patancheru, 1996
- Correlation between fungal load on germinated and ungerminated F_1 seed (Treated), Akola and Patancheru, 1996
- Correlation between physical characters, Akola and Patancheru, 1996
- Correlation between biochemical characters
- Correlation between protein fractions and physical characters

Plate : 8 by *C. lunata*

A	Anthesis	-	(LS) Shriveled grain, embryonic region (13.2 x)
B	10 DAA	-	(LS) Hilar areas and embryo (33.3 x)
C	20DAA	-	(TS) Embryonic axis, scutellum and near hilar viod (33.3 x)
D	30DAA	-	(TS) Pericarp, aleurone layer, endosperm (66.6 x)
E	40 DAA	-	(TS) Pericarp (33.3 x)

(Pc-Pericarp, Al-Aleurone layer, E-Endosperm, Er-Embryonic region, Ea-Embryonic axis, Hv-Hilar void, F-Fungus mycelium, Fs-Fungus mycelium and spores)

Plate : 8 by *C. lunata*

A	Anthesis	(LS) Shriveled grain, embryonic region (13.2 x)
B	10 DAA	(LS) Hilar areas and embryo (33.3 x)
C	20DAA	(TS) Embryonic axis, scutellum and near hilar viod (33.3 x)
D	30DAA	(TS) Pericarp, aleurone layer, endosperm (66.6 x
E	40 DAA	(TS) Pericarp (33.3 x)

(Pe-Pericarp, Al-Aleurone layer, E-Endosperm, Er-Embryonic region, Ea-Embryonic axis, Hv-Hilar void, F-Fungus mycelium, Fs-Fungus mycelium and spores)

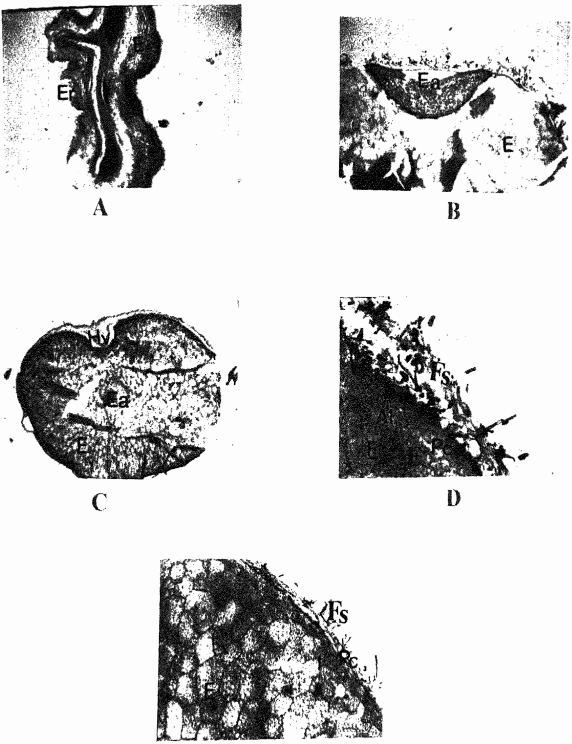


Plate 8. Infection by *C. lunata*

Plate : 9 Infection by different fungi (fluorescence microphoto)

A (LS) At anthesis all region except endosperm *F. moniliforme* (20 x)

B (LS) 10 DAA, Hilar, *F. moniliforme* (100 x)

C (LS) Embryonic region *F. monilifore* (100 x)

D (TS) Endosperm (intercellular) *F. monilifore* (100 x)

E (LS) Embryonic region *C. lunta* (100 x)

F (TS) Pericarp, *C. lunata* (100 x)

(Pe-Pericarp, E-Endosperm, Ea-Embryonic axis, Hi-Hilar,
Cp-Coleoptile, Ch-Coleorrhiza, F-Fungus mycelium,
Fs-Fungus mycelium and spores).

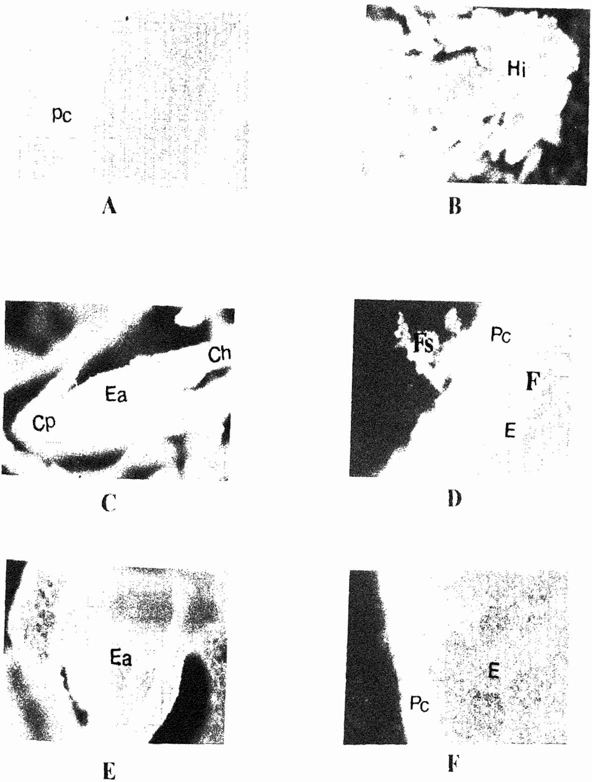


Plate 9. Infection by *F. moniliforme* and *C. lunata*
Fluorescence microphoto)

4.11.1 Correlation between fungal load on germinated and ungerminated F_1 seed (Untreated), Akola and Patancheru, 1996

Fungal load viz. *F. moniliforme*, *F. pallidoroseum* *C. lunata* other fungi and their score on germinated (GS) and ungerminated (UGS) (untreated) F_1 seed were recorded at both locations and correlation between them with TGMR as a dependent variable were worked out and results are presented in Table 69.

4.11.1.1 Germinated seed

Out of 12 characters studied, germinated seed had a significant negative correlation with seven characters at both the locations viz. ungerminated seed, score (GS), *F. moniliforme* (UGS), *C. lunata* (UGS), other fungi (UGS), score (UGS), and TGMR. however, *F. moniliforme* (GS) at Akola and *F. pallidoroseum* (UGS) at Patancheru location. Whereas, significant positive correlation exhibited in other fungi (GS) at Akola and *F. moniliforme* (GS), *F. pallidoroseum* (GS), *C. lunata* (GS) and other fungi (GS), at Patancheru.

4.11.1.2 Ungerminated seed

Ungerminated seed had a significant positive association with six characters score (GS), *F. moniliforme* (UGS), *C. lunata* (UGS), other fungi (UGS), score (UGS), and TGMR at both the location, and *F. pallidoroseum* (UGS) at Patancheru only. However, significant negative association was exhibited in *F. moniliforme* (GS) and other fungi (GS) at both location and *F. pallidoroseum* (GS), and *C. lunata* (GS) at Patancheru location only.

4.11.1.3 Infection by *F. moniliforme* (GS)

F. moniliforme (GS) exhibited significant positive correlation with score (GS) (0.76), *F. moniliforme* (UGS) (0.72), score (UGS) (0.71) *C. lunata* (UGS) (0.67), TGMR (0.65), other fungi (UGS) (0.38) and *C. lunata* (GS) (0.28) at Akola location. whereas, with *F. pallidoroseum* (GS) (0.78), *C. lunata* (GS) (0.48), Patancheru. However, significant negative association was exhibited with other fungi (GS) (-0.49) at Akola and *C. lunata* (UGS)(-0.64), *F. moniliforme* (UGS) (-0.52), TGMR (-0.38), *F. pallidoroseum* (UGS) (-0.31), score (UGS) (-0.30)and other fungi at Patancheru.

4.11.1.4 Infection by *F. pallidoroseum* (GS)

F. pallidoroseum (GS) had a significant positive association with *F. pallidoroseum* (UGS) (0.55) at Akola and *C. lunata* (GS) (0.56), other fungi (UG) (0.28) at Patancheru location. However, *F. pallidoroseum* (GS) exhibited significant a negative association with *C. lunata* (GS), score (GS), score (UGS), and TGMR at Akola location and score (GS), *F. moniliforme* (UGS), *F. pallidoroseum* (UGS), *C. lunata* (UGS), other fungi (UGS), score UGS, and TGMR at Patancheru location.

4.11.1.5 Infection by *C. lunata* (GS)

C. lunata (GS) exhibited significant positive correlation with score (UGS), score (GS), and TGMR at Akola and other fungi (GS) at Patancheru, significant negative correlation was exhibited with all characters except other fungi (GS) at Patancheru.

4.11.1.6 Infection by other fungi (GS)

Other fungi (GS) exhibited significant and negative association with all characters at both locations except *F. pallidoroseum* (UGS) at Akola and score (GS) at Patancheru.

4.11.1.7 Score (GS)

Score (GS) also exhibited significant positive correlation at both locations for all the characters except *F. pallidoroseum* (UGS) at Akola, where, significant negative correlation was noticed.

4.11.1.8 Infection by *F. moniliforme* (UGS)

F. moniliforme (UGS) had a significant positive association with all the characters at both the locations, except *F. pallidoroseum* (UGS) at Akola.

4.11.1.9 Infection by *F. pallidoroseum* (UGS)

F. pallidoroseum (UGS) had a significant positive association with all the characters at Patancheru, however TGMR (-0.28) exhibited significant negative association at Akola.

4.11.1.10 Infection by *C. lunata* (UGS)

C. lunata (UGS) exhibited significant positive correlation with all the characters at both the locations.

4.11.1.11 Infection by other fungi (UGS)

Other fungi (UGS) also exhibited significant positive association with all the characters at both the locations.

4.11.1.12 Score (UGS)

Score (UGS) also exhibited highly significant positive correlation with TGMR at both the locations.

4.11. 2 Correlation between fungal load on germinated and ungerminated F_1 seed (Treated), Akola and Patancheru, 1996

Fungal load viz. *F. moniliforme, F. pallidoroseum* , *C. lunata* and other fungi and their score on germinated and ungerminated F_1 (Treated) seed were recorded at both locations and correlation between them were worked out and results are presented in Table 70.

4.11.2.1 Germinated Seed

Out of 12 characters studied, germinated seed had a significant negative association with eight characters UGS, score (GS), *F. moniliforme* (UGS), *F. pallidoroseum* (UGS), *C. lunata* (UGS), other fungi (UGS), score (UGS) and TGMR (UGS) at both locations. However, significant negative association was exhibited in *F. moniliforme* (-0.72), *C. lunata* (GS) (-0.40) and *F. pallidoroseum* (GS) (-0.36) at Akola location and significant positive association with *C. lunata* (GS) (0.60), *F. pallidoroseum* (GS) (0.46), *F. moniliforme* (GS) (0.45) and other fungi (GS) (0.43) at Patancheru.

4.11.2.2 Ungerminated seed

Out of 11 characters, ungerminated seed had a significant positive association with seven characters score (GS), *F. moniliforme* (UGS), *F. pallidoroseum* (UGS), *C. lunata* (UGS), other fungi (UGS) score (UGS) and TGMR at both locations. However. significant positive association exhibited with *F. moniliforme* (GS) (0.72), *C. lunata* (GS) (0.40), *F. pallidoroseum* (GS) (0.36) and other fungi (GS) (0.26) at Akola and significant negative association with *C. lunata* (GS) (-0.60), *F. pallidoroseum* (GS) (-0.47), *F. moniliforme* (GS) (-0.45) and other fungi (GS) (-0.43) at Patancheru.

4.11.2.3 Infection by *F. moniliforme (GS)*

F. moniliforme (GS) exhibited significant positive correlation for all characters except other fungi (GS) at Akola location, but only for *F. pallidoroseum* (GS) (0.60), *C. lunata* (GS) (0.59) and other fungi (GS) (0.46) at Patancheru. Significant negative correlation with *C. lunata* (UGS) (-0.52), *F. pallidoroseum* (UGS) (-0.44), other fungi (UGS) (-0.39) and *F. moniliforme* (UGS) (-0.32) was exhibited at Patancheru.

4.11.2.4 Infection by *F. pallidoroseum* (GS)

F. pallidoroseum had a significant positive association with *F. moniliforme* (UGS) (0.41), other fungi (UGS) (0.36) and *F. pallidoroseum* (UGS) (0.30) at Akola, and with *C. lunata* (GS) (0.48) and other fungi (GS) (0.36) at Patancheru. Five characters viz. *C. lunata* (UGS) (-0.53), other fungi (UGS) (-0.45), *F. pallidoroseum* (UGS) (-0.41), *F. moniliforme* (UGS) (-0.34) and TGMR (-0.28) exhibited significant negative correlation at Patancheru. The remaining characters exhibited non-significant positive and negative association at both locations.

4.11.2.5 *C. lunata* (GS)

All the characters except *F. pallidoroseum* (UGS) and other fungi (UGS) and only one character i.e. other fungi (GS) have shown significant positive correlation with *C. lunata* (GS) at Akola and Patancheru locations respectively. Seven out of eight characters exhibited negative correlation of which five exhibited significant negative correlation with *C. lunata* (GS).

4.11.2.6 Infection by other fungi (GS)

Other fungi (GS) exhibited significant positive with score (UGS) (0.60), TGMR (0.59), score (GS) (0.56), and *C. lunata* (UGS) (0.31) at Akola location. However, at Patancheru all characters exhibited negative association of which four viz. *F. pallidoroseum* (UGS) (-0.44), *C. lunata* (UGS) (-0.43), other fungi (UGS) (-0.38) and *F. moniliforme* (UGS) (-0.36) were significant.

4.11.2.7 Score (GS)

Score (GS) exhibited highly significant positive correlation with all the traits at both the locations.

4.11.2.8 Infection by *F. moniliforme* (UGS)

F. moniliforme (UGS) also exhibited significant positive correlation at both the locations for all the traits.

4.11.2.9 Infection by *F. pallidoroseum* (UGS)

Four characters viz. *C. lunata* (UGS), other fungi (UGS), score (UGS) and TGMR exhibited significant positive correlation with *F. pallidoroseum* (UGS) at both the locations.

4.11.2.10 Infection by *C. lunata* (UGS)

C. lunata exhibited highly significant positive correlation with TGMR (0.76, 0.74), score (UGS) (0.70, 0.68) and other fungi (UGS) (0.69, 0.84) at Akola and Patancheru, respectively.

4.11.2.11 Infection by other fungi (UGS)

Other fungi (UGS) exhibited significant positive correlation with TGMR (0.68, 0.66) and score (UGS) (0.54, 0.57) at Akola and Patancheru, respectively.

4.11.2.12 Score (UGS)

Score (UGS) exhibited highly significant positive correlation with TGMR (0.85, 0.85) at both locations.

4.11.3 Correlation between physical characters, Akola and Patancheru, 1996

Twelve characters at both the locations were correlated using germination percent as a dependent variable Table 71.

4.11.3.1 100-grain weight

The study of results revealed that, 100 grain weight had significant and positive correlation with TGMR (0.40) and *F. moniliforme* (0.28) and significant negative correlation with glume covering (-0.26) and *F. pallidoroseum* (-0.26) at Akola location. however. at Patancheru location none of the characters is having significant positive and negative association.

4.11.3.2 Grain hardness

Grain hardness had a significant positive association with DTF (0.42) and significant negative association with endosperm texture (-0.61) and *F. pallidoroseum* (-0.32) at Akola, whereas, at Patancheru, significant positive association was observed with other fungi (0.50), DTF (0.39), germination (0.30), whereas. significant and negative association was observed with endosperm texture (-0.33) and *F. moniliforme* (-0.26).

4.11.3.3 Endosperm texture

Endosperm texture had a significant and positive correlation with *F. pallidoroseum* (0.41) and significant negative correlation with DTF (-0.54), *C. lunata* (-0.54), electrical conductivity (-0.51), germination (-0.41), mesocarp thickness (-0.39), TGMR (-0.39) and *F. moniliforme* (-0.35) at Akola location, whereas, at Patancheru it had significant and positive correlation with germination (0.52) and significant negative correlation with TGMR (-0.87), *F. moniliforme* (-0.59), mesocarp thickness (-0.55), electrical conductivity (-0.54) and DTF (-0.51).

4.11.3.4 Electrical conductivity

Out of 9 characters studied, 5 characters viz. *F. moniliforme* (0.67, 0.72), TGMR (0.64, 0.82) , *C. lunata* (Akola, 0.61), mesocarp thickness (0.56, 0.59) and Days to 50% flowering (0.50, 0.40), exhibited significant positive correlation at Akola and Patancheru respectively. However, germination (-0.66, -0.82) , other fungi (-0.44, -0.31) and *F. pallidoroseum* (Akola, -0.33) indicated significant negative correlation at Akola and Patancheru, respectively.

4.11.3.5 Days to 50% flowering

Days to 50% flowering at Akola had significant positive association with mesocarp thickness (0.41), *F. moniliforme* (0.37), *C. lunata* (0.37) and TGMR (0.29) whereas, significant negative correlation were established with germination (-0.38), glume covering (-0.33) and *F. pallidoroseum* (-0.32) . However, at Patancheru significant positive correlation was exhibited with *C. lunata* (0.46), mesocarp thickness (0.39).

TGMR (0.34), *F. moniliforme* (0.31) and *F. pallidoroseum* (0.26) and negative association with germination (-0.20) and glume covering (-0.05).

4.11.3.6 Glume covering

Glume covering had no significant correlation (positive or negative) with most of the variables at both the locations. However positive correlation was noticed with germination at Akola (0.06) and Patancheru (0.11) whereas, negative correlation was exhibited with mesocarp thickness, *F. moniliforme*, *C. lunata* and TGMR at both locations.

4.11.3.7 Mesocarp thickness

Mesocarp thickness at Akola location has a significant positive association with *C. lunata* (0.68), TGMR (0.65) and *F. moniliforme* (0.51), however, significant negative correlation, was exhibited with germination (-0.57) and *F. pallidoroseum* (-0.38). At Patancheru TGMR (0.64) and *F. moniliforme* (0.58) exhibited significant positive association however, significant negative correlation exhibited with germination only (-0.53).

4.11.3.8 Infection by *F. moniliforme*

F. moniliforme had a significant positive correlation with TGMR (0.68) and *C. lunata* (0.45) and significant negative correlation with germination (-0.82) and other fungi (-0.52) at Akola, however at Patancheru significant positive correlation was exhibited with TGMR (0.77) and *F. pallidoroseum* (0.49) and significant negative in germination (-0.76) and other fungi (-0.50).

4.11.3.9 Infection by *F. pallidoroseum*

F. pallidoroseum at Akola had exhibited significant negative correlation with TGMR (-0.41) and *C. lunata* (-0.40) and significant positive correlation with germination (0.28), however, at Patancheru germination (-0.19), other fungi (-0.18) and *C. lunata* (-0.17) exhibited negative correlation and TGMR (0.19) indicated positive correlation

4.11.3.10 Infection by *C. lunata*

C. lunata exhibited significant positive correlation with TGMR (0.73) and significant negative correlation with germination (-0.59) at Akola. Whereas, at Patancheru other fungi (0.23) and TGMR (0.19) exhibited positive but non significant and germination (-0.23) indicated non significant negative correlation.

4.11.3.11 Infection by other fungi

Other fungi had significant positive association with germination (0.56, 0.41) at Akola and Patancheru respectively. other fungi had a significant negative correlation with TGMR (-0.31) at Akola and non significant negative association (-0.24) at Patancheru.

4.11.3.12 TGMR

TGMR exhibited highly significant negative correlation with germination (-0.78) and (-0.83) at both the locations.

4.11.4 Correlation between biochemical characters

For biochemical characters viz. proteins, soluble sugars, tannins and flavan-4-ols were correlated with grain hardness and TGMR as dependent variable and results are presented in Table 72.

4.11.4.1 Protein

Protein exhibited significant positive correlation grain hardness (0.29), total sugars (0.27), non significant negative correlation with flavan-4-ols (-0.15). Correlation with the remaining characters could not be established.

4.11.4.2 Soluble sugars

Total sugars exhibited significant positive correlation with tannins (0.35) and grain hardness (0.26), significant negative association with TGMR (-0.26) and non-significant positive with flavan-4-ols (0.24).

4.11.4.3 Tannins

Tannins exhibited highly significant positive correlation (0.73) with flavan-4-ols, however grain hardness (-0.37) and TGMR (-0.75) exhibited significant negative correlation.

4.11.4.4 Flavan-4-ols

Flavan-4-ols was found to be negatively associated with grain hardness (-0.59) and TGMR (-0.78).

4.11.4.5 Grain hardness

Grain hardness had a significant positive correlation with TGMR.

4.11.5 Correlation between protein fractions and physical characters

Correlation between six protein fractions viz. Albumin and globulin. prolamin, cross-link prolamin, glutelin like, glutelin. and residues with physical characters viz. mesocarp thickness, endosperm texture, germination and grain hardness were correlated and the results are presented in Table 73.

4.11.5.1 Albumin and globulin.

Out of nine characters only two characters viz. prolamin (0.55) and cross link prolamin (0.36) exhibited significant positive correlation. whereas. three characters viz. glutelin-like (-0.73), glutelin (-0.73) and endosperm texture (-0.45) indicated significant negative correlation other characters recorded positive and negative non-significant association with albumin and globulin.

4.11.5.2 Prolamin

Prolamin had a highly significant correlation with cross-link prolamin (0.64) and grain hardness (0.63), however significant negative association were exhibited in endosperm texture (-0.73), glutelin like (-0.69), germination (-0.69) and glutelin (-0.66). Other two characters viz. mesocarp thickness (0.35) and residues (0.34) recorded positive non significant association.

4.11.5.3 Cross-link prolamin

Cross-link prolamin exhibited significant positive correlation with grain hardness (0.63) and mesocarp thickness (0.42). However, four characters viz. germination (-0.60), glutelin (-0.59), glutelin-like (-0.58) and endosperm texture (-0.57) exhibited significant negative association. Residues (0.11) exhibited positive but non-significant association.

4.11.5.4 Glutelin-like

Gluletin-like had a significant positive association with glutelin (0.72). endosperm texture (0.62) and germination (0.57). whereas, with grain hardness had a significant negative correlation (-0.47). Mesocarp thickness (-0.20) and residues (-0.18) also reported negative association but non-significant.

4.11.5.5 Glutelin

Glutelin exhibited significant and positive correlation with germination (0.56) and endosperm texture (0.52), whereas, negative significant correlation with grain hardness (-0.42). Mesocarp thickness (-0.34) and residues (-0.07) also reported statistically non significant negative association.

4.11.5.6 Residues

All the characters associated with residues exhibited non-significant positive and negative association. Highest negative association was recorded with germination (-0.32).

4.11.5.7 Mesocarp thickness

Mesocarp thickness exhibited positive and negative significant association with grain hardness (0.41) and germination (-0.48) respectively. Endosperm texture recorded negative association (-0.33) but non-significant.

4.11.5.8 Seed germination

Seed germination exhibited significant negative (-0.38) association with grain hardness.

CHAPTER – V

DISCUSSION

PAGES : 129 - 144

CHAPTER V
DISCUSSION

Parental diversity

Genetic divergence of parental lines is an important pre-requisite for obtaining desirable segregants in the progenies. Three red resistant, five white elite and two white susceptible parental lines of sorghum selected for the study provided sufficient variability for various quantitative traits. The analysis of variance also exhibited significant variation for all the characters except infection by *F. pallidoroseum* and other fungi under study which is indicative of their genetic diversity.

Combining ability effects

Combining ability is necessary in selection of appropriate parents in hybridization. Since, it gives an idea whether a particular parents combines well in a cross and also denotes specific performance of cross combination against the expectations from the general combining ability of parents.

The results (Table 74) revealed that none of the parental lines was a good general combiner for all the traits under study. However, IS-9471 had desirable gca for nine (F_1) and three (F_2) characters. This line could transmit higher grain hardness, corneous endosperm texture, lower plant height, more glume covering, low fungal infection by *F. pallidoroseum*, more proteins, more soluble sugars, more tannins and more flavan-4-ols in F_1 crosses and whereas, more grain hardness, lower plant height and low fungal infection by of *F. moniliforme* in F_2 progenies. Similarly parental lines SPV-1201, IS-6335, GJ-35-15-15 and IS-2284 transmitted favourable genes for various traits to F_1 crosses and F_2 progenies notable among these are the increased grain hardness, corneous endosperm texture, tannins, flavan-4-ols and reduced infection by *F. moniliforme* and *F. pallidoroseum*. In general transmission of traits in F_1 crosses was more pronounced than those in F_2 progenies.

The results indicated that the first five parents IS-9471, SPV-1201, IS-6335, GJ-35-15-15 and IS-2284 can be categorised as good general combiners for various physical and biochemical characters. Since higher general combining effects correspond with additive and for additive to additive interaction (Griffings, 1956b) and represent the fixable genetic components of variation, these parental lines appear to be worthy of exploitation in a recombination breeding program.

Specific combining ability effects is the indicative of heterosis and also the dominance and epistatic gene action. Denis and Girard (1977) reported loss in viability to be so important part of the grain mold syndrome, that they recommend a germination test as a part of standard evaluation for identification of grain mold resistance.

First cross AKms-14B x IS-6335 exhibited significant sca effects for germination per cent in both F_1 and F_2 diallel progenies. The same cross exhibited significant desirable sca effects for other component characters viz., 100-grain weight, electrical conductivity, days to 50% flowering, mesocrp thickness, TGMR, *F. moniliforme*, protein, tannins, and flavan-4-ols in F_1 diallel, and electrical conductivity and TGMR in F_2 diallel (Table 75). Significant sca effects on germination both in F_1 and F_2 diallel progenies of other crosses were also noted. In addition, significant sca effects were recorded for other important grain mold resistance components, such as TGMR, grain hardness, endosperm texture, infection by *F. moniliforme*, and *F. pallidoroseum*.

Among the 10 specific combinations (Table 75) first, second and ninth were most desirable, since these had significant positive sca effects for germination in both F_1 and F_2 progenies. Of the parental lines involved in above three crosses, IS-6335 IS-9471, and SPV-1201 were identified as good general combiners. Therefore one can expect good segregants in further generation from these crosses. It can therefore, be suggested that biparental mating among the segregants of these crosses may be attempted to evolve line with better grain mold tolerance.

Gene action governing inheritance of characters

The gca and sca variances for the traits studied indicate the gene action associated with them. Knowledge gained on the relative magnitude of various types of gene actions is useful in deciding the most appropriate breeding procedures.

In the present investigation the variance due to gca were larger than that of sca for the characters, like 100-grain weight, endosperm texture, tannins and flavan-4-ols in F_1 progenies, and for cob length, TGMR, and infection by *F. moniliforme* and *C. lunata* both in F_1 and F_2 progenies. Therefore, additive gene action was more predominant for these characters. Ghorade (1995) reported the role of additive gene effects for 100-grain weight.

)abholkar and Baghel (1982) reported similar results for tannin content. Karale *et al.*, (1984) ɜported similar results for cob length. No literature is available on inheritance of TGMR.)abholkar and Baghel (1980). Narayana and Prasad (1983), Kataria *et al.* (1990) reported milar results for infection by *Fusarium* and *Curvularia*.

For grain hardness and glume covering both gca and sca estimates were gnificant. Their ratio of more than 1 demonstrated preponderance of additive type gene tion in F_1 diallel. In F_2 diallel, though both estimates were significant, the ratio of gca/δ^2sca works out to be less than 1 indicating predominance of more non-additive gene tion. The role of additive gene action for these traits have been reported by Ghorade (1995) d the role of additive gene action for grain hardness was reported by Rana et al. (1978).

In case of plant height lower ratio of δ^2gca/δ^2sca indicated non-additive gene ion in F_1 diallel. These results are similar to those of Nimabalkar and Bapat (1987) and ger *et al.* (1988). The higher ratio of δ^2gca/δ^2sca indicated predominance of additive gene ion in controlling plant height in F_2 progenies. These findings were in confirmation with the ervation of Patil and Thombre (1986) and Shekar *et al.* (1987).

The results obtained for electrical conductivity and other fungi fungal load were ilar to those of plant height, which is supported by Ghorade (1995) for F_2 diallel, but tradictory to F_1 diallel.

For days to 50% flowering, mesocarp thickness, proteins and soluble sugars, in liallel, though both the estimates were significant, the ratio of δ^2gca/δ^2sca works out to be than 1 indicating non-additive gene action. These results are in agreement with Kanaka ;2) and Huger *et al.* (1988). For germination and infection by *F. pallidoroseum* though the estimates were significant, the ratio of δ^2gca/δ^2sca comes out to be less than unity in F_1 F_2 diallel progenies, indicating predominance of non-additive gene action. Contradictory ts were reported by Ghorade (1995) for germination and for *F. pallidoroseum* no ıture is available.

In the present investigation, it could be concluded that gca variance were ›minant for most of the characters studied, i.e., 100-grain weight, grain hardness, ıperm texture, cob length, glume covering, TGMR, *F. moniliforme*, *C. lunata*, tannins lavan-4-ols. However, sca variance was predominant for electrical conductivity, days to flowering, mesocarp thickness, germination, *F. pallidoroseum*, proteins and soluble sugars. Studies on gene action governing inheritance of endosperm texture, flavan-4-ols and TGMR have been made for the first time, and thus these are new information.

Heterosis

In the present investigation, of the several agronomic, physical and bio-chemical parameters studied, desirable significant heterosis and heterobolities were observed for 100-grain weight, electrical conductivity, DTF, plant height, cob-length, mesocarp thickness, TGMR, seed germination, infection by *F. moniliforme*, *F. pallidoroseum*, *C. lunata*, tannins and flavan-4-ols (Tables 12-17). These parameters can significantly contribute towards reducing or preventing infection and colonization by mold fungi. Similar results were reported by Kanaka (1982) for 100-grain weight; Ghorade (1995) for electrical conductivity and seed germination, Quinby (1963), Goyal and Joshi (1976) and Saradaman (1981) for cob-length; Naryana and Prasad (1983) and Ghorade (1995) for fungal load.

Biochemical characters

For proteins and soluble sugars none of the crosses exhibited significant desirable heterosis or heterobeltiosis, however, for tannins significant heterosis exhibited from 2.38 to 38.64%, whereas for flavan-4-ols the range for heterosis was from 5.67 to 52.10% and for heterobeltiosis 26.45 to 48.37%. From the data of heterosis and heterobeltiosis for seed germination, it is observed that crosses with high magnitude of heterosis or heterobeltiosis have not necessarily showed better *per se* performance or vice-versa. Hence the selection of superior crosses should necessarily be based not only on magnitude of heterosis but also on actual performance of crosses for germination so that appropriate selection can be made without errors.

On the basis of their *per se* performance for germination and the extent of heterosis and heterobeltiosis, it is concluded that out of 10 crosses, first four crosses i.e. ICSB-101B x IS-2284, ICSB-101 B x IS-6335, ICSB-101B x IS-9471 and SPV-1201 x IS-2284 could be stated as a desirable ones for mold resistance breeding. These crosses need to be exploited in further generations for isolating mold resistance lines

Physical characters

Hundred-grain weight of kernels was less in all the entries tested at Patancheru during 1996 under controlled conditions. Over all 86.25% increase in *F. moniliforme* load was recorded at Patancheru over Akola in the same year. Bhatnagar (1971), Gray *et al.* (1971) and Mathur *et*

. (1975) reported that *F. moniliforme* and *C. lunata* interfere with carbohydrate translocation developing kernels causing reduction in size and weight of seed. Similar results were also ported by Glueck and Rooney (1976), Castor (1977), Castor and Frederiksen (1980), Singh d Agrawal (1989) and Somani (1992). Seventy per cent loss in grain weight was reported by ay *et al.* (1971) in central Kentucky USA. Sundaram *et al.* (1972) reported losses up to 50% e to head molds in hybrid sorghum in experimental plots at Coimbatore. Glueck and Rooney 976) reported test weight loss from 62.2 lb/bu to 47.3 lb/bu under severe weathering nditions at College Station, Texas. Singh and Agrawal (1989) reported that sorghum seed ected with *C. lunata*, *F. moniliforme* and *Phoma sorghina* reduced 100-grain weight by 69, and 40%, respectively. Significant specific combining ability for 100-grain weight was ticed in two F_1 crosses (AKms-14B × IS-6335 and SPV-1201 × SRT-26B), as well nificant heterosis for grain weight in two crosses (AKms-14B × IS-6335 and SRT-26B × 6335) out of 10 superior F_1 crosses. Gene action in F_1 diallel was additive for 100-grain ight.

Rana *et al.* (1984), Bandyopadhyay (1988), Stenhouse *et al.* (1990) Reddy *et* (1991), Jambunathan *et al.* (1992) and Kumari *et al.* (1992) reported that in white-grained ghums hardness contribute to resistance. Hardness was measured by force required to ak the grain. From the present studies it is observed that, parent SPV-1201 exhibited ximum grain hardness followed by GJ-35-15-15 and ICSB-101 B at both the locations. ereas, cross SPV-1201 x GJ-35-15-15 exhibited highest grain hardness i.e. 7.85 and 7.43 kg ^{2} and (Av. 7.64 kg/cm^2) at Akola and Patancheru, respectively. Colored parental lines and sses having more floury endosperm were brittle and required less breaking strength. Over less grain hardness was recorded at Patancheru than at Akola during1996, indicating that, trolled conditions cause more deterioration of grain than natural infection. Jambunathan *et* (1992) reported higher grain hardness in grain grown in post rainy season than in grain vn in rainy season. Mukuru (1992), Jambunathan *et al.* (1992) and Somani (1992) also ted that mold resistance in white grain advanced selections was associated with grain lness, whereas, resistance in red-grain types was associated with flavan-4-ols and grain lness. The present results are in confirmation of these results. Grain hardness is governed dditive and non-additive gene action in F_1 and F_2 diallel, respectively.

In the present investigation among 45 crosses eight crosses exhibited corneous endosperm six-crosses exhibited floury endosperm and 31 crosses indicated intermediate (Table 5) Clark *et al* (1973) and Ellis (1972) noticed that corneous endosperm characteristic is not necessary for resistance to weathering however if all other things were equal a line with more corneous grain would resists deterioration more than would a floury endosperm line because of more dense structure and organization Glueck *et al* (1977) and Glueck and Rooney (1980) noticed that grain with more corneous endosperm were more likely to resist deterioration than floury endosperm lines Similar results were reported by Garud (1992) and Somani (1992) Significant specific combining ability was noticed in F_1 diallel in only one cross (IS-2284 IS-6335) out of 10 and this character is governed by additive gene action in F_1 diallel

Seventeen of the 45 crosses exhibited electrical conductivity less than 150 dSm^{-1} and six between 150 and 200 dSm and 22 more than 200 dSm-1 Electrical conductivity on higher sides was recorded at Patancheru than at Akola this might be due to more electrolytes leakage because of more deterioration under controlled conditions at Patancheru Measuring of seed leachates and correlation with germination could become an efficient techniques for studying the effects of grain mold severity on seed viability (Forbes 1986) Glueck and Rooney (1980) reported that cultivars with thick mesocarp and floury endosperm texture increased water absorption and richer leachates Somani (1992) noticed that the electrical conductivity of seed leachates was more in susceptible cultivars Crosses ICSB-101B IS-2284 ICSB-101B IS-6335 and ICSB-101B IS-9471 selected on the basis of germination indicated lower electrical conductivity Electrical conductivity is governed by non-additive and additive gene action in F_1 and F_2 diallel respectively

Glumes appear to be plants first defense against fungal invasion and colonization (Waniska *et al* 1992) But it was also reported that even on completely covered but not compact glumes, mold development was noticed (Somani 1992) It was also reported that except *F moniliforme* infection of other fungi takes place from uncovered portion of kernels by glumes Murty (1975) noticed *Curvularia* infection on a portion of seed not covered by glume and concluded that open head with seed completely enclosed in long papery glumes are relatively resistant to field deterioration Gangadharan *et al* (1978) noticed similar observation and concluded that fully enclosed grain by glume and loose heads are the factors associated with resistance. Glueck and Rooney (1980) and Somani (1992) reported similar results. Mansuetus *et al.* (1988) showed that disease incidence was negatively associated with glume cover (r = -0.56) and glume length (r =-0.56). Pigmentation in the pericarp and glume may impart some degree of resistance (Waniska *et al.*, 1992). Sorghum contains polyphenols (tannins) in colored pericarp and tannins are deterrents to mold Harris and Burns (1973). In the present study, 11 F_1 crosses showed more than 50% glume covering at Akola, and 21 F_1 crosses at Patancheru. More glume covering was noticed in three crosses of the 10 crosses (Table 77) which exhibited resistant reaction to mold. This character is governed by additive and non-additive gene action in F_1 and F_2, diallel respectively.

With regards to mesocarp thickness, 15 out of 45 crosses at both locations exhibited less than 50 μm thickness (thin). Thin mesocarp is considered as resistant trait for grain mold. The mesocarp is thin when the gene is dominant (Z-) and thick when the gene is recessive (zz). Ten out of 10 crosses based on germination and grain mold resistance recorded less than 50 μm mesocarp thickness (Table 77). Glueck and Rooney (1980) reported similar results, and stated further that thin mesocarp sorghum withstand weathering better than those with thick mesocarp, thick mesocarp contains starch and protein which support more fungal colonies than thin mesocarp. Castor (1981) provided additional evidence that infection takes place by relatively few species of fungi during anthesis . Also a number of different tissues appear to be involved in resistance to colonization. Since the infection takes place at such an early stage, the presence or absence of testa has little effect on initial colonization. His work substantiate the fact that mesocarp provide an ideal environment for early colonization. Miller (1981) reported similar results. This trait is governed by non additive gene action in F_1 diallel.

Visual appraisal has been the most common means of quantifying grain mold to date. Visual appraisal involves a complex of factors and can estimate severity, incidence and damage, depending upon the method of assessment. Visual assessment, obviously the quickest and easiest method of disease assessment, is used for screening large number of samples (Bandyopadhyay and Mughogho, 1988 a). According to Frederiksen *et al.* (1982) comparing threshed grain is the most accurate method of visual assessment of grain mold. Hence TGMR is an important character for evaluation of crosses, less TGMR is considered as favourable for grain mold resistance. As TGMR grade exhibited significant positive association with different types of fungal load indicated that low TGMR grade is favourable. Forbes (1986) reported

›sitive associations with visual assessment as percentage of kernels moldy (r = 0.98) with ›lony forming with of *F. moniliforme*. Additive gene action was exhibited for this trait in F_1 ıd F_2 diallel.

Poor seed germination is positively correlated with infection level by mold ngi. There was 86.26% more load of *F. moniliforme* and 165.27% more load of *F. ıllidoroseum* at Patancheru over Akola in F_1, that may have resulted in lower germination. owever, 108.95% more *C. lunata* load was recorded at Akola over Patancheru. Germination considered desirable character for mold resistance. Denis and Girard (1977) and Castor and ederiksen (1980) recommended germination test as a part of standard evaluation for entification of grain mold resistance. Many fungi were reported responsible for loss in rmination Tarr (1962) reported *Aspergillus, Fusarium* and *Rhizoctonia* spp. were sponsible for poor emergence of sorghum seedlings, since these fungi destroy starchy ıdosperm of seed and thus deprive young seedling of its food. Tripathi (1974) reported, duced germination by (42%) due to *Colletotrichum graminicola* followed by *C. lunata* 0%), *F. moniliforme* (37%) and *Phoma insidiosa* (26%) . Mathur *et al.* (1975) reported aximum *F. moniliforme* and *F. semitectum* form 70 samples collected from U.P., Gujrat and ıjasthan (northern India). *F. moniliforme* affected both germination and seedling growth ıd was mainly observed in embryos. Castor (1975) reported maximum *Fusarium* and *ırvularia* as a principal pathogens and caused discoloration and reduction in viability of rghum seed.

Dayan and Dalmacio (1982) reported *F. moniliforme* and *C. lunata* as most edominant fungi invading embryo and endosperm thereby reduced seed viability in ıilippines. Wu (1983) isolated 16 genera of which *F. moniliforme* was most prominent gether with *C. lunata* in Taiwan. Granja and Zambolim (1984) reported low germination in rghum due to *F. moniliforme*. Deshmukh (1989) noticed that *C. lunata* , *F. moniliforme* and *serohilum halodes* caused considerable reduction in germination from Vidarbha. Since these ngi destroy starchy endosperm of seed and thus deprive young seedling of its food. In the esent investigation better heterotic crosses for germination showing heterosis and terobeltiosis for other components were: ICSB-101B × IS-2284, ICSB-101B × IS-6335, SB-101B × IS-9471, SPV-1201 × IS-2284, AKms-14B × IS-6335, GJ-35-15-15 × IS-6335, RT-26B × IS 9471, IS-2284 × IS-9471, SRT-26B × IS-6335 and SPV-104 × IS-6335, which xhibited 81.75 to 90.00% germination. The significant heterosis exhibited for other omponents characters were electrical conductivity, mesocarp thickness, TGMR, *F. oniliforme*, *C. lunata*, *F. pallidoroseum*, tannins and flavan-4-ols contributed towards mold sistance in above crosses (Table 77). Germination is governed by non-additive gene action in $_1$ and F_2 diallel.

Based on *F. pallidoroseum* infestation at two locations it appears that *F. allidoroseum* is comparatively of minor importance in grain mold at Akola, whereas, it is an nportant mold fungus next to *C. lunata* at Patancheru. This variation possibility might be due variations in the ecological conditions. Only one cross ICSB-101B × IS-2284 out of 10 lected on basis of germination exhibited significant heterosis for this trait. This character is overned by non-additive gene action in both F_1 and F_2 diallel.

C. lunata is another major fungus associated with grain mold. It is number one ingus in some parts, causing reduction in weight, germination and viability (Bhatnagar, 971; Mathur *et al.*, 1967, Tripathi, 1974; and Khare *et al.*, 1976). *C. lunata* has been found nportant also in Taiwan (Wu and Cheng, 1990), Thailand (Boon-Long, 1992) and also from fferent parts of India (Bhale and Khare, 1982; Deshmukh, 1989; Somani, 1992). At Akola 39 ıt of 45 crosses recorded more than 31% *Curvularia* load. However, at Patancheru 35 out of 5 crosses recorded 16-30% *C. lunata* load and over all, there was 108.95% increase at kola over Patancheru. Significant heterosis was recorded in cross SRT-26 × IS-6335 and terobeltiosis in five crosses (ICSB-101B × IS-6335, ICSB-101B × IS-9471, GJ-35-15-15 × -6335, SRT-26B × IS-9471 and SRT-26B × IS-6335) of the 10 crosses selected on basis of rmination in F_1 diallel. This character is governed by additive gene action in F_1 and F_2 allel.

The protein content of the parental lines ranged in between 8.93 and 12.94% ıd those of 45, F_1 crosses, it ranged between 5.23 and 10.56%. The cultivars presently under ide cultivation are medium hard with moderate protein content. The results obtained are in ncurrence with those of Desai *et al.*, (1992) and Somani (1992). In the present studies, a gnificant specific combining ability (sca) was noticed in three F_1 crosses viz., Akms-14B × -6335, SPV-104 × IS-2284 and SPV-104 × IS-6335. It is also revealed that this specific nstituent is governed by non additive gene inheritance in F_1 diallel.

In this investigation soluble sugars content varied form 1.20 to 2.30% in ents and 0.80 to 1.80% in F_1 crosses. Only one cross SPV-104 x IS-6335 exhibited iificant heterotic effects. It is also concluded that this trait is controlled by non additive e. Glueck *et al.,* (1997) reported that in deteriorated grains, soluble carbohydrates are ally decreased as they are used to provide energy for the growth and development of fungi. the contrary Somani (1992) opined that due to enzymolysis soluble sugars increased in 'dy grains.

In the present investigation the TGMR was 1.75 to 2.50 in colored grain that gest the tannin is deterrent to molding fungi and these observations confirm the findings of ier workers (Ellis, 1972; Murty, 1975; Glueck and Rooney, 1980; Rooney and Miller, 1; Hahn et al., 1984; Bandyopadhyay, 1988; Mansuetus, 1990). Nine of the 10 crosses cted for higher germination (Table 77) exhibited significant heterosis for tannin or flavan-4- or both. These characters is governed by additive gene inheritance in F_1 diallel.

Hagerman and Butler (1981) noticed tannin associated protein consist of three or components, two of which are high molecular weight prolamin and one of these was e rich in proline. Guiragossian *et al.,* (1978) noticed that mutation in P-721 sorghum eased quality of kafirin (prolamin) with and increased albumin and globulin. It suggest the prolamin is inversely correlate with albumin and globulin. Similar trend was noticed in present studies also Subramanian *et al.*, (1990). Similar observations have been noticed for t of crosses in present investigation. However, the percentage of this fraction was on quite ıer side i.e. 65.16% in IS-9471 whereas, it was bit less in other colored grain parents.

Prolamin content was maximum in AKms-14B followed by SPV-1201 and GJ-15-15 whereas, crosslink prolamin was maximum in SPV-104 followed by SPV-946 and 35-15-15. All these parental lines have white grain. It is interesting to note that prolamin crosslink prolamin were on quite lower side in all colored grain parental lines and hence stance to grain mold in colored grain cultivars can be attributed to tannins and flavan-4-ols er than grain hardness. Similar trend was noticed in F_1 crosses where colored grained ntal line was used and gene for colored testa was dominant. These finding are in ıissance with those of (Gluck and Rooney 1980; Bandyopadhyay 1986; Jambunathan 1986; uru 1992). In white grained sorghum the prolamin and cross-like prolamin were on higher in SPV-946, SPV-104 and AKms-14B all these parental lines have more breaking strength e by indicating that the endosperm is vitreous and prolamin and cross link prolamin ributes for vitreousness. Clark *et al.*, 1973; Ellis 1972, Somani 1992) noticed five to six ; dense layer beneath the aleurone layer was present in tolerant to resistant cultivars. nari and Chandrashekar to had similar observations and reported that, prolamin and cross- prolamin are more in the dense layer which contributed to resist deterioration by grain d. The present results are with tolerant cultivars are in concurrence with the results of ve workers. However, the mold in SPV-104 and AKms-14B was more even though the amin and cross prolamin content are high, this might be due to higher mesocarp thickness hence the infestation was more but restricted mere to pericarp only.

In F_1 crosses prolamin and cross link prolamin content was increased where, in ot parent from white grain had more prolamin and cross link prolamin suggesting that gene his particular traits is dominant.

ct of pre-treatment

rall, there was significant increase in germination in pre-treated over untreated control in ntal lines, F_1 crosses and F_2 progenies at Akola and Patancheru grown during 1996 and ntal lines and F_1 crosses of two seasons at Akola grown during 1995,1996. There was ease in germination at Akola over Patancheru during 1996. There was significant reduction *F. moniliforme* load at both locations in pre-treated seeds over untreated control, however all, there were 86.26 and 28.32% increase in *F. moniliforme* infection at Patancheru over la in F_1 and F_2 diallel, respectively. These results are in concurrence with results of other kers (Bhagwat and Datar, 1974; Mathur *et al.*, 1975; Castor and Frederiksen, 1981; vasekaran, 1983; Granja and Zambolim, 1984; Wu, 1983). The variation between two ons at Akola was due to infection of seed due to *F. moniliforme* at the time of anthesis use of continuous rains (Somani 1992). For *F. pallidoroseum* there was a significant ease in load in pre-treated over control whereas, there was an increase of 165.27 and 6% at Patancheru over Akola in F_1 and F_2 diallel on germinated seed. However, two ons Akola 1996 recorded more load over Akola 1995 season.

Significant reduction in ungerminated seed was noticed in pre-treated seed over eated control at both locations and both seasons at Akola. There was significant reduction ingal load of *F. moniliforme* and *F. pallidoroseum*: in F_1 and F_2 progenies, however for *C.*

lunata there was increase in load was recorded in F_1 crosses at Patancheru. This might be due to more superficial infestation of *C. lunata* at Akola under natural condition, whereas due to deep seated infestation the pre-treatment did not revealed any effect on *C. lunata* at Patancheru.

Histopathology

From the infection and colonization studies it was seen that the Fusarial penetration (both species) usually take place from hilar end and no pericarpal infection was observed. Curvularial infection however, is usually through both kernel ends i.e. stylar and hilar as well directly though the pericarp wall. These findings are similar with those of Castor (1977) and Castor and Frederiksen (1980). Inoculations at anthesis has shown development of Fusaria in developing kernels in all the parts of spikelets and denser growth around the ovary base and progress acropetally between aleurone layer and pericarp subsequently endosperm, embryonic tissue. For *C. lunata* infection was observed on ovary wall, pericarp, endosperm and embryonic tissue. Similar observations were recorded by Forbes (1986) and Bandyopadhyay (1986).

Correlation studies

The knowledge of association of different grain mold contributing components is of significant importance in grain mold resistance breeding programme. This study provides reliable information on nature, extent and effectivity of selection. The simple correlation studies between fungal load of untreated and pre-treated, germinated and ungerminated seeds and contribution of physical and biochemical characters if any, towards resistance have been studied in the present investigation since many researchers had putforth different physical and biochemical characters contributing towards grain mold resistance. The available literature however, revealed that no appropriate correlation between various factors for mechanism and genetics of grain mold resistant had been established.

Germinated seed (untreated) has shown negative association with *F. moniliforme*, *C. lunata*, score (GS) and TGMR at Akola location, indicating that with the low fungal load of above fungi there was increased germination and reduced TGMR. Whereas, at Patancheru, fungal load (GS) had significant positive association thereby indicating that, fungal load has no positive effect on germination. However, ungerminated seed had positive correlation with fungal load of all fungi and score, indicating that on ungerminated seed the ıgal load of *F. moniliforme* and *C. lunata* was more that ultimately might have reduced the rmination and increased the TGMR. Wu and Cheng (1990) reported similar results for *C. ıata*, *F. moniliforme* and some other fungi.

Positive significant correlation was establish between *F. moniliforme* (GS) and *lunata* (GS) with TGMR at Akola. Forbes *et al.* (1989) too established similar correlation regards to *F. moniliforme* only. However, at Patancheru negative significant association of th the fungi with TGMR was noticed. This might be due to continuous congenial condition · infection by moldy fungi. Significant association between molding fungi and TGMR was ticed in ungerminated seed, it proved that with increasing fungal load there is decrease in :mination and increase in TGMR. Similar observation have been made by Bhatnagar)71), Tripathi (1974), Castor (1977), Rao and Williams (1977), Castor and Frederiksen)80), Vidyasekaran (1982) and Forbes (1986).

Correlation studies of fungal load on germinated and ungerminated (treated) :d revealed that, germinated seed had significant negative correlation with *F. moniliforme* S), *F. pallidoroseum* (GS) *C. lunata* (GS), other fungi (GS), and TGMR at Akola that, licates that with the minimum load of these fungi there is improvement in seed germination. ıwever, significant positive association exhibited with germinated (treated) seed and *F. ɒniliforme*, *F. pallidoroseum*, *C. lunata* and other fungi at Patancheru revealing that the :sence of molding fungi did not effect seed germination. It indicates that, there is no effect pre-treatment of seed in impairing germination since controlled conditions at Patancheru ulted in total loss of viability. All molding fungi on germinated seed increased score and ·reased TGMR at both the locations. Fungal load on ungerminated seed had a significant ociation with all fungi, score and TGMR at both the locations indicating that, presence of ıre fungal load reduces germination, increase score and TGMR. Forbes *et al.*, (1989) also ɒorted similar results but for *F. moniliforme* and TGMR.

ırrelation between physical characters

ndred grain weight has shown positive correlation with days to 50% flowering at Akola. nilar results were also reported by Patil *et al.* (1980) and Patil and Thombre (1985). wever, no correlation studies between grain hardness and mold contributing characters viz. losperm texture, electrical conductivity, days to 50% flowering, glume covering, mesocarp ıess. fungal load of different fungi, disease severity and seed germination has been ed so far. The present studies tried to correlate these factors.

As anticipated the endosperm texture has negative significant correlation with hardness, because the grain hardness is usually exhibited by vitreous endosperm. Similar vation was also reported by Maxson *et al.* (1971). As regards to correlation with ıcal conductivity, it is observed that there was positive correlation at one location, where ıing was done under natural conditions, even when there was good mold development, ver, a negative correlation was established at another location i.e., Patancheru which be due to totally controlled conditions i.e., due to providing more favourable condition fection, establishment and deterioration by molding fungi at Patancheru.

Grain hardness exhibited significant positive correlation at both locations with indicating that late maturing crosses escape mold attack and exhibited more grain ess. Grain hardness has shown significant positive correlation with germination at cheru, thereby confirm the finding of Ghorade (1995). As regard to endosperm texture, increasing corneousness of endosperm there is decrease in electrical conductivity, rity period, mesocarp thickness, *F. moniliforme, C. lunata* , TGMR and germination. :k *et al.* (1977), Glueck and Rooney (1980), Garud (1992), Kumari *et al.* (1992) and ıni (1992) recorded similar observation for TGMR.

As regard to electrical conductivity, with the increased maturity period, carp thickness, *F. moniliforme, C. lunata* load and TGMR there was increase in electrical uctivity. Whereas, fully covered grain, other fungi and germination exhibited negative ;iation with electrical conductivity. Glueck and Rooney (1980) reported similar rvation for mesocarp thickness. Forbes (1989) reported similar observations for *F. liforme*, TGMR and germination while Ghorade (1995) reported similar trend for ination, *F. moniliforme* and *C. lunata* . As regard to glume covering, increase in glume ring decrease fungal load of all fungi and TGMR and increase in germination was ed. Similar observations were made by Murty (1975) Gangadharan *et al.* (1978), Glueck Rooney (1980), Mansuetus (1988) and Somani (1992) for TGMR; and Narayana and ıd (1980) for TGMR. With the increase mesocarp thickness there is increase in fungal of *F. moniliforme, C. lunata* and TGMR and decrease germination. Glueck and Rooney 0), Castor (1981) and Miller (1981) also reported similar observations.

Increase in fungal load of *F. moniliforme* increases TGMR and seed nation at both locations. These results are in accordance with those of Rao and Williams), Denis and Girard (1977), Vidyasekaran (1983), Forbes (1986), Deshmukh (1989) for R and germination. With the increase in fungal load of *C. lunata, there is* increase in R and decrease in germination. Similar observations were reported by Tripathi (1974) ao and Williams (1977).

elation between biochemical characters

ns exhibited positive significant correlation with flavan-4-ols indicating that, with the ise in tannins there is corresponding rise in flavan-4-ols. However, tannins and flavan-4- id negative significant correlation with grain hardness and TGMR indicating that grain iess is not an important contributing character for grain mold resistance if tannins and 1-4-ols are present. However, tannins and flavan-4-ols are highly correlated with mold ance (Mukuru, 1992).

In the present investigation grain hardness and soluble sugars are significantly ive correlated with protein, it indicates that increase in grain hardness is correlated with ase in protein and it might be due to some protein fractions contributing towards hardness.

Tannin is commonly present in the pigmented pericarp and testa layer in ium. Condensed tannin are formed by polymerisation of molecular units, of flavanoids as flavan-3-ols (catechin) and flavan-3,4-diols (leucoanthocyanidins). Flavan-3-ols give o anthocyanidins Swain and Bate-Smith (1962), Harris (1969), Weinges *et al.* (1969) and erson and Butler (1983), Ellis (1972), Harris and Burns (1973), Murty (1975) and unathan *et al.* (1986) reported that sorghum seed tannin content is strongly and negatively lated with seed molding indices.

The present study confirms the finding of above researchers that flavan-4-ols detected only in coloured grained crosses, and mold infestation was also less and there by ins exhibited positive significant correlation with flavan-4-ols and mold resistance. uru (1992) also reported similar finding.

relation between protein fractions and physical characters

indicated from the present study that albumin and globulin has shown significant positive elation with prolamin and cross-link prolamin, however, highly negative significant ciation was established with glutelin, glutelin-like, endosperm texture and germination.

Kumari *et al.* (1992) noticed intense deposition of protein in hard grain than in in. Indira *et al.* (1991) and Kumari and Chandrashekar (1992) reported that prolamin is ›ntributing to hardness of grain and corneousness (vitreous) endosperm contains higher ın and such grains are less deteriorated due to grain mold fungi. Glueck and Rooney Mukuru (1982), Bandyopadhyay (1988) and Somani (1992) noticed that non pigment npact cell layer beneath the aleurone layer was present in resistant cultivars. Kumari *et* ›92) noticed more prolamin in these 5-6 compact layer. Similarly Abdelrahman and y (1984) reported role of cross-link prolamin in grain mold resistance.

It is observed from the present study that glutelin-like and glutelin has ;ant positive correlation with endosperm texture and germination and negative ;ant association with grain hardness. It is seen that with more floury endosperm, there is on in grain hardness and increase in germination.

CHAPTER – VI

SUMMARY

PAGES : 145 - 151

CHAPTER VI

SUMMARY

Grain mold is a major production constraint of early maturing, high yielding sorghum cultivars, in Vidarbha region of Maharashtra There are number of fungal species involved in the grain mold complex, but the important pathogenic fungi are: *Fusarium moniliforme*, *F. pallidoroseum*, and *C lunata*

The present investigation was carried out to determine the mechanism of host resistance, including physical, agronomic and biochemical parameters, and understand genetics and heritability of various parameters imparting resistance to grain mold in selected sorghum lines.

For incorporation of mold resistance into elite material of good grain quality, following aspects were investigated after performing 10 x 10 diallel, excluding reciprocals, viz., amount of heterosis and heterobeltiosis, the general and specific combing ability for selection of potential parents and crosses. and to ascertain the inheritance of some important quantitative (physical, biochemical) characters associated with grain mold resistance

The experimental material was selected from germplasm collection of Sorghum Research Unit, Dr. PDKV, Akola and ICRISAT, Patancheru, India, comprised of 10 parental lines, SPV-1201, ICSB-101B, SPV-946, GJ-35-15-15, SRT-26B, (elite), SPV-04, AKms-14B (susceptible), IS-2284, IS-6335 and IS-9471 (resistant), havingwide range of ariability. During the *Kharif* 1994-95 and 1995-96 these parents were crossed to make half iallel (excluding reciprocals) to obtain 45 crosses An experiment was conducted during *harif* 1995 at Akola (10 parents + 45 crosses) to study the mold reaction under natural ondition besides agronomic traits, plant characters and to obtain F_1 seed. Another periments was carried out during *Kharif* 1996 at both locations, Akola under natural nditions and at Patancheru under controlled condition using 10 parents, 45 F_1 crosses and F_2 progenies in a randomize block design.

Data were recorded on plant height, days to 50% flowering, cob length, thresh in mold rating (TGMR), 100-grain weight, glume color, glume covering, grain hardness, losperm texture, pericarp/ mesocarp thickness, presence of testa layer and electrical ductivity of grain leachates. Biochemical characters, such as proteins, proteins fractions (albumin and globulin, prolamin, cross-link prolamin, glutelin-like, glutelin and residues) soluble sugars, tannins and flavan-4-ols were also studied.

Data were also recorded on grain infection and colonization by of *F. moniliforme*, *F. pallidoroseum*, *C. lunata* and other fungi, on pre-treated and untreated germinated and ungerminated seed of parents and F_1 grown at Akola, *Kharif* 1995 and parents, F_1 and F_2 grown both at Akola and Patancheru, *Kharif* 1996. Seed germination was recorded using Ragdoll's (rolled paper towel) method and standard blotter plate method of ISTA (1976). Observations were recorded on five plants from F_1 and 15 plants from F_2 progenies in each replication. Arithmetic averages of scores were used for further computation. Data were analysed as per Griffings (1956 b) method 2 model 1 as further extended by Singh (1973 a, 1973 b) and standard method suggested by Panse and Sukhatme (1954). The salient features of the results pertaining to mean performance, heterosis, combining ability, physical, agronomic, biochemical traits effect of pre-treatment on fungal load, histopathology of infection and correlation are summarized below :

Significant gca in positive direction for 100-grain weight indicated that parent -35-15-15 and sca for crosses, SPV-1201 × SRT-26B and AKms-14B × IS-6335 were having high value for this character along with superior performance for many other characters. Similarly for germination sca effects for crosses AKms-14B × IS-6335, AKms-3 × IS-9471 and SPV-1201 × SRT-26B were found to posses high germination percentage and were resistant to grain mold with many other grain mold resistance contributing factors in and F_2 diallel.

Heterosis and heterobeltiosis were studied for all the characters. The highest estimates of heterobeltiosis were up to 18.75% for 100-grain weight, 5.49% for grain hardness, -19.63% for endosperm texture, -80.89% for electrical conductivity, -22.04% for days to 50% flowering, -19.04% for plant height, 19.54% for cob length, 25.00% for glume covering, -64.39% for mesocarp thickness, –61.11% for TGMR, -62.41% for *F. moniliforme*, 25% for *F. pallidoroseum* , -52.72% for *C. lunata*, -22.22% for other fungi, 2.29% for soluble sugars, 0.07% for tannins and 48.37% for flavan-4-ols. Crosses having significant positive heterobeltiosis for germination was recorded in 17 and first four were SPV-1201 × SRT-26B, SPV-1201 × ICSB-101B, ICSB-101B × SPV-946 and ICSB-101B × IS-9471. Similarly, 37 crosses exhibited significant positive heterosis for germination, first four higher itude crosses were AKms-14B × IS-6335, AKms-14B × IS-9471, ICSB-101B × AKms- and ICSB-101B × IS-9471.

The mean squares due to genotypes were significant which indicated the nce of substantial degree of diversity for all the characters studied. Variance due to gca sca were significant for almost all the characters. This indicates the importance of tive as well as non-additive type of gene action in the expression of these characters. But er magnitude of variance due to gca revealed that additive gene action was predominant haracters like cob length, TGMR, *F. moniliforme* and *C. lunata* in F_1 crosses and F_2 el progenies. Additive gene action was also predominant for the characters like 100-grain ght, grain hardness, endosperm texture, glume covering, tannins and flavan-4-ols in F_1 ses. For germination and *F. pallidoroseum* the variance due to gca was lower than sca cating non additive gene inheritance in F_1 and F_2 progenies; electrical conductivity, DTF, it height, mesocarp thickness other fungi, proteins and soluble sugars indicated non itive gene action in F_1 crosses and grain hardness, glume covering in F_2 progenies.

Germination test is a standard evaluation method of grain mold resistance. ed on this, the crosses having significantly high specific combing ability effects for mination percentage are considered useful for the purpose of resistance to grain mold. itive and significant sca effect for germination percentage was obtained in 15 crosses of F_1 llel set. The sca effects of AKms-14B × IS-6335 and AKms-14B × IS-9471 crosses were higher magnitude exhibiting significant superiority over other crosses. The next better up of crosses included five crosses ICSB-101B × IS-9471, IS-2284 × IS-6335, SPV-104 × 9471, SPV-104 × IS-2284, IS-101B × IS-2284, SPV-104 × IS-6335 and SPV-1201 × T-26B. Only eight progenies exhibited significant positive sca effects for germination centage of F_2 diallel of which first four higher magnitude progenies were AKms-14B × 6335, SPV-1201 × SRT-26B, AKms-14B × GJ-35-15-15 and SPV-946 × IS-6335.

On the basis of average over two locations the highest 100-grain weight, in rents was recorded in SPV-104 (2.72 g) and (2.66 g), however, cross SPV-1201 × SPV- 04 (2.94 g) exhibited highest grain weight in F_1 diallel. Hundred grain weight was less in l the entries tested at Patancheru during 1996, under controlled condition.

Maximum grain hardness was exhibited in parents SPV-1201 (7.35 kg/cm^2) ıoss SPV-1201 × GJ-35-15-15 (7.64 kg/cm^2) . Colored parents and crosses ıhibited less breaking strength as compared to white. Over all, less breaking strength was recorded at Patancheru than at Akola. In general, parental line GJ-35-15-15 (24.15%) and F_1 cross SPV-1201 × GJ-35-15-15 (25-13%) recorded corneous endosperm texture. Corneous endosperm contribute toward resistance in white grain type.

In general, more electrical conductivity was recorded at Patancheru over Akola, because grain deterioration was more under controlled condition. Five crosses viz., ICSB-101B × IS-6335, AKms-14B × IS-6335, GJ-35-15-15 × IS-6335, SRT-26B × IS-6335 and SPV-104 × IS-6335 exhibited earliness. More glume covering was recorded in six of 10 crosses viz., AKms-14B × IS-6335, GJ-35-15-15 × IS-6335, SRT-26B × IS-6335, ICSB-101 × IS-2284, ICSB-101B × IS-6335 and SPV-104 × IS-6335, which indicated resistant reaction o mold.

Mesocarp thickness is an important character for grain mold resistance. Thin nesocarp less than (50 µm) was observed in all crosses selected on basis of germination, hese are ICSB-101 B IS-2284, ICSB-101B IS-6335, ICSB-101B IS-9471, AKms-14B IS-6335, GJ-35-15-15 × IS-6335 and SPV-104 × IS-6335.

Thresh grain mold rating is an important character for evaluating of cross. ne out of 10 crosses selected on basis of germination exhibited 2.00 or less than 2.00 GMR grade indicating resistance to grain mold.

Thirty and nine crosses exhibited more than 75% germination at Akola and tancheru, respectively. On pooled basis 24 crosses recorded germination more than 75% ich had only two white crosses viz. SPV-1201 × SRT-26B (77.25%) and SPV-1201 × SB-101B (75.50%) exhibited tolerant reaction to mold on germination basis. In general, 39% decrease germination and 86.26 % increase *F. moniliforme* load at Patancheru was orded.

F. moniliforme is a major grain mold fungus which interfere with bohydrate translocation causing reduction in kernel size, seed viability and germination. Patancheru location 86.26% and 28.32 % more *F. moniliforme* load was observed over ola in F_1 and F_2 diallel. Five out of 10 crosses viz., ICSB-101B × IS-6335, ICSB-101B ×

171, AKms-14B × IS-6335, SRT-26B x IS-9471, and SPV-104 × IS-6335 exhibited less *oniliforme* load over better parents and are resistant to grain mold. Over all there was ?7 and 36.60% increase in *F. pallidoroseum* load in F_1 and F_2 progenies at Patancheru Akola. It is comparatively of minor importance in grain molding at Akola, whereas, it is ıportant molding fungus next to *C. lunata* at Patancheru.

C. lunata was observed a major molding fungus at Akola recording 108.95 and 1% more load in F_1 and F_2 progenies over Patancheru. Five out of 10 cross viz., ICSB-B × IS-6335, ICSB-101B × IS-9471 GJ-35-15-15 × IS-6335, SRT-26B × IS-9471 and -26B × IS-6335 estimated less *C. lunata* load over better parents and are resistant to grain . *C. lunata* was observed a major mold fungus at Akola 108.95 and 46.34% more load Patancheru. Positive heterosis of highest magnitude was exhibited in cross ICSB-101B × 335, however, significant heterobeltiosis was exhibited in five out of 10 crosses viz., 3-101 B × IS-6335, ICSB-101B × IS-9471 GJ-35-15-15 × IS-6335, SRT-26B × IS-9471 SRT-26B × IS-6335. In general at Akola 283.44 and 46.50 % more other fungi load was ›ited in F_1 and F_2 progenies, respectively over Patancheru.

As regards to biochemicals characters, protein fractions albumin and globulin, min, cross-link prolamin, glutelin-like, glutelin and residual protein, soluble sugars, ns and flavan-4-ols was investigated from Akola 1995 seed samples. Tannins ranged een 0.02 and 5.84 CE% in parents and F_1 crosses and flavan-4-ols between 0.00 and) A_{550g}^{-1}. Tannins and flavan-4-ols were positively correlated with colored pericarp and layer. In colored grain TGMR scores of 1.75 to 2.50 suggest that tannin is deterrent to l fungi. Nine out of the 10 crosses selected on the basis of germination percent exhibited ficant heterosis and heterobeltiosis for tannin or flavan-4-ols or both.

In white grained sorghum the prolamin and cross-link prolamin were higher in SPV-SPV-104 and AKms 14B and all these parental lines had greater seed hardness there by ating that the endosperm is vitreous and prolamin and cross link prolamin contribute ousness. It is interesting to note that prolamin and cross link prolamin were quite lower l the colored grain parents and crosses, hence resistant to grain mold in colored grain vars can be attributed to tannins and flavan-4-ols rather than grain hardness.

In present investigation effect of (0.1% $HgCl_2$) on germination and mycoflora oth germinated and ungerminated seed was studied. Over all there was significant ncrease in germination in pre-treated over untreated control was observed at both locations. Iowever, there was 27.39% in F_1 crosses and 24.69% in F_2 progenies increased in ;ermination at Akola over Patancheru 1996. For *F. moniliforme* there was significant eduction in load at both locations in pre-treated seeds over untreated control. In general, nere was 86.26 and 28.32% increase load of *F. moniliforme* was observed at Patancheru over ıkola in F_1 and F_2 diallel, respectively. There was 165.27 and 36.36% increase load of *F. allidoroseum* was recorded at Patancheru over Akola in F_1 and F_2, respectively. At Akola, igher load was recorded during 1996 than in 1995. For *C. lunata* on germinated seed 0.69% reduction in load was recorded at Akola, however, there was 21.73% increase in load Patancheru in pre-treated over untreated control. Over all, there was 108.95% and 46.43% crease in *C. lunata* load at Akola over Patancheru in F_1 and F_2 diallel respectively. For her fungi more load was recorded at Akola than Patancheru. In F_1 crosses reduction in ngal load was recorded on ungerminated pre-treatment seed particularly of *F. moniliforme*, owever significant increase in load of *C. lunata* was recorded at Patancheru.

Germinated seed had negative correlation with fungal load of all fungi and GMR at Akola, whereas at Patancheru significant positive correlation was noticed in pre-ated and untreated seed. Hundred-grain weight had significant positive correlation with GMR and *F. moniliforme* and significant negative with glume covering and *F. llidoroseum* at Akola. Grain hardness recorded significant positive association with DTF, nificant negative with endosperm texture and *F. pallidoroseum* at Akola. Grain hardness owed negative association with endosperm texture (-0.61) and (-0.33) at both locations. dosperm texture had significant negative correlation with DTF (-0.52), *C. lunata* (-0.54), ctrical conductivity (-0.51) germination (-0.41), mesocarp thickness (-0.39), TGMR(-0.39) l *F. moniliforme* (-0.35) at Akola, similar trend was exhibited at Patancheru. Electrical ıductivity had positive correlation with *F. moniliforme* , TGMR, *C. lunata* (Akola), socarp thickness and days to 50% flowering at both locations, however significant ative with *F. pallidoroseum* at Akola.

Days to 50% flowering had significant positive correlation with mesocarp kness, *F. moniliforme, C. lunata* and TGMR, *F. moniliforme* exhibited significant ative association with germination and positive association with TGMR at both locations. *lunata* also exhibited positive correlation with TGMR and negative with germination at

cola. TGMR has shown highly significant negative correlation with germination (-0.78)
d (-0.83) at Akola and Patancheru, respectively.

Protein content had positive correlation with grain hardness (0.29). Total ;ars exhibited significant correlation with tannins (0.35); tannins and flavan-4-ols had ;hly significant negative correlation with grain hardness and TGMR. Prolamin and cross-k prolamin exhibited positive correlation with grain hardness (0.63, 0.55), respectively, vever negative with germination, glutelin, glutelin-like and endosperm texture. Glutelin-; and glutelin exhibited significant positive association with germination, endosperm ture, whereas, negative with grain hardness, and mesocarp thickness.

Some physical and biochemical characteristics contribute to resistance to grain 'ds. In white grained sorghum greater grain hardness, low electrical conductivity, thin ocarp, more glume covering are some of the desired traits besides more of prolamin and amin-like protein fraction and for some of the characters respective gene (s) are dominant have additive action. However, in red grains, condensed tannins, flavan-4-ols and ence of testa layer are some of the biochemical characters contributing towards resistance e, Indian sorghums are white grained sorghum, some additive desirable gene can be rporated in white back ground source. Histopathological studies, however, confirmed the er results of various workers. The study has clearly established the genetics, inheritance physical and biochemical traits for resistance.

Implication of these findings for genetic improvement of mold resistance in ıum is considered and the following suggestions are offered on breeding methodology for r utilization of the experimental material.

'arental lines IS-9471, SPV-1201, IS-6335, GJ-35-15-15 and IS-2284 with high gca effect ɔr most of the characters contributing towards resistance to grain mold may be utilized in ybrid on breeding program.

he crosses: Akms 14B × IS 6335, ICSB-101 B × IS-9471, ICSB-101B × IS-2284, SPV-)4 × IS-6335, GJ-35-15-15 × IS-6335 and SPV-1201 × SRT-26B exhibited high gca fects, desirable heterosis for most of the characters and additive gene action for ıportant traits (agronomic, physical and biochemical) related to grain mold resistance. herefore it is suggested that these crosses and their progenies may be utilized to generate ·tter tolerance to grain mold infection.

ıportant traits imparting resistance to grain mold fungi are: low electrical conductvity, in mesocarp, low. TGMR, grain hardness, more glume covering, more tannins, more

LITERATURE CITED

PAGES : 152 – 166

LITERATURE CITED

.bdelrahman, A.A. and R.C. Hoseney (1984). Basis for hardness in pearl millet, grain sorghum and corn. *Cereal Chem.* 61 : 232-235

.bdullah, B.K. and S.A. Dadhum (1978). Seed mycoflora of *Sorghum bicolor* in Iraq. *Arab. Gulf Sci. Res.* 5 (3) : 401-404

.msalu, A. and D.R. Bapat (1990). Heterosis studies in sorghum. *J. Maharashtra Agric. Univ.* 15(3):299-302.

.nahosur, K.H. and R.K. Hegde (1980). Head mold of sorghum their effect on germination and *In vitro* evaluation of fungicides. *Mysore J. Agric. Sci.* 14 : 60-63.

.nahosur, K.H. and S.H. Patil (1982). Some promising sources of resistance to grain molds of sorghum. *Sorghum Newsletter.* 25 : 109.

.nahosur, K.H. (1983). Assessment of the techniques used in identifying sorghum resistant to grain molds. *Sorghum Newsletter.* 26 : 119.

.nahosur, K.H. (1992). Assessment of the techniques used in identifying sorghum resistant to grain mold. *Sorghum Newsletter.* 26 : 109

.nonymous, (1984). Proc. Jt. Agresco Research Committee meeting of Maharashtra Agril. Univ. held at Rahuri.

.grikar, G.P. and V.M. Chavan (1957). A study of heterosis in sorghum. *Indian J. Genet.* 17 : 65-72.

.rif, A.G. and M. Ahmed (1969). Some studies on the fungi associated with sorghum seeds and sorghum soils and their control. 1. Flora of sorghum seeds and seed treatment. *W. Pakistan. J. Agril. Res.* 7 (4) : 102-117.

.alsubramanian, K.A. (1977). Diseases of sorghum and their control. *Seed & Farm.* 3 (12) : 84-85.

.andyopadhyay, R. (1986). Grain mold. *In* Compendium of Sorghum Diseases. (Frederiksen, R.A., ed.) St. Paul, MN, USA : The American Phytopathological Society, pp 36-38.

.andyopadhyay, R. (1988). "Sorghum grain molds" Talk delivered at sorghum Field Day, ICRISAT, Patancheru, India.

.andyopadhyay, R., and L.K. Mughogho (1988a). Evaluation of field screening techniques for resistance to sorghum grain molds. *Plant Dis.* 72 (6) : 500-503.

.andyopadhyay, R., L.K.Mughogho and K.E. Prasada Rao (1988). Sources of resistance to sorghum grain molds. *Plant Dis.* 72 (6) : 504-508

.hagwat, V.Y. and S.M. Pedgaonkar (1973). Studies on head mold of jawar. Effect of individual fungus on seed viability during storage. *Sorghum Newsletter.* 16 : 65-66.

agwat, V.Y. and V.V. Datar (1974). Pink mold on grain sorghum. *Sorghum Newsletter* **17** : 60-61.

ale, M.S. and M.N. Khare (1982). Seed-borne fungi of sorghum in Madhya Pradesh and their significance. *Indian Phytopath.* **35** (4) : 676-678.

atnagar, G.C. (1971). Discoloration of great millet grains in earheads due to *Curvularia lunata. Rajasthan J. Agric. Sci.* **2** : 113-115.

apure, U.R., B.J.S. Gouda, and J.V. Goud (1980). Evaluation of newly developed ms lines and pollinators in line x tester analysis in grain sorghum. *Mysore J. Agric. Sci.* **15** : 56-60.

ikely, M.E. and L.L. Castor (1979). Studies of the infection of sorghum kernels with *Curvularia lunata. Sorghum Newsletter.* **22** : 127.

on-Long, T. (1992). "Sorghum Diseases in Thailand" *In* Sorghum and Millets Diseases – A Second World Review. (de. Milliano, W.A.J., Frederiksen, R.A. and Bengston, G.D. eds.), ICRISAT, Patancheru, India, pp 41-43.

rikar, S.T. and N.L. Bhale (1982). Line x Tester analysis for yield and yield components in winter sorghum. *Sorghum Newsletter.* **25** :13.

llard, R.W. and D.J. Elias (1980). "Sorghum Polyphenols and bird resistance" *In,* Proc. Symp. on Polyphenols in Cereals and Legumes, 36th Annual Meeting of Inst. of Food Technologist., 10-13 June. 1979. St. Louis, Missouri, USA pp 43-49.

ler, L.G. (1981). "Polyphenols and their effects on Sorghum quality." *In* Proc. Int. Symp. Sorghum Grain Qual., 28-31, Oct., 1981. ICRISAT, Patancheru, India pp 294-311.

ler, L.G. (1982). Relative degree of polymerization of sorghum tannin during seed development and maturation *J. Agric. Food Chem.* **30** : 1090-1094.

ler, D.R. and R. Bandyopadhyay (1990). Evaluation of sprinkler irrigation and misting to produce grain molds, *In* "Cereals program", ICRISAT Annual Report, 1990 pp 22-23.

tor, L.L. (1977). Seed molding of grain sorghum. Development of high yielding, disease-and insect-resistance sorghum cultivars. Annual Progress Report, TAES-USAID Contract ta-c-1092 Texas, College Station, Agri. Expt. Stn. Texas.

tor, L.L. and R.A. Frederiksen (1977). Seed molding of grain sorghum caused by *Fusarium* and *Curvularia* species. *Proc. Amer. Phytopath. Soc.* **4** : 151.

tor, L.L. (1979). "Seed molding of grain Sorghum". *In* Third progress report on development of high yielding sorghum cultivars with disease and insect resistance. College Station, Texas, U.S.A. Texas Agril. Expt. Stn.

tor, L.L., and R.A. Frederiksen (1980). *Fusarium* and *Curvularia* grain mold in Texas. In Sorghum Diseases A World Review: Proc. of the Int. Workshop on Sorghum Diseases 11 to 15 Dec. 1978, ICRISAT, Hyderabad, India, pp 93-102.

astor, L.L. and R.A. Frederiksen (1981). *Fusarium* head blight occurrence and effects on sorghum yields and grain characteristics in Texas. *Plant Dis.* **64** : 1017-1019.

astor, L.L. (1981). Grain mold histopathology, damage, assessment and resistance screening within *Sorghum bicolor* (L.) Moench. lines. Ph.D. thesis, Texas A & M. Univ. College Station, Tx. USA. 192 pp.

handrasekharan, A., S. Palanisamy and M.N. Prasad (1985). Breeding for disease resistance against grain mold. *Sorghum Newsletter* **28**.: 84.

handrashekarappa, K. (1987). Heterosis and line x tester studies on analysis in combining ability in grain and forage sorghum crosses. *Mysore J. Agric. Sci.* **19**: 21-22.

lark, L.E., E.B. Ellis and J.W. Johnson (1973). Evaluation of selected sorghum lines for weathering resistance. *In* Proc. 8th Biennial grain sorghum research and utilization conference, Lubbock, Texas, U.S.A, pp 66-69.

ummings, D.P. and J.D. Axtell (1973). Inheritance and improvement of protein quality and content of sorghum. In Res. Prog. Rept. Deptt. of Agronomy, Purdue Uni. Indiana, USA, pp. 112-122.

abholkar, A.R. and S.S. Baghel (1978). Breeding for grain mold resistance. *In* Proc. 8^{th} AICSIP, workshop, April, 1978. Dharwar, India.

abholkar, A.R. and S.S. Baghel (1980). Inheritance of resistance to grain mold of sorghum. *Indian J. Genet.* 40 (2) : 472-475.

abholkar, A.R. and S.S. Baghel (1982). Inheritance of tannin in grain of sorghum *Indian J. Genet.* **42** (2) : 204-207.

abholkar, A.R. and S.S. Baghel (1983). Diallel analysis of grain mold resistance in sorghum. *Genetica Agraria.* **37** (3-4) : 327-334.

ayan, M.P. and S.C. Dalmacio (1982). Sorghum grain mold : Identification, incidence and pathogenicity. Philippine Phytopath. 18 (1-2) : 68-77.

eosthale, Y.G., V. Nagarajan and K. Visweswar Rao (1972). Some factors influencing the nutrient composition of sorghum grain. *Indian. J. Agric. Sci.* **42** : 100-108.

enis, J.C. and J.C. Girard (1977). Sorghum grain mold in Senegal : methods used for identifying resistant varieties. *In* Int. Sorghum Workshop, 6-13 Mar, 1977. ICRISAT, Hyderabad, India.

esai, B.B., D.G. Inamdar, U.D. Chavan and R.M. Naik (1992). Proximate composition and protein fractions of some promising sorghum cultivars. *J. Maharashtra Agric. Univ.* 17 (2) : 307-308.

eshmukh, R.N. (1989). Seed borne fungi of sorghum and their control. Ph.D. Thesis, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

eshmukh, R.N. and J.G. Raut (1993). Site of infection of *C. lunata* infection in sorghum seed. *Indian Phytopath.* 46 : 251-252.

ᴦ ɹhpande, G.D., P.T. Salve and S.B. Choulwar (1985). Determination of time of infection of *C. lunata* and *F. monılıforme* with artificial inoculations. *Sorghum Newsletter* **28** : 88-89.

oherty, C.A., R.D. Waniska, L.W. Rooney, C.F. Earp and J.H. Poe (1987). Free phenolics compounds and tannins in sorghum caryopsis and glumes during development *Cereal Chem.* 64 (1) : 42-46.

ubois, M., K.A. Gills, J.K. Hamilton, P.A. Rabors and F. Smith (1956). Calorimetric method for determination of sugars and related substances. *Anal. Chem.* **28** : 350-356.

hingra, O.D. and J.B. Sinclair (1995). Basic Plant Pathology Methods : Histological techniques. CRC Press Inc. BOCA Raton, Florida ,18 pp.

lwards, W.M. and J. Curtis (1943). Grain sorghums, their products and uses. ACE 193, NM-229. Northern Regional Research Lab., U.S. Dept. Agric. Peoria.

lis, M.B. (1971) "Dematiaceous Hyphomycetes". Commonwealth Mycological Institute, Kew, Surrey.

lis, E.B. (1972). Morphological characteristics in relation to seed deterioration in sorghum, M.S. Thesis, Texas A & M University, College Station, Texas, 51 pp.

lis, E.B., (1975). The effects of endosperm characteristics in relation to seed deterioration in sorghum. M.S. Thesis, Texas, A & M University, College Station, Texas, 51 pp.

ele, J.P., R.A. Frederiksen and F.R. Miller (1993). The association of gene controlling caryopsis traits with grain mold resistance in sorghum. *Phytopathology* **83** (5) : 490-495.

ıO (1996). Quarterly bulletin of statistics. Food and Agricultural Organization of the United Nations. Rome, Italy, 9 : 25.

ıher, R.A. (1958). Statistical method for research workers, XIII edn. Oliver and Boyd. Ltd. Eemberg. pp 36 .

rbes, G.A. (1986). Characterizationof grain mold resistance in sorghum (*Sorghum bıcolor* L. Moench). Ph.D. thesis, Texas A &M University, College Station, TX, USA. 75 pp.

rbes, G.A., R.A. Frederiksen and L.M. Seitz (1989). Assessment of sorghum grain mold: disease intensity and disease loss. *Seed Scı. & Technol.*, 17:297-307.

rbes, G.A., R. Bandyopadhyay and G. Garicia (1992). A review of Sorghum Grain Mold. *In* Sorghum and Millets Diseases, a Second World Review, (de Milliano, W.A.J., Frederiksen, R.A. and Bengston,G.D. eds,) Patancheru, India pp 253-264.

:deriksen, R.A., L.L. Castor and D.T. Rosenow (1982). Grain mold, small seed and head blight : the *Fusarıum* connection in sorghum. Proc. 37th Ann. Corn and Sorghum Industry Res. Conf. 37 : 26-36.

ngadharan, K., B. RamaRaj, M.N. Prasad and S. Palanisamy (1978). Studies on head molds of sorghum in Tamil-Nadu. *Sorghum Newsletter* **21** : 70-71.

ıgadharan, K., M.N. Prasad, S. Palanisamy and B. RamaRaj (1978). Artificial screening of sorghum for head molds. *Sorghum Newsletter* **21** : 117.

ud, T.B. (1992). Resistance sources, mechanism and resistance screening techniques for grain molds *In* Proc. of XXII Annual Sorghum Workshop, Surat, Gujrat, India, pp26.

ud, T.B., B.N. Aglave and S.S. Ambekar. (1994), Integrated approach to tackle the grain mold problem in Maharashtra. *International Sorghum and Millet Newsletter* **35** : 101-102.

rade, R.B. (1995). Studies on genetics of grain mold resistance in sorghum. (*Sorghum bicolor* (L.) Moench Ph.D. Thesis Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

aj, K. and J.V. Goud, (1981). Heterosis for vegetative characters in grain sorghum. *Indian J. Heredity* **13** : 9-13.

ck, J.A. and L.W. Rooney (1976). Physical and chemical characterization of sorghum lines with resistance to grain deterioration. *Cereal Food World.* **21**:436-437.

ck, J.A., (1977). "Field deterioration of sorghum : differences among sorghum lines and the relationship to characteristics of grain" *In* Proc. Sorghum Disease and Insect Resistance Workshop, 6-9 July, 1977. Corpus Christii, Texas, USA. Misc. Publ. Texas Agric. Expt Stn. No. 1373 pp 69-74.

:k, J.A., and L.W. Rooney (1977). The relationship between kernel structure, water uptake and water movement in sorghum. *Cereal Foods World* **22** : 472.

:k, J.A., L.W. Rooney, D.T. Rosenow and F.R. Miller (1977). Physical and structural properties of field deteriorated sorghum grain. *In* 3rd Ann. Progr. Rep. Texas A & M. Univ., College Station, Texas, USA, pp 102-112.

:k, J.A. and L.W. Rooney (1980). Chemistry and structure of grain in relation to mold resistance. *In*, Sorghum Diseases-A World Review,. Proc. Int. Workshop on Sorghum Diseases, 11-15 Dec. 1978. ICRISAT, Hyderabad, India, pp 119-140.

ıath, A. and H.S. Shetty (1985). Occurrence and location of *Fusarium* species in Indian sorghum seed. *Seed Sci. & Technol.* **13** : 521-528.

ıath, A, H. Shekar Shetty and H.S. Prakash (1987). Colonization of *Fusarium* species in sorghum seeds and their significans. *Indian Phytopath.* 40 (2) : 181-185.

, S.N. and P. Joshi (1976). Heterosis and inbreeding depression in sorghum. *Indian J. Genet.* **36** : 96-101.

ı, E.M. and L. Zambolim (1984). The incidence of phytopathogenic fungi on sorghum seeds. Revista Ceres. **31** : 115-119.

E., G.D. Lacefield and J.A. Lowe (1971). Head mold on grain sorghum. *Plant Dis. Reptr.* **55** : 337-339 ıwell. P. and J.D. Schofield (1986). A starch granules protein associated with endosperm softness in wheat. *Cereal Chem.* **63** : 379-380.

ngs, B. (1956b). Concept of general and specific combining ability in relation to diallel crossing system. *Aust J. Biol. Sci.* 9 : 463-493.

ı. A.K. and Y.P. Gupta (1974). Distribution of amino acids and protein fractions in the developing grain of *Sorghum vulgare* Pers. *Indian J. Agric. Res.* **8** : 162-164.

ı, A and D. Singh (1988). Effect of fungicidal treatments on long storage pathogens and viability of sorghum seeds. *Indian Phytopath.* **41** (1) : 110.

gossian, V., B.A.K. Chibber, S. Van Scoyo., R. Jambunathan, E.T. Mertz and J.D. Axtell (1978). Characteristics of proteins from normal high lysine and high tannin sorghums. *J. Agric. Food Chem.* **26** : 219-223.

man, A.E. and L.G. Butler (1981). The specificity of proathocyanidin protein interaction *J. Biol. Chem.* **25** (6) : 4494-4497.

D.H., L.W. Rooney and J.M. Faubion (1983). Sorghum phenolic acids, their HPLC separation and their relation to fungal resistance. *Cereal Chem.* **60** (4) : 255-259.

D., L.W. Rooney and C.F. Earp (1984). Tannins and Phenols of Sorghum. *Cereal Foods World* **29** : 776-779.

D.H. and L.W. Rooney (1986). Effect of genotype on tannins and phenols in sorghum. *Cereal Chem.* **63**(1):4-8.

en, L. and D.S. Murty (1983). A screening test for grain hardness in sorghum employing density grading in sodium nitrate solution. *J. Cereal Sci.* **1** (4) : 265-276.

, H.B. (1969). Proceedings of 24th Annual Corn, Sorghum, Research Conference, pp. 113-122.

, H.B. and R.E. Burns (1973). Relationship between tannin content of sorghum grain and preharvest seed molding *Agro. J.* **65** : 957-959.

, H.K., F.R. Immer and D.C.Smith (1955). Methods of plant breeding, McGrow Hill Book Company, New York.

icks, S.B. and R.B. Taylorson (1976). Variation in germination and amino acid leakage of seeds with temperature related to membrane phase change. *Plant. Physiol.* **58** (1) : 7-11.

, G.B., Paramaswarappa and J.V. Goud (1988). Genetic evaluation on new male sterile lines in sorghum. *Mysore J. Agric. Sci.* **20** : 262-265.

AT (1986).Annual Progress Report International Crop Research Institute for Semi-Arid Tropics, Patancheru, India, pp-12.

S.K. and J.Y. Goud (1981). Genetic analysis of quantitative characters in an inter cross of sorghum. *Mysore J. Agric. Sci.* **15** : 6-11.

J. Mohan and B.S. Rana (1991). Genotype x Environmental interaction for in mold resistance and seed weight in sorghum. *Indian Phytopath.* **44** (4) : 3-525.

1966). International Rules for seed testing, *Proc. Int. Seed Testing Assn.* **31** : 52.

1976). International Rules for seed testing. *Seed Sci. & Technol.* 4: 3-49.

ian, R. and E.T. Mertz (1973). Relationship between tannin levels, rat growth d distribution of proteins in sorghum. *J. Agric. Food Chem.* **21** : 692-696.

ian, R., E.T. Mertz and J.D. Axtell (1975). Fractionation of soluble proteins of gh lysine and normal sorghum grain. *Cereal Chem.* **52** : 119-121.

han, R., N.S.Rao and S. Gutru (1983). Rapid methods for estimating protein and sine in sorghum. *Sorghum bicolor* (L.) Moench. *Cereal Chem.* 60 (3) : 192-4.

han, R., L.G. Butler. R. Bandyopadhyay and L.K. Mughogho (1986). olyphenol concentration in grain, leaf and callus tissue of mold susceptible and old resistant sorghum cultivars. *J. Agric Food Chem.* **34** (3) : 425-429.

han, R., M.S. Kherdekar and R. Bandyopadhyay (1990). Flavan-4-ols oncentration in mold-susceptible and mold-resistant sorghum at different stages f grain development. *J. Agric. Food Chem.* **38** : 545-548.

than, R. and M.S. Kherdekar (1991). Flavan-4-ols concentration in leaf tissues of rain mold-susceptible and mold-resistant sorghum plants at different stages of af development. *J. Agric. Food Chem.* 39 (6) : 1163-1165.

than. R.. M.S. Kherdekar and P. Vaidya (1991). Ergosterol concentration in old susceptible and mold resistant sorghum at different stages of grain evelopment and its relationship to flavan-4-ols. *J. Agric. Food Chem.* 39 (10) : 866-1870.

than. R., M.S. Khedekar and J.W. Stenhouse (1992). Sorghum grain hardness nd its relationship to mold susceptibility and mold resistance. *J. Agric Food Chem.* 40 (8): 1403-1408.

E.S. and A.B. Valleja (1986). Agronomic traits in sorghum which determines esistance to grain molds in the coastal area of Mexico. *Sorghum Newsletter.* **29** : 36.

H.U., D.R. Bapat and P.H. Dhande (1984). Combining ability studies in sorghum. *Sorghum Newsletter.* 27 : 29-30.

l, A.E. and O.J. Webster (1966). Manifestation of hybrid vigour in grain sorghum and relation among the components of yields, weight per branchlet and height. *Crop Sci..* **6** : 513-515 ınaka, S.K. (1982). Genetic analysis of ten quantitative characters in sorghum. *Thesis abstract.* **8** (1) : 72-73.

ırper, R.W. and J.R. Quinby (1963). Sugary endosperm in sorghum. *J. Heredity* **54** : 121.

ıtaria, S.K., R. Singh and P.K. Shrotria. (1990). Inheritance of resistance to grain mold fungi in three *Sorghum bicolor* crosses. *Envir. and Ecol.* **8** (4) : 111-113.

ıare, A.D., S.H. Kshirsagar, A.R. Ghanekar, M.S. Ketkar, V.S. Khandel and R.N. Prabhune (1976). Sorghum Research in 1975-76 at the Nimbkar Agri. Res. Insti., Phaltan. *Sorghum Newsletter.* **19** : 42-43.

rleis, A.W., K.D. Crosby and T.L. Housley (1984). A method for quantitatively measuring vitreous endosperm area in sectioned sorghum grain. *Cereal Chem.* **61** : 556-558.

ɔlreuter D.J.G., (1763). In Cytogenetics and Plant Breeding, Chandrashekharan and Parthasarathy. page : 351.

ɔfoid, K.D., J.W. Maraville and W.M. Ross (1976). A test for determining the presence of testa in sorghum. Univ. of Nebraska, Lincoln. Publ. No. 77846.

ɔteswara Rao, G. and P. Poornachandrudu (1977). Testing of agronomically important varieties for their reaction to head molds. *Sorghum Newsletter.* **14** : 43-44.

ulkarni, V. and V.K. Shinde. (1985). Heterosis and inbreeding depression in grain sorghum. *Indian J. Agric. Sci.* **55** : 505-509.

ulkarni, N., K.N. Murty and S.K. Hussain (1975). Breeding for grain mold resistance. *Sorghum Newsletter.* **18** : 19.

umari, S.R., A. Chandrashekar and H.S. Shetty (1992). Proteins in developing sorghum endosperm that may be involved in resistance to grain molds. *J. Sci. Food Agric.* **60** (3) : 275-282.

umari, S.R. and A. Chandrashekar (1994). Relationship between grain hardness and the content of prolamin and three antifungal protein in sorghum *J. Cereal Sci.* **20** (1) : 93-99.

ıosuwan, P. and R. E. Atkins (1977). Estimates of combining ability and heterosis in converted exotic sorghum. *Crop Sci.* **17** : 47-50.

ındry, J. and T. Moreaux (1970). Heterogeneite of the glutelins of maize grain : selection extraction and comparison in amino acids of the three fractions isolated (in French). *Bull. Soc. Chim. Bio.* **52** : 1021-1037.

iang, J. Y. and J.K. Bai (1988). Studies on fungi causing sorghum grain decaying. *J. Shenyang Agril. Univ.* **19** (1) : 27-34.

uttrell, E.S. (1950). Grain sorghum diseases in Georgia in 1949. *Plant Dis. Reptr.* **34**(2) : 45-52.

Tannins concentration and In vitro dry matter disappearance of seeds of birds resistant sorghum hybrids.
labbayard, B.B. and K.W. Tipton (1975). *Philippines Agric.* 59 : 1-6.

nsuetus, A.S.B., R.A. Frederiksen, R.D. Waniska, G.N. Odvody, J. Craig, and D.T. Rosenow (1988). The effects of glume caryopses characteristics of sorghum on infection by *F. moniliforme* Shel. *Sorghum Newsletter* 31:100.

nsuetus, A.S.B. (1990) The role of glumes of sorghum in resistance to grain mold *Res. & Training Newsletter.* 5 (4) : 18-19.

rtinez, M.J., L.M. Giorda and M. Balzarini (1994). Relationship between resistance to grain mold and concentration of flavan-4-ols of sorghum grain. *International Sorghum and Millets Newsletter.* 35 : 96-97.

ithur, S.B., R. Sharma and L.M. Joshi (1967). Moldy heads disease of sorghum, isolations of associated fungi on blotter and agar. *Proc. Int. Seed. Test. Assn.* 32 (3) : 639-645.

ithur, S.K., S.B. Mathur and P. Neergaard (1975). Detection of seed-borne fungi in sorghum and location of *Fusarium moniliforme* in the seed. *Seed Sci. & Technol.* 3 : 683-690.

ixson, E.D., W.B. Fryar, L.W. Rooney and M.N. Krishna-Prasad (1971). Milling properties of sorghum grain with different proportions of corneous to floury endosperm. *Cereal Chem.* 48 : 478-490.

ixson, E.D., L.E. Clark, L.W. Rooney and J.W. Johnson (1972). Factors affecting the tannin content of sorghum grain as determined by two methods of tannin analysis. *Crop. Sci.* 12 : 233-235.

axson, E.D., L.W. Rooney, R.W. Lewis, L.E. Clark and J.W. Johnson (1973). The relationship between tannin content, enzyme inhibition, rat performance and characteristics of sorghum grain. *Nutrn. Report Interl.* 8 : 145-152.

c Millan, W.W., B.R. Wiseman, R.E. Burns, H.B. Harris and G.L. Greene, (1972). Bird resistance in diverse germplasm of sorghum. *Agron. J.* 64 : 821-822.

elakeberhan, A., L.G. Butler, G. Ejeta and A. Menkir (1996). Grain mold resistance and polyphenol accumulation in sorghum *J. Agric. Food Chem.* 44 (8) : 2428-2434.

enkir, A., G. Ejeta, L.G. Butler, A. Melakeberhan, H.L. Warren (1996). Fungal invasion of kernels and grain mold damage assessment in diverse sorghum germplasm. *Plant Dis.* 80 (2) :1399-1402.

iller, F.R. (1981). Genetic and environmental response characteristics of sorghum:. *In* sorghum in eighties. Proc. Int. Symp. on sorghum, 2-7 Nov., 1981, ICRISAT, Patancheru. pp 393-402.

ukuru, S.Z. (1988). Breeding for grain resistance. *In* Proceedings of the sixth EARSAM Regional Workshop on sorghum and millet Improvement in Eastern Africa, Mogadisheu, Somalia, pp 445-460.

ukuru, S.Z. (1992). Breeding for grain mold resistance: *In* Sorghum and Millets Diseases A Second World Review (de Milliano, W.A.J., Frederiksen, R.A. and Bengston, G.D. eds) ICRISAT Patancheru, India, pp 273-285.

unghate, A.G. (1980). Detection and elimination of seed borne fungi of sorghum. M.Sc. (Agri.) Thesis, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

ınck, L.(1981). Personal communication. Carlsberg Research Laboratory, Department of Biotechnology, Copenhagenvally, Denmark.

urty, D.S. (1975). Breeding for early mold-resistant sorghum. ICRISAT Sorghum consultants Meeting 15-17 Apr., 1975 ICRISAT, Hyderabad, India.

urty, D.S., K.N. Rao and L.R. House (1980). Breeding for grain mold-resistant sorghum at ICRISAT. *In* Sorghum Diseases, A World Review, Proceedings of the International Workshop on Sorghum Diseases, ICRISAT, Patancheru, India, pp154-162.

ırayana, D. and M.N. Prasad (1980). Studies on grain mold resistance. Presented at 10th Ann. Sorghum Workshop. AICSIP, at TNAU, Coimbatore, May 13, 1980.

ırayana, D. and M.N. Prasad (1982). Complications in identification of resistance source to grain molds in sorghum. *Sorghum Newsletter*. **25** : 108-109.

ırayana, D. and M.N. Prasad (1983). Inheritance of resistance to *Fusarium* grain mold in sorghum. *In* abstract of contributed papers of the 15th International Congress of Genetics 12-21 December, 1983, New Delhi, India pp. **2** : 727.

ırsimhan, K.S. and G. Rangaswami (1969). Influence of mold isolates from sorghum grain on viability of the seed. *Curr. Sci.* **38** : 389-390.

:ucere, N.J. and G. Sumrell (1979). Protein fractions from five varieties of grain sorghum : Amino acid composition and solubility properties. *J. Agric. Food Chem.* **27** (4) : 809-812.

:ucere, N.J. and G. Sumrell (1980). Chemical composition of different varieties of grain sorghum *J. Agric Food Chem.* **28** : 19.

mbalkar, V.S. and D.R. Bapat (1987). Studies in vegetative characters in sorghum. *Current Res. Report* (M.P.A.U.) **3** : 1-4.

›ble, M. and M.J. Richardson (1968). An annotated list of seed borne diseases *Proc. Int. Seed Test. Assm.* **33** : 1-191.

vasike, C.C., E.T. Mertz, R.C. Pickett, D.V. Glover, B.A.K. Chibber and S.V. Van Scoyoc (1979). Lysine level in solvent fraction of pearl millet. *J. Agric. Food Chem* . **27** : 1329-1331.

›uchowski, W. and W. Bushuk (1980). Wheat hardness Comparison of methods and its evaluation. *Cereal Chem.* **57** : 421.

laniswamy, S. and A. Subramanian (1986). Genetics analysis of yield and yield components in sorghum. *Madras Agric. J.* **73** : 541-544.

nse, V.G. and P.V. Sukhatme (1954). Statistical methods for agriculture workers. ICAR Publication, New Delhi. pp 210 .

H. and A.R. Dabholkar (1981). Gene effects for grain size yield of sorghum. *ndian J. Genet.* **41** : 259-263.

.H., K.B. Desai., K.R.V. Raju and R.K. Parikh (1980). Estimates of heritability and other genetic parameters in F_2 population of sorghum. *Sorghum Newsletter* 23:22-23.

.C. and M.V. Thombre (1985). Yield components and their application for n in sorghum. *J. Maharashtra Agric. Univ.* **10** : 262-264.

.C. and M.V. Thombre (1986). Genetic analysis of grain yield and its components in sorghum. *J. Maharashtra Agric. Univ.* **11** (1) : 17-19.

.C. (1990). Inheritance of grain yield and its components in grain sorghum. *J. Maharashtra Agric. Univ.* **15** (1) : 54-57.

o, J.M., J.P. Neto and C. da (1979). Identification of *Sorghum bicolor* (L.) Moench seed in Rio Grande do sul. Agronima Sulrid Gran. **15** (1) : 127-131.

M.L. and L.G. Butler (1977). Rapid visual estimation and spectrophotometric determination of tannin content of the sorghum grain. *J. Agric. Food Chem.* **25** : 1268-1273.

M.L., S. Van Scoyoc and L.G. Butler (1978a). A critical examination of the vanillin reaction as an assay for tannin in sorghum grain. *J. Agric. Food Chem.* **26**:1214-1218.

M.L., A.M. Stromberg and L.G. Butler (1979). Tannin content as a function of grain maturity and drying conditions in several varieties of *Sorghum bicolor* (L). Moench. *J. Agric. Food Chem.* **27** (6) : 1270-1274.

y, J.R. (1963). Manifestation of hybrid vigour in sorghum. *Crop Sci.* **3** : 288-291.

B.S., V.J. M. Rao, D.P. Tripathi and N.G.P. Rao (1977). Genetic analysis of some exotic x Indian crosses in sorghum. XVII Resistance to grain deterioration. *Indian J. Genet. Plant Breed.* **37** (3) : 480-487.

B.S., V.J.M. Rao, D.P. Tripathi and N.G.P. Rao (1978). Genetic analysis of some exotic x Indian crosses in sorghum. XVIII Breeding for resistance to grain deterioration. *Indian J. Genet. Plant Breed.* **38** : 322-332.

B.S., K.H. Anahosur, V.H.S. Rao, R. Parameswarappa and N.G.P. Rao (1984). Inheritance of field resistance to sorghum grain molds. *Indian J. Genet and Plant Breed.* 44.

N.G.P. (1970 a). Genetic analysis of some exotic x Indian crosses in sorghum, Heterosis and its interaction with season. *Indian J. Genet.* **30** (2): 347-361.

K.N. and R.J. Williams (1977). Fungi associated with moldy grains of sorghum. *In*, Proc. Int. sorghum workshop, 6-13 March, 1977, ICRISAT Hyderabad, India.

G.N. and K.N. Rao (1982). Screening of sorghum varieties against grain molds. *Sorghum Newsletter.* **25** : 112.

'. Cherula and T.V.S.R. Mohan Rao (1984). Head molds and grain deterioration Jowar in Andhra Pradesh. Presented at All India Co-ord. Sorghum Improv. 'oj. Workshop, 3-6 May, 1984, Dharwad.

..P., S.D. Singh and J.W. Stenhouse (1995) Grain mold resistance in guinea ›rghum germplasm. *International sorghum and millets Newsletter*. **36** : 94-95.

\.G.R. and T.V. Reddy (1977). Studies on grain molds of sorghum. *Sorghum 'ewsletter*. **20** : 10.

K.R.N. and N. Nagur (1981). Correlation studies between yield and yield omponents. *Sorghum Newsletter*. **24** : 18.

B.V.S., L.K. Mughogho and R. Jambunathan (1991). Breeding grain mold esistant seed parents and hybrids. *In* Cereals Program. Ann. Rep. 1991, Page-28 CRISAT Patancheru, India, pp 28.

S. (1984). Total phenol and phenolic acid contents of sorghum tissue from boot tage to post maturity weathering. M.S. Thesis. Texas A and M. Univ. College Station, Texas.

L.W. and R.D. Sullins (1969). A laboratory method for milling small samples of sorghum grain. *Cereral Chem*. **46** : 486-490.

L.W. and F.R. Miller (1982). Variation in the structure and kernel characteristics of sorghum. *In* Proc. Int. Symp. Sorghum Grain Qual. 28-31 Dec. ICRISAT, Patancheru, India, pp 143-162.

A.K. and B.A. Monapora (1981) Diallel analysis of forage yield and its components in sorghum. *Madras Agric. J.* **68** : 296-300.

nan, M. (1981). Heterosis in sorghum. *Sorghum Newsletter*. **24** : 20-23.

ing. J.F. and L.W. Rooney (1979). A staining procedure to determine the extent of bran removal in pearled sorghum. *Cereal Chem.* **56** (6) : 545-548.

raman, K, R.D. Waniska, and L.W. Rooney (1994). Screening antifungal proteins in sorghum cultivars preliminary results. *International Sorghum and Millet Newsletter* **35** : 136.

raman, K. R.D. Waniska and L.W. Rooney (1996). Physiological changes in sorghum antifungal proteins. *J. Agric. Food Chem.* **44** (8) : 2435-2441.

L.M., D.B. Sauer, H.E. Mohr and R. Burroughs (1975). Weathered grain sorghum: natural occurrence of alternariols and storability of the grain. *Phytopathology*. **65** : 1259-1263.

ıa H.C., N.K. Jain and R.K. Agrawal (1976). Effect of seed treatment with fungicides alone and in combination with carbofuran on stand and yield of *Sorghum bicolor* (L) Moench. *JNKVV Res. J.* **10** : 83-84.

r, V.B., J.J. Maheswari and R.S Wadhokar (1987). Heterosis and combining ability in sorghum. *Ann. Plant Physiol.* **1** : 101-106.

I., R. Parmeswarappa, S.S. Patil and K. Anahosur (1994). Inheritance of grain d resistance in sorghum. *J. Maharashtra Agric. Sci.* **19** (2) : 257-259.

.K., R. Singh and V.K. Agrawal (1986). Screening for germplasm resistance orghum grain mold. *Sorghum Newsletter*. **29** : 10-12.

H. (1994). Cytogenetics and plant breeding. Chandrashekharan and thasarathy page 353.

M.R. and I.D. Khan (1973). Fungi and factors associated with the 'elopment of sorghum ear molds. *Trans. Mycol. Soc. Japan* **14** (3) : 289-293.

(1973 a). Diallel analysis over different environments I. *Indian J. Genet.* **33** : 7-136.

(1973b). Diallel analysis for combining ability over several environments II. *lian J. Genet.* **33** : 469-481.

and K. Jambunathan(1980). Evaluation of rapid methods for the estimation of otein in chickpea (*Cicer arietinum*). *J. Sci. Food Agric.* **31** : 247-254.

.P. and V.K. Agrawal (1987). Relative susceptibility of different sorghum ltivars to grain molds. *Bangladesh J. Bot.* **16** (1) : 111-114.

).P., V.K. Agrawal, and R.K. Khetarpal (1988). Etiology and host pathogen lationship of grain molds of sorghum. *Indian Phytopath.* 41 (3) : 389-397.

.P., and V.K. Agrawal (1989). Effect of different degrees of grain molds fection on yield and quality of sorghum seed. *Indian J. Plant Pathol.* 7 (2) : 103-)8.

.D., K.E.P. Rao. S.S. Navi and M.V. Satyanaranyana (1993). Identification of :sistance to grain mold in white grain sorghum. *Sorghum Newsletter*. **34** : 24.

R.B. (1992). Studies on biochemical status of resistant and susceptible *Sorghum icolor* cultivars against grain molds. Ph.D. Thesis, Dr. Panjabrao Deshmukh :rishi Vidyapeeth, Akola.

R.B., R.B. Pandrangi, D.B. Patil and S.G. Wankhade (1993). Amino acid pectra of healthy and moldy grains of hybrid sorghum SPH-388. *New lpproaches in Agric. Technol.* **3** : 57-60.

, C.F. and L.A. Tatum (1942) General and specific combining ability effects in ingle crosses of corn. *Agro. J.* **34** : 923-932.

A. and T. Nagur (1980). Association between yield and yield components and nultiple regression analysis in sorghum. *Sorghum Newsletter*.**23**:10-12.

ıse, J.W., B.V.S. Reddy and R. Bandyopadhyay (1990). Breeding for grain molds resistance in cereals programme. ICRISAT Annual Rep. 1990, ICRISAT, Patancheru, India, pp 19-21.

T. and E.C. Bate-Smith, (1962). New leucoanthocyanidins in grass. *In* Comparative Biochem Vol. III. Eds. Florkin, A.M. and Mason. H.S., Acad, Press, N.Y.

anson, A. F. and R. Hunter (1936). Effect of germination and seed size on sorghum stands. *J. Amer. Soc. Agron.* **28** (2) : 997-1004.

amlata and R.S. Rana (1988). Combining ability for biological yield and harvest index in sorghum. *Indian. J. Genet.* **48** (2) : 149-153.

ırup, G. (1955). Fungi associated with sorghum seed. *Kansas Dis. Abst.* **10** : 1710-1711.

ramanian, V., R. Jambunathan, and S. Suryaprakash (1980). Note on soluble sugars of sorghum. *Cereal Chem.* **57** (6) : 440-441.

ramanian. V., L.G. Butler, R. Jambunathan and K.E. Prasad Rao (1983). Some agronomic and biochemical characters of brown sorghums and their possible role in bird resistance. *J. Agric Food Chem.* **31** : 1303-1307.

'amanian,V. and R. Jambunathan (1984). Chemical composition and food quality of sorghum. *In* Nutritional and Processing quality of sorghum (Salunke, D.K., Chavan, J.K., and Jadhao, S.J. Eds.) IBA Publication : New Delhi.

amanian, V.. N. Seetharama, R. Jambunathan and P. Venkateswera Rao (1990). Evaluation of protein quality of sorghum *(Sorghum bicolor* (L.) Moench). *J. Agric. Food Chem.* **38**:1344-1347.

aram, M.V., L.T. Palmer, K. Nagrajan and J.M. Prescott (1972). Disease survey of sorghum and millets in India. *Plant Dis. Reptr.* **56**(9):740-743.

S.A.J. (1962). Diseases of sorghum, Sudan grass and broom corn. Kew, U.K: Commonwealth Agricultural Bureau 380 pp.

thi, R.K. (1974). Head fungi of sorghum, phytotoxin and their effect on seed germination. *Indian Phytopath.* **27** (4) : 499-501.

thi, D.P., B.S. Rana, K.G. Kotaran, and N.G.P. Rao (1976). Genetic analysis of some exotic x Indian crosses in sorghum XVI effects of directional selection on yield and component characters. *Indian J. Genet.* **36** (1) : 250-258.

scoyoc, S., W.G. Ejeta and J.D. Axtell (1988). Kernel characteristics and protein fraction changes during development of high lysine and normal sorghum. *Cereal Chem.* **65** : 75-80.

sekaran, P. (1983). Control of *F. moniliforme* infection in sorghum seed. *Seed Sci. and Technol.* **11** (2) : 435-439.

ıksha, T.K. and L.V.S. Sastry (1968). Studies on protein content and amino acid composition of some varieties of grain sorghum. *J. of Agril. and Food Chem.* **16** : 199-203.

G.C. and D.H. Meckenstock (1992). Sorghum diseases in central America and the Caribbean basin *In* Sorghum and Millets Diseases : A Second World Review (de Milliano, W.A.J., Frederiksen, R.A. and Bengston, G.D. eds.) ICRISAT, Patancheru, India, pp 67-73.

a, R.D., J.H. Poe, R. Bandyopadhyay (1989). Effects of weathering on phenolic acids in sorghum caryopses *J. Cereal Sci.* **10** (3) : 217-225.

Waniska, R.D., G.A. Forbes, R. Bandyopadhyay, R.A. Frederiksen and L.W. Rooney (1992). Cereal chemistry and grain mold resistance. *In* Sorghum and Millets Diseases-A Second World Review,.(de Milliano, W.A.J., Frederiksen, R.A. and Bengston. G. D.eds.) ICRISAT, Patancheru, India, pp 265-272.

Vatterson, J. J. and LG. Butler (1983). Occurrence of unusual leucoanthocyanidin and absence of proanthocyanidins in sorghum levels. *J. Agric. Food Chem.* **31** (1) : 4-45.

Veinges, K.K., W. Bahr, W. Ebert, K. Goritz and H.D. Marx (1969). Konstitution, ensterhung and bedeutung der flavonoid-gerbstoffe, *Fortschr. Chem. Org. Natrustoffe*. **27** : 158-160.

/haley, W.G. (1952). Physiology of gene action in hybrids. IOWA, State College Press, pp 79-92.

'illiams, R.J. and K.N. Rao (1978). A review of sorghum grain molds. *In* Sorghum Diseases - A World Review, Proc. Int. Workshop on Sorghum Disease, ICRISAT, Hyderabad, India, pp 79-92.

'illiams, R.J. and K.N. Rao (1981). A review of sorghum grain molds *Trop. Pest Mgmt.*, **27** (2) : 200-211.

u, W.S. (1983). Sorghum diseases in Taiwan and characterization and control of its seed borne pathogens. *Pl. Prot. Bull. Taiwn,* **25** (1) : 1-13.

u, W.S. and K.C. Cheng (1990). Relationship between seed health, seed vigour and the performance of the sorghum in field. *Seed Sci. and Technol.* **18 (3)** : 713-719.

APPENDICES - I TO XI

PAGES : 167 - 300

I - 1

Table: 1 Weekly weather data for year 1995 and 1996 recorded at Agro-meteorological laboratory, Akola

1995								1996							
Week	Date	Rainfall in (mm)	Rainy days	Temperature (°C)		Relative humidity (%)		Week	Date	Rainfall in (mm)	Rainy days	Temperature (°C)		Relative humidity (%)	
				Max.	Min.							Max.	Min.	Morning	Evening
23	4-10 June	0.00	NIL	44.30	28.40	63.00	19.00	23	4-10 June	0.00	NIL	42.00	26.40	66.00	31.00
24	11-17	13.20	3	41.20	27.00	71.00	31.00	24	11-17	0.00	NIL	41.50	25.40	68.00	34.00
25	18-24	10.00	2	38.90	26.30	73.00	35.00	25	18-24	24.40	1	37.90	24.10	77.00	41.00
26	25-1 July	31.60	3	35.00	23.70	86.00	57.00	26	25-1 July	0.00	NIL	33.20	25.50	77.00	41.00
27	2-8	4.40	1	38.20	25.50	80.00	48.00	27	2-8	9.40	2	37.00	25.40	79.00	41.00
28	9-15	201.60	5	33.40	22.90	92.00	65.00	28	9-15	4.80	NIL	35.60	24.70	80.00	48.00
29	16-22	63.20	4	29.60	23.00	90.00	79.00	29	16-22	32.60	2	34.70	24.40	84.00	58.00
30	23-29	54.0	4	30.60	22.80	91.00	68.00	30	23-29	68.40	6	27.80	22.60	91.00	85.00
31	30-5 Aug.	8.00	2	31.40	23.40	90.00	64.00	31	30-5 Aug.	25.20	3	30.00	23.10	91.00	75.00
32	6-12	3.60	1	31.80	23.50	83.00	60.00	32	6-12	11.50	1	28.60	22.70	91.00	79.00
33	13-19	0.00	NIL	33.30	23.00	78.00	49.00	33	13-19	5.60	1	32.20	23.60	86.00	57.00
34	20-26	1.00	NIL	33.90	23.70	79.00	51.00	34	20-26	74.90	1	31.20	22.90	88.00	71.00
35	27-2 Sep.	78.30	1	33.40	24.50	85.00	67.00	35	27-2 Sep.	51.80	3	29.40	22.60	92.00	74.00
36	3-9	45.60	1	30.30	21.90	89.00	57.00	36	3-9	133.90	2	31.00	22.80	92.00	70.00
37	10-16	7.50	2	33.60	22.40	91.00	60.00	37	10-16	55.10	3	31.80	23.10	92.00	69.00
38	17-23	8.70	1	32.40	22.00	85.00	56.00	38	17-23	1.80	NIL	30.90	21.80	88.00	66.00
39	24-30	9.80	1	35.30	21.60	83.00	44.00	39	24-30	20.40	2	34.10	22.90	84.00	54.00
40	1-7 Oct.	0.00	NIL	36.20	20.80	81.00	33.00	40	1-7 Oct.	51.40	4	31.10	22.30	88.00	65.00
41	8-14	0.00	NIL	34.30	20.80	82.00	50.00	41	8-14	0.00	NIL	32.80	17.60	80.00	34.00
42	15-21	2.00	NIL	32.90	19.80	90.00	45.00	42	15-21	0.00	NIL	32.60	17.40	77.00	37.00
43	22-28	0.00	NIL	34.00	13.60	76.00	23.00	43	22-28	97.40	5	29.80	20.90	93.00	79.00
44	29-4 Nov.	0.00	NIL	33.50	11.60	81.00	21.00	44	29-4 Nov.	8.50	1	31.00	14.90	79.00	33.00
45	5-12	0.00	NIL	32.30	11.20	80.00	25.00	45	5-12	0.00	NIL	31.70	16.80	77.00	39.00

Table 2 Analysis of variance (Pooled F_1) for physical, agronomic, and pathological traits, Akola and Patancheru, 1996

Sr. No.	Characters	Sources and degrees of freedom									
		Environ ments (1)	Treat-ments (54)	Parents (9)	Hybrids (44)	Parents vs hybrids (1)	Treat - ments × Env. (54)	Parents ×Env. (9)	Hybrids × Env. (44)	Parents vs. Hybrids × Env. (1)	Error (108)
1	100 grain weight	170.26**	7.25**	12.03**	6.15**	12.45**	1.91**	2.36*	1.78**	3.32	0.05
2	Grain hardness	302.43**	4.77**	4.38**	4.80**	7.04**	1.59**	2.16*	1.37	6.18*	0.60
3	Endosperm texture	11.71**	13.26**	18.67**	11.04**	62.38**	1.80**	0.55	2.09**	0.56	37.10
4	Elc. conductivity	419.70**	14.69**	27.16**	8.48**	175.73**	6.60**	11.84**	4.44**	54.24**	2111.85
5	DTF	122.67**	25.55**	18.42**	26.84**	33.16**	5.78**	3.09**	6.11**	15.33**	5.18
6	Plant height	0.26	39.60**	45.36**	28.08**	494.63**	2.55**	4.56**	2.11**	3.88	206.43
7	Cob length	17.43**	4.49**	4.24**	3.89**	33.02**	0.87	0.99	0.87	0.31	5.32
8	Glume covering	19.99**	4.11**	4.86**	4.01**	1.70	1.29	0.95	1.32	2.70	88.80
9	Mesocar thickness	0.67	54.57**	28.44**	55.34**	255.80**	1.64*	2.38*	1.49*	1.69	25.46
10	TGMR	192.86**	27.42**	31.12**	26.04**	54.92**	8.27**	7.48**	8.26**	15.64**	0.12
11	Germination	726.47**	25.22**	24.70**	19.40**	285.70**	4.66**	4.40**	4.27**	24.43**	22.87
12	*F. moniliforme*	637.64**	4.73**	5.60**	4.10**	24.35**	1.65**	0.99	1.82**	0.08	76.78
13	*F. pallidoroseum*	603.45**	1.84**	1.17	1.95**	3.21	1.71**	1.10	1.87**	0.05	10.17
14	*C. lunata*	333.63**	3.49**	5.00**	3.04**	9.70**	2.70**	1.47	3.02**	0.01	68.76
15	Other fungi	426.93**	1.81**	0.99	1.64*	16.55**	1.43**	0.77	1.59*	0.32	36.48

Figures in parenthesis indicate degrees of freedom
* Significant at 5%
** Significant at 1%

Table 3 Analysis of variance (Pooled F_2) for physical, agronomic and pathological traits, Akola and Patancheru, 1996

Sr. No.	Characters	Environments (locations) (1)	Treatments (54)	Parents (9)	F_2 crosses (44)	Parents vs F_2 crosses (1)	Treatments ×Env. (54)	Parents × Env. (9)	F_2 crosses ×Env. (44)	Parents vs . F_2 crosses × Env. (1)	Error (108)
1	Grain hardness	341.10**	5.42**	4.90**	3.53**	93.71**	3.48**	2.65**	3.55**	7.55**	0.50
2	Ele. conductivity	269.45**	33.45**	39.75**	31.97**	42.06**	9.76**	17.56**	5.01**	148.62**	1443.08
3	Plant height	308.94**	6.80**	18.16**	4.56**	3.24	3.15**	1.59	2.68**	37.70**	458.94
4	Cob length	0.30	5.44**	6.06**	4.86**	25.39**	1.55*	1.47	1.48*	5.72**	3.77
5	Glume covering	0.11	3.37**	6.09**	2.79**	4.81*	0.87	0.85	0.90	0.02	41.04
6	TGMR	140.22**	10.17**	28.31**	4.23**	108.05**	2.36**	5.00**	1.61*	11.23**	11.82
7	Germinaton	215.10**	7.63**	12.40**	4.44**	104.86**	2.57**	1.86	2.08**	30.52**	46.24
8	*F. moniliforme*	130.25**	1.81**	2.87**	1.13	22.02**	1.01	1.26	0.95	1.15	121.77
9	*F. pallidoroseum*	101.49**	1.16	1.01	0.97	11.18**	1.41*	1.49	0.50	40.89**	314.27
10	*C. lunata*	116.39**	2.59**	3.59**	2.35**	4.28*	1.47*	1.80	1.40	1.92	94.42
11	Other fungi	70.46**	1.15	1.16	1.08	4.02*	1.52*	0.80	1.10	26.66**	29.77

Figures in parenthesis indicate degrees of freedom

* Significant at 5%

** Significant at 1%

Table. 4 Analysis of variance for biochemical characters of parental lines and F_1 crosses at Akola, 1995. Akola 1995

Sr.No.	Characters	Sources and degrees of freedom					
		Replications (1)	Treatments (54)	Parents (9)	Hybrids (44)	Parents vs. Hybrids (1)	Error (54)
1	Protein	0.302	211.761**	65.035**	104.552**	6249.488**	0.00103
2	Soluble sugars	0.507	8.629**	9.018**	6.565**	95.940**	0.00324
3	Tannins	3.206	2061.853**	3809.883**	1747.343**	168.055**	0.00028
4	Flavan-4-ols	3.558	846.121**	1267.962**	769.066**	439.937**	0.0028

Figures in parenthesis indicate degrees of freedom.

* Significant at 5%

** Significant at 1%

Table : 5 Mean values of parents and F_1 crosses for different characters in 10 × 10 diallel of sorghum Akola and Patancheru, 1996

Sr. No	Parents/Crosses	100 grain weight (g)			Grain hardness kg/cm^{-2}			Endosperm texture (%)			Ele. conductivity (millimhose)			Days' to 50% flowering		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	SPV-1201	2.81	2.51	2.66	8.67	6.03	7.35	30.80	27.90	29.35	159.50	397.50	278.50	73.00	78.00	75.50
2	ICSB-101B	2.51	1.61	2.06	6.94	5.58	6.26	26.15	29.70	27.93	242.50	372.00	307.25	72.00	73.00	72.50
3	AKms-14B	2.57	1.36	1.97	6.95	3.15	5.05	32.80	34.00	33.40	188.50	571.00	379.75	68.50	70.00	69.25
4	SRT-26B	2.06	1.47	1.76	6.56	4.44	5.50	32.10	40.55	36.33	300.50	445.00	372.75	69.50	73.50	71.50
5	GJ-35-15-15	2.24	1.58	1.91	8.11	4.52	6.31	22.40	25.90	24.15	218.20	342.50	280.25	77.50	79.00	78.25
6	SPV-946	2.19	1.73	1.96	7.25	3.75	5.50	35.05	27.65	31.35	151.50	446.50	299.00	77.50	78.00	77.75
7	SPV-104	2.90	2.54	2.72	6.08	2.78	4.43	46.80	52.25	49.53	260.00	846.50	553.25	80.00	76.50	78.25
8	IS-2284	1.76	1.45	1.60	5.91	4.48	5.20	56.95	56.25	56.60	108.00	226.50	167.25	70.00	76.50	73.25
9	IS-6335	1.69	1.59	1.64	6.68	5.52	6.10	55.85	55.95	55.90	122.00	214.00	168.00	66.00	59.00	62.50
10	IS-9471	1.91	1.73	1.82	6.10	5.32	5.72	55.30	59.15	57.23	105.00	231.50	168.25	71.50	70.50	71.00
11	SPV-1201 x ICSB – 101B	2.62	2.38	2.50	7.14	7.05	7.09	32.10	29.25	30.67	138.00	292.00	215.00	74.50	83.50	79.00
12	SPV-1201 x AKms – 14 B	2.61	1.85	2.23	5.57	5.24	5.40	38.75	36.55	37.65	150.00	399.50	274.75	75.00	83.50	79.25
13	SPV-1201 x SRT – 26B	3.25	2.08	2.66	7.23	5.25	6.24	43.25	40.80	42.03	155.00	287.50	221.25	76.00	85.50	80.75
14	SPV-1201 x GJ-35-15-15	2.53	1.80	2.17	7.85	7.43	7.64	21.15	29.10	25.13	135.00	275.00	205.00	74.50	85.50	80.00
15	SPV-1201 x SPV – 946	1.99	2.06	2.02	6.97	6.88	6.92	33.95	35.80	34.88	237.50	278.00	257.75	76.00	80.50	78.25
16	SPV-1201 x SPV – 104	3.41	2.47	2.94	6.46	6.22	6.34	45.05	48.35	46.70	144.00	408.00	276.00	74.50	85.50	80.00
17	SPV-1201 x IS – 2284	2.26	1.77	2.02	7.30	4.55	5.93	48.00	57.75	52.88	118.00	201.50	259.75	71.00	82.00	76.50
18	SPV-1201 x IS-6335	2.29	1.72	2.00	7.60	5.05	6.32	45.35	50.15	47.25	102.50	209.50	156.00	71.50	82.00	76.75
19	SPV-1201 x IS - 9471	2.71	2.09	2.40	6.08	5.23	5.65	51.05	56.20	53.63	112.50	217.00	164.75	74.00	80.50	77.25
20	ICSB – 101B x AKms 14 B	1.92	1.88	1.90	6.86	3.95	5.40	45.00	42.95	45.47	156.00	358.50	257.25	68.00	71.00	69.50
21	ICSB – 101B x SRT – 26 B	1.95	1.79	1.87	5.27	3.80	4.53	41.30	35.15	38.22	167.00	284.50	225.75	68.50	70.00	69.25
22	ICSB – 101B x GJ-35-15-15	1.95	1.77	1.87	6.64	5.12	5.88	31.10	25.55	28.33	164.00	257.50	210.75	72.00	74.00	73.00
23	ICSB – 101B x SPV – 946	2.43	1.82	2.13	7.32	5.60	6.46	35.80	38.35	37.07	124.50	339.50	232.00	70.50	80.50	75.50
24	ICSB – 101B x SPV – 104	2.88	2.58	2.72	6.64	3.90	5.28	39.75	41.95	40.85	150.50	400.00	275.25	71.00	73.00	72.00
25	ICSB – 101B x IS – 2284	2.08	2.20	2.14	6.44	4.61	5.53	46.10	55.15	50.63	106.50	167.00	136.75	69.50	71.00	70.25
26	ICSB – 101B x IS – 6335	2.08	2.04	2.06	6.70	5.94	6.32	43.55	50.65	47.10	99.00	122.00	110.50	62.00	60.00	61.00
27	ICSB – 101B x IS – 9471	2.17	2.17	2.17	5.88	5.07	5.48	54.90	53.15	54.03	94.00	154.00	126.50	66.00	70.50	68.25
28	AKms – 14 B x SRT – 26B	2.11	1.94	2.03	3.96	2.85	3.40	54.00	52.20	53.10	230.00	343.00	286.50	66.50	70.50	68.50
29	AKms – 14 B x GJ-35-15-15	1.79	1.77	1.70	4.64	2.82	3.73	38.25	44.70	41.47	157.50	342.50	250.00	68.00	70.00	69.25
30	AKms – 14 B x SPV – 946	2.49	2.06	2.28	6.32	3.63	4.97	55.35	50.20	52.78	150.50	347.50	249.00	66.00	70.50	68.25
31	AKms – 14 B x SPV – 104	2.88	2.22	2.55	4.89	3.45	4.17	56.30	57.20	56.75	177.00	485.00	331.00	68.00	71.50	69.75
32	AKms – 14 B x IS – 2284	2.38	1.76	2.07	6.19	4.77	5.48	55.75	66.60	61.17	114.00	172.50	143.25	65.00	71.50	68.50
33	AKms – 14 B x IS – 6335	2.42	2.05	2.23	6.72	4.22	5.47	64.55	63.25	63.90	98.50	122.50	110.50	60.50	59.00	59.75
34	AKms – 14 B x IS – 9471	2.25	2.32	2.29	5.35	4.04	4.70	58.80	62.15	60.48	100.50	134.50	117.50	65.00	60.00	62.50

able 5 Condt.. .. .. .

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SRT – 26B x GJ-35-15-15	2.16	1.59	1.88	6.95	4.52	5.74	41.30	33.25	37.28	149.50	407.00	278.25	70.00	73.00	71.50
SRT – 26B x SPV – 946	2.38	2.02	2.20	5.84	4.53	5.18	46.35	41.90	44.13	174.00	267.50	220.75	72.00	75.00	73.50
SRT – 26B x SPV – 104	2.72	2.13	2.42	6.45	3.99	5.22	52.55	50.65	51.60	166.50	329.00	247.50	66.50	71.50	69.50
SRT – 26B x IS – 2284	2.27	1.81	2.04	5.36	4.92	5.14	46.75	57.70	52.22	119.00	140.00	129.50	60.50	71.50	66.00
SRT – 26B x IS – 6335	2.31	1.87	2.09	6.09	4.18	5.13	59.65	60.15	59.90	123.00	84.50	103.75	59.50	60.00	59.75
SRT – 26B x IS – 9471	2.15	2.15	2.15	5.63	3.53	4.58	34.50	64.00	49.25	201.00	113.00	157.00	70.50	71.00	70.75
GJ-35-15-15 x SPV – 946	2.50	1.72	2.11	7.68	3.77	5.73	36.15	30.45	33.30	184.50	318.50	251.50	76.00	78.50	77.25
GJ-35-15-15 x SPV 104	2.26	2.12	2.19	7.28	3.83	5.55	48.35	41.10	44.72	186.00	387.00	286.50	72.50	74.00	73.25
GJ-35-15-15 x IS – 2284	1.92	1.56	1.74	7.03	4.27	5.65	46.30	59.10	52.70	129.00	168.00	128.50	65.50	77.00	71.25
GJ-35-15-15 x IS – 6335	2.03	1.51	1.77	5.77	4.06	4.91	46.85	61.10	53.97	106.50	120.00	113.25	63.00	67.00	65.00
GJ-35-15-15 x IS – 9471	2.02	1.84	1.93	5.91	4.24	5.07	42.90	61.60	52.25	157.00	172.00	164.50	72.00	71.50	71.25
SPV – 946 x SPV – 104	2.79	2.13	2.46	6.41	3.85	5.13	43.40	44.30	43.85	138.50	475.00	306.75	72.00	78.50	75.25
SPV – 946 x IS – 2284	2.48	1.74	2.11	6.22	4.52	5.37	35.50	55.70	45.60	108.00	115.50	111.75	66.00	71.50	68.75
SPV – 946 x IS – 6335	1.99	1.72	1.85	6.99	4.72	5.86	36.05	53.80	44.92	115.50	126.50	121.00	67.50	93.50	75.50
SPV – 946 x IS 9471	2.04	2.07	2.06	6.42	4.35	5.39	45.75	56.75	51.25	122.50	82.00	102.25	74.50	59.00	66.75
SPV – 104 x IS 2284	2.32	2.03	2.17	4.45	3.58	4.01	72.25	56.35	64.30	118.50	252.50	185.50	68.50	74.00	71.25
SPV – 104 x IS 6335	2.34	1.99	2.16	5.33	3.44	4.38	74.00	64.25	69.13	114.50	169.50	142.00	63.00	59.00	61.00
SPV – 104 x IS 9471	2.71	2.59	2.65	4.69	3.58	4.13	68.55	63.20	65.88	107.50	104.00	105.75	64.00	59.00	61.50
IS 2284 x IS –6335	1.76	1.63	1.69	6.83	4.36	5.59	53.20	55.85	54.53	108.00	188.50	148.25	62.00	70.50	66.25
IS 2284 x IS - 9471	1.94	1.76	1.86	5.63	4.75	5.19	53.65	62.05	57.85	114.00	187.00	150.50	70.00	74.00	72.00
IS 6335 x IS 9471	2.19	1.75	1.97	5.32	4.37	4.85	53.40	56.65	55.03	90.00	159.00	124.50	62.00	59.00	60.50
Parental range	1.69 to 2.90	1.36 to 2.54	1.60 to 2.72	5.91 to 8.67	2.78 To 6.03	4.43 to 7.35	22.40 to 56.95	25.90 to 59.15	24.15 to 57.23	105.00 to 300.50	214.00 to 846.50	167.25 to 553.25	66.00 to 80.00	59.00 to 79.00	62.50 to 78.25
Hybrid range	1.76 to 3.41	1.51 to 2.58	1.68 to 2.94	3.96 to 7.85	2.82 To 7.43	3.40 to 7.64	21.15 to 74.00	25.55 to 66.60	25.13 to 69.13	90.00 to 237.50	82.00 to 485.00	102.25 to 331.00	59.50 to 76.00	59.00 to 85.50	59.75 to 80.75
SE (m)	0.155	0.090	0.249	0.479	0.549	1.051	2.628	3.402	3.730	17.909	42.758	85.400	0.852	0.639	3.452
CD at 5%	0.442	0.257	0.710	1.367	1.567	3.000	7.502	9.711	10.650	51.110	122.028	243.721	2.433	1.825	9.854

L_1 = Akola L_2 = Patancheru

Table : 6 Mean values of parents and F_1 crosses for different characters

Sr. No.	Parents/Crosses	Plant height (cm)			Cob length (cm)			Glume covering (%)			Mesocarp thickness (µm)			TGMR		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	SPV-1201	226.00	243.50	234.75	23.10	22.50	21.80	50.00	50.00	50.00	67.99	73.23	70.61	3.00	4.00	3.50
2	ICSB-101B	164.50	166.50	165.50	26.20	28.90	27.55	75.00	75.00	75.00	97.52	96.57	97.05	3.00	4.50	3.75
3	AKms-14B	136.00	140.00	138.00	24.10	23.30	23.70	50.00	50.00	50.00	72.37	64.67	68.52	4.00	5.00	4.50
4	SRT-26B	157.00	179.00	168.00	23.10	25.40	24.25	50.00	50.00	50.00	78.86	86.48	82.67	3.00	4.50	3.75
5	GJ-35-15-15	262.00	237.00	249.50	23.30	24.30	23.80	50.00	50.00	50.00	64.86	74.53	69.70	2.50	4.50	3.50
6	SPV-946	283.00	264.00	237.75	23.30	23.70	23.50	50.00	50.00	50.00	45.45	62.59	54.02	2.00	4.50	3.25
7	SPV-104	218.00	178.50	198.25	21.20	17.00	19.10	62.50	50.00	56.25	87.50	90.42	88.96	3.50	5.00	4.25
8	IS-2284	214.50	282.50	248.50	22.30	22.20	22.25	50.00	75.00	62.50	92.38	87.38	89.88	2.00	2.00	2.00
9	IS-6335	241.50	254.50	248.00	23.20	27.00	25.10	75.00	75.00	75.00	72.33	74.84	74.08	2.00	2.00	2.00
10	IS-9471	257.00	285.00	271.25	24.90	27.70	26.30	50.00	50.00	50.00	66.02	59.91	62.96	2.00	1.50	1.75
11	SPV-1201 x ICSB – 101B	299.50	318.50	309.00	23.70	24.00	23.85	50.00	50.00	50.00	59.07	61.22	60.15	2.75	3.00	2.88
12	SPV-1201 x AKms – 14 B	301.00	283.50	292.25	22.30	22.10	22.20	37.50	50.00	43.75	94.64	89.22	91.93	3.00	4.00	3.50
13	SPV-1201 x SRT – 26B	269.50	269.00	269.25	21.30	22.80	22.05	37.50	50.00	43.75	91.67	88.29	89.98	2.75	3.50	3.13
14	SPV-1201 x GJ-35-15-15	281.00	313.00	297.00	24.80	26.70	25.75	50.00	50.00	50.00	86.46	84.12	85.29	2.75	3.00	2.88
15	SPV-1201 x SPV – 946	233.50	255.00	244.25	25.80	23.60	24.70	37.50	50.00	43.75	68.14	63.03	65.58	2.50	4.00	3.25
16	SPV-1201 x SPV – 104	280.50	297.50	289.00	20.40	21.50	20.95	50.00	62.50	56.25	82.95	80.88	81.92	3.00	4.50	3.75
17	SPV-1201 x IS – 2284	293.00	318.00	305.50	22.90	24.60	23.75	37.50	62.50	50.00	60.48	63.00	61.74	2.00	2.00	2.00
18	SPV-1201 x IS-6335	340.00	319.00	329.50	26.30	27.60	26.95	62.50	75.00	68.75	43.69	42.97	43.33	2.00	2.00	2.00
19	SPV-1201 x IS – 9471	343.00	340.00	341.50	27.30	28.60	27.95	37.50	62.50	50.00	40.65	38.59	39.62	2.00	2.00	2.00
20	ICSB – 101B x AKms 14 B	183.00	183.00	183.00	29.30	30.20	29.75	50.00	50.00	50.00	78.74	81.72	80.23	3.50	5.00	4.25
21	ICSB – 101B x SRT – 26 B	222.00	220.00	221.00	28.90	30.00	29.45	62.50	75.00	68.75	87.46	86.81	87.13	3.00	5.00	4.00
22	ICSB – 101B x GJ-35-15-15	266.00	246.00	256.00	28.50	28.80	28.65	50.00	62.50	56.25	90.76	91.80	91.28	3.00	3.50	3.25
23	ICSB – 101B x SPV – 946	298.00	290.00	294.00	28.10	25.80	26.95	50.00	62.50	56.25	82.34	81.59	81.96	2.75	3.00	2.88
24	ICSB – 101B x SPV – 104	217.50	204.00	210.75	24.10	26.40	25.25	50.00	50.00	50.00	85.97	81.44	83.71	3.00	4.00	3.50
25	ICSB – 101B x IS – 2284	306.00	310.00	308.00	27.30	27.60	27.45	50.00	62.50	56.25	44.26	53.76	49.01	2.00	2.00	2.00
26	ICSB – 101B x IS – 6335	312.00	295.50	303.25	28.50	30.40	29.45	75.00	75.00	75.00	40.50	33.74	37.13	2.00	2.00	2.00
27	ICSB – 101B x IS – 9471	305.00	294.00	399.50	29.50	32.10	30.80	50.00	50.00	50.00	52.59	47.11	49.85	2.00	2.00	2.00
28	AKms – 14 B x SRT – 26B	196.00	210.00	203.00	24.00	21.00	25.55	50.00	50.00	50.00	96.79	99.56	98.13	3.50	5.00	4.25
29	AKms – 14 B x GJ-35-15-15	208.00	231.00	219.50	27.20	29.70	28.45	50.00	75.00	62.50	63.89	67.13	65.51	3.00	5.00	4.00
30	AKms – 14 B x SPV – 946	286.00	276.00	281.00	26.80	26.90	26.85	50.00	75.00	62.50	60.39	67.17	63.78	3.50	5.00	4.25
31	AKms – 14 B x SPV – 104	191.00	207.50	199.25	22.80	24.10	23.45	50.00	50.00	50.00	60.18	60.36	60.27	3.50	5.00	4.25
32	AKms – 14 B x IS – 2284	271.00	274.50	276.75	24.80	25.30	25.05	37.50	50.00	43.75	55.22	60.23	57.72	2.00	2.00	2.00
33	AKms – 14 B x IS – 6335	293.50	253.50	273.50	25.30	27.50	26.40	62.50	62.50	62.50	43.52	49.30	46.31	2.00	1.50	1.75
34	AKms – 14 B x IS – 9471	299.00	287.00	293.00	27.80	29.00	28.40	50.00	37.50	43.75	52.92	52.32	52.62	2.00	1.50	1.75

Table 6 Condt.. .. ..

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
35	SRT – 26B x GJ-35-15-15	206.50	197.50	202.00	26.70	24.70	25.70	50.00	50.00	50.00	62.66	64.15	63.40	3.00	5.00	4.00
36	SRT – 26B x SPV – 946	253.00	254.00	253.50	23.90	27.50	25.70	50.00	50.00	50.00	85.91	93.56	89.73	2.75	4.00	3.38
37	SRT – 26B x SPV – 104	213.50	213.50	213.50	22.10	24.80	23.45	50.00	50.00	50.00	87.56	86.00	86.78	3.00	5.00	4.00
38	SRT – 26B x IS – 2284	301.50	307.00	304.25	24.10	27.30	25.70	50.00	50.00	50.00	63.61	62.16	62.89	2.50	2.00	2.25
39	SRT – 26B x IS – 6335	274.50	248.50	261.50	23.40	26.55	24.98	62.50	62.50	62.50	59.67	62.79	61.23	2.50	2.00	2.25
40	SRT – 26B x IS – 9471	259.50	282.50	271.00	22.80	30.60	26.70	50.00	50.00	50.00	57.32	49.58	53.45	2.50	1.50	2.00
41	GJ-35-15-15 x SPV – 946	275.00	244.50	260.50	23.20	22.20	22.70	50.00	62.50	56.25	75.72	61.34	68.53	2.50	5.00	3.75
42	GJ-35-15-15 x SPV 104	303.50	255.50	279.50	23.00	24.90	23.95	50.00	50.00	50.00	67.44	80.61	74.03	2.25	5.00	3.63
43	GJ-35-15-15 x IS – 2284	319.50	320.50	300.00	27.60	26.70	27.15	62.50	62.50	62.50	45.97	53.74	49.85	2.00	2.00	2.00
44	GJ-35-15-15 x IS – 6335	329.00	303.50	316.25	29.70	26.50	28.10	62.50	75.00	68.75	36.55	35.90	36.06	2.00	2.00	2.00
45	GJ-35-15-15 x IS – 9471	291.50	308.00	299.75	25.70	31.05	28.38	50.00	50.00	50.00	48.55	33.89	41.22	2.50	1.50	2.00
46	SPV – 946 x SPV – 104	311.50	288.50	300.00	25.10	25.00	25.05	50.00	75.00	62.50	49.41	68.85	59.13	2.00	5.00	3.75
47	SPV – 946 x IS – 2284	279.50	297.50	288.50	21.40	28.20	24.80	50.00	37.50	43.75	56.92	50.69	53.81	2.50	2.00	2.25
48	SPV – 946 x IS – 6335	297.50	322.00	309.25	26.00	27.10	26.55	62.50	75.00	68.75	43.94	38.51	41.22	2.00	2.00	2.00
49	SPV – 946 x IS 9471	328.50	288.00	308.25	26.10	29.20	27.65	62.50	50.00	56.25	33.78	35.56	34.67	2.00	2.00	2.00
50	SPV – 104 x IS 2284	288.50	302.00	295.25	22.70	22.60	22.65	37.50	75.00	56.25	37.09	39.47	38.28	2.00	3.00	2.50
51	SPV – 104 x IS 6335	297.50	269.50	293.50	26.50	27.60	27.05	75.00	75.00	75.00	32.03	31.32	31.68	2.00	2.00	2.00
52	SPV – 104 x IS 9471	283.50	256.00	269.75	25.30	28.40	26.85	37.50	50.00	43.75	47.26	46.23	46.95	2.00	2.00	2.00
53	IS 2284 x IS –6335	280.50	302.50	291.50	25.60	26.30	25.95	75.00	75.00	75.00	61.75	62.57	62.16	2.00	1.50	1.75
54	IS 2284 x IS - 9471	270.00	301.00	285.50	23.30	25.30	24.30	37.50	37.50	37.50	66.72	64.73	65.73	2.00	2.00	2.00
55	IS 6335 x IS 9471	287.50	274.00	280.75	29.40	28.55	28.98	50.00	50.00	50.00	32.20	33.82	33.01	2.00	1.50	1.75
	Parental range	136.00	140.00	138.00	21.20	17.00	19.10	50.00	50.00	50.00	45.45	59.91	54.02	2.00	1.50	1.75
		to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
		283.00	285.50	273.75	26.20	28.90	27.55	75.00	75.00	75.00	97.52	96.57	97.05	4.00	5.00	4.50
	Hybrid range	183.00	183.00	183.00	20.40	21.00	20.95	37.50	37.50	37.50	32.20	33.82	33.01	2.00	1.50	1.75
		to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
		343.00	340.00	341.50	29.70	32.10	30.80	75.00	75.00	75.00	96.79	99.56	98.13	3.50	5.00	4.25
	SE (m)	3.708	6.047	11.12	1.634	1.434	1.169	6.306	6.077	5.899	2.926	6.773	2.040	0.207	0.252	0.565
	CD at 5%	10.582	17.257	37.713	4.664	4.093	3.338	17.998	17.343	16.835	8.352	19.330	5.822	0.593	0.719	1.614

Table : 7 Mean values of parents and F_1 crosses for different characters in 10 × 10 diallel of sorghum Akola and Patancheru, 1996

Sr. No	Parents/Crosses	Germination (%)			*F. moniliforme* (%)			*F. pallidoroseum* (%)			*C. lunata* (%)			Other fungi (%)		
		L1	L2	Pooled	L1	L2	P.	L1	L2	P.	L1	L2	P.	L1	L2	P.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	SPV-1201	67.50 (55.25)	30.00 (33.07)	48.75 (44.15)	20.67	54.67	37.67	0.71	12.00	6.36	56.00	34.67	45.33	23.33	1.02	12.18
2	ICSB-101B	47.00 (43.25)	26.50(30.98)	36.75(37.11)	26.67	52.67	39.67	0.71	12.67	6.69	58.00	28.00	43.00	15.34	6.08	10.67
3	AKms-14B	29.00(32.53)	2.50(8.64)	15.75(20.58)	46.00	58.67	52.33	0.71	7.34	4.02	44.00	34.00	9.00	9.34	1.02	5.18
4	SRT-26B	81.50(64.62)	12.00(20.12)	46.75(42.37)	26.01	51.34	38.67	2.36	10.00	6.18	56.00	37.33	46.67	16.00	1.69	8.85
5	GJ-35-15-15	72.50(51.40)	29.50(32.89)	51.00(42.15)	18.66	52.67	35.66	0.71	13.34	7.02	60.00	30.00	45.00	21.34	4.08	12.67
6	SPV-946	75.50(60.29)	18.00(25.09)	46.75(42.69)	18.00	62.67	40.34	1.02	14.67	7.84	57.34	26.00	41.67	26.00	1.02	13.51
7	SPV-104	50.00(45.00)	6.00(13.98)	28.00(29.49)	38.67	71.34	55.00	0.71	10.00	5.36	44.67	18.67	31.67	16.00	0.71	8.36
8	IS-2284	82.50(65.03)	61.00(51.36)	71.75(58.19)	20.00	48.00	33.99	1.69	19.34	10.51	46.67	24.00	35.33	24.67	5.33	15.00
9	IS-6335	86.00(68.04)	53.00(46.73)	69.50(57.39)	7.99	47.33	27.66	2.67	10.67	6.67	26.00	15.33	20.67	20.00	5.34	12.67
10	IS-9471	79.00(63.04)	48.50(44.14)	63.75(53.58)	5.33	34.00	19.67	1.02	10.00	5.51	24.00	22.67	23.34	20.00	7.34	13.67
11	SPV-1201 x ICSB – 101B	85.00(67.26)	66.00(54.34)	75.50(60.00)	18.01	53.33	35.67	1.69	12.00	6.84	56.67	29.33	43.00	24.00	5.34	14.67
12	SPV-1201 x AKms – 14 B	62.50(52.25)	34.00(35.65)	48.25(43.95)	13.34	55.33	34.34	0.71	16.67	8.69	61.33	21.34	41.33	25.33	8.00	16.67
13	SPV-1201 x SRT – 26B	85.00(67.63)	69.50(56.49)	77.25(62.06)	15.34	36.00	25.67	0.71	10.00	5.36	50.67	30.00	40.33	34.00	24.00	29.00
14	SPV-1201 x GJ-35-15-15	64.50(53.47)	58.50(49.90)	61.50(51.68)	29.33	40.00	34.67	1.69	12.00	6.84	50.67	26.66	38.67	19.34	20.66	20.00
15	SPV-1201 x SPV – 946	57.00(49.05)	62.00(52.02)	59.50(50.53)	35.99	42.00	38.99	0.71	10.67	5.69	50.00	26.00	38.00	16.00	21.33	18.67
16	SPV-1201 x SPV – 104	78.00(62.12)	32.00(34.36)	55.00(48.24)	14.67	48.00	31.33	0.71	7.34	4.02	55.33	37.33	46.33	32.67	9.34	21.00
17	SPV-1201 x IS – 2284	98.00(82.14)	75.50(60.43)	86.75(71.28)	8.36	37.34	22.85	2.35	16.67	9.51	28.00	32.00	30.00	21.33	8.66	15.00
18	SPV-1201 x IS-6335	97.00(80.17)	66.00(54.60)	81.50(67.39)	7.34	40.00	23.67	0.71	16.00	8.35	18.00	31.34	24.67	18.67	10.00	14.34
19	SPV-1201 x IS - 9471	94.00(76.72)	67.50(55.24)	80.75(65.98)	8.66	6.00	17.33	2.00	12.66	7.30	18.00	28.00	23.00	17.33	10.00	13.66
20	ICSB – 101B x AKms 14 B	66.50(54.70)	42.50(40.69)	54.50(47.69)	19.34	56.00	37.67	1.69	14.66	8.18	59.33	16.66	38.00	19.34	6.00	12.67
21	ICSB – 101B x SRT – 26 B	67.50(55.25)	39.00(38.65)	53.25(46.95)	11.99	66.67	39.33	0.71	18.67	9.69	68.00	14.00	41.00	21.34	1.33	11.33
22	ICSB – 101B x GJ-35-15-15	72.50(58.42)	58.00(49.61)	65.25(54.02)	9.34	55.33	32.33	0.71	16.00	8.36	67.33	22.67	45.00	23.34	6.00	14.67
23	ICSB – 101B x SPV – 946	77.50(61.75)	63.00(52.51)	70.25(57.16)	14.67	58.00	36.33	3.02	16.66	9.89	49.33	22.00	35.67	34.00	2.00	18.00
24	ICSB – 101B x SPV – 104	58.50(49.89)	37.00(37.44)	47.75(43.67)	34.01	70.67	52.34	0.71	21.34	11.02	49.33	8.00	28.67	17.34	0.71	9.02
25	ICSB – 101B x IS – 2284	95.00(77.14)	85.00(67.50)	90.00(72.32)	14.66	32.00	23.33	0.71	5.34	3.02	38.00	20.66	29.33	33.33	8.67	21.00
26	ICSB – 101B x IS – 6335	91.00(72.56)	88.50(70.54)	89.75(71.55)	9.99	21.34	15.66	1.02	6.67	3.85	26.66	14.00	20.33	34.00	7.33	20.66
27	ICSB – 101B x IS – 9471	96.50(79.24)	80.00(63.78)	88.25(71.51)	10.68	22.66	16.67	1.69	8.00	4.84	27.34	21.34	24.33	26.67	8.00	17.33
28	AKms–14 B x SRT – 26B	62.50(52.23)	26.00(30.62)	44.25(41.43)	28.67	54.67	41.67	1.69	11.34	6.51	50.67	24.66	37.67	19.34	5.33	12.33
29	AKms–14 B x GJ-35-15-15	49.50(44.71)	33.50(35.34)	41.50(40.03)	23.32	53.33	38.33	4.0	15.33	9.66	52.67	26.67	39.67	19.33	5.33	12.33
30	AKms–14 B x SPV – 946	64.00(54.93)	24.00(29.01)	44.00(41.97)	17.34	49.33	33.33	0.71	14.67	7.69	59.33	30.66	45.00	23.34	5.33	14.33
31	AKms–14 B x SPV – 104	32.50(34.66)	18.00(25.04)	25.25(29.85)	35.33	54.67	45.00	4.67	18.67	11.67	48.00	20.00	34.00	12.00	6.00	9.00
32	AKms–14 B x IS – 2284	89.00(70.65)	55.00(47.87)	72.00(59.26)	15.34	36.67	26.00	6.0	13.34	9.67	47.33	31.34	39.33	27.34	10.00	18.67
33	AKms–14 B x IS – 6335	94.00(76.26)	77.00(61.63)	85.50(68.91)	14.01	25.34	19.67	3.33	8.67	6.0	30.67	20.00	25.33	37.34	6.00	21.67
34	AKms–14 B x IS – 9471	83.00(65.69)	77.00(61.48)	80.00(63.58)	16.67	37.34	27.00	2.35	10.66	6.51	39.33	22.66	31.00	22.00	8.00	15.00

Contd.. .. ..

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
35	SRT – 26B x GJ-35-15-15	88.50(70.80)	37.00(37.46)	67.25(53.82)	12.68	67.33	40.01	0.71	16.66	8.69	55.33	12.00	33.67	34.00	3.69	18.84
36	SRT – 26B x SPV – 946	71.00(57.44)	44.50(41.83)	57.75(49.64)	26.01	62.67	44.33	0.71	16.66	8.69	54.00	18.67	36.33	20.66	1.39	11.18
37	SRT – 26B x SPV – 104	58.50(49.93)	44.00(41.56)	51.25(45.74)	30.67	52.00	41.33	1.69	15.34	8.51	53.33	26.67	40.00	15.34	4.00	9.67
38	SRT – 26B x IS – 2284	98.50(75.24)	64.00(53.22)	78.75(64.23)	11.32	40.67	26.00	1.69	10.00	5.84	46.00	22.67	34.33	34.00	5.34	19.67
39	SRT – 26B x IS – 6335	92.00(73.57)	73.50(59.14)	82.75(66.35)	10.01	34.00	22.00	3.34	7.33	5.33	36.67	15.33	26.00	25.34	6.00	15.67
40	SRT – 26B x IS – 9471	89.00(64.87)	79.50(63.46)	84.25(64.17)	9.34	31.33	20.34	3.02	9.33	6.17	31.34	14.66	23.00	17.34	4.66	11.00
41	GJ-35-15-15 x SPV – 946	52.00(56.10)	28.50(32.25)	40.25(44.17)	20.00	60.00	40.00	1.02	10.00	5.51	56.00	25.33	40.67	24.66	5.34	15.00
42	GJ-35-15-15 x SPV 104	69.00(60.25)	24.00(29.31)	46.50(44.78)	22.66	59.33	41.00	2.67	15.33	9.00	50.00	20.00	35.00	18.66	6.66	12.66
43	GJ-35-15-15 x IS – 2284	86.50(67.21)	73.00(58.79)	79.75(63.00)	9.34	40.00	24.67	4.67	10.66	7.67	38.67	16.67	27.67	18.67	4.66	11.67
44	GJ-35-15-15 x IS – 6335	90.00(74.32)	79.50(63.12)	84.75(68.72)	13.99	44.67	29.33	4.67	12.67	8.67	32.00	19.34	25.67	22.00	8.00	15.00
45	GJ-35-15-15 x IS – 9471	89.00(61.13)	65.00(53.74)	77.00(57.44)	7.99	46.67	27.33	1.33	17.34	9.33	32.00	21.34	26.67	22.66	7.34	15.00
46	SPV – 946 x SPV – 104	81.50(68.04)	14.00(21.94)	47.75(44.98)	11.33	68.67	40.00	1.02	7.33	4.18	58.00	22.00	40.00	32.00	2.35	17.18
47	SPV – 946 x IS – 2284	87.50(64.22)	68.50(55.85)	78.00(60.10)	15.34	50.00	32.67	4.67	17.34	11.00	30.67	22.00	26.33	23.34	6.00	14.67
48	SPV – 946 x IS – 6335	96.00(77.21)	60.00(50.85)	78.00(64.03)	11.99	52.00	32.00	2.35	21.34	11.85	29.34	20.67	25.00	26.00	4.00	15.00
49	SPV – 946 x IS 9471	85.00(72.35)	31.00(33.70)	58.00(53.03)	11.99	42.67	27.33	3.34	16.66	10.00	30.66	18.67	24.67	23.34	7.34	15.34
50	SPV – 104 x IS 2284	90.50(72.10)	73.00(59.09)	81.75(65.60)	15.99	35.33	25.66	7.33	13.34	10.33	34.67	26.67	30.67	27.34	7.34	17.33
51	SPV – 104 x IS 6335	89.50(71.09)	74.00(59.49)	81.75(65.60)	5.99	36.67	21.33	1.69	11.34	6.51	36.00	22.67	29.33	29.37	7.34	18.33
52	SPV – 104 x IS 9471	91.50(73.41)	65.00(53.93)	78.25(63.67)	7.99	44.00	26.00	2.35	10.66	6.51	38.67	16.67	27.67	22.66	5.34	14.00
53	IS 2284 x IS –6335	85.50(67.65)	67.50(55.25)	76.50(61.45)	6.01	36.67	21.34	3.02	9.34	6.18	31.33	20.67	26.00	24.66	4.66	14.66
54	IS 2284 x IS - 9471	90.50(72.20)	77.50(61.75)	84.00(66.97)	12.01	34.00	23.00	8.00	12.00	10.00	30.00	26.67	28.33	26.00	6.67	16.34
55	IS 6335 x IS 9471	89.50(70.56)	63.50(52.85)	76.25(61.75)	6.00	30.00	18.00	2.35	6.66	4.51	23.33	22.00	22.67	17.33	5.34	11.33
	Parental range	29.00 to 86.00	2.50 to 61.00	15.75 to 71.75	5.33 To 38.67	34.00 to 71.34	19.67 to 55.00	0.71 to 2.67	7.34 to 19.34	4.02 to 10.51	24.00 to 60.00	15.33 to 37.33	20.67 to 46.67	9.34 to 24.67	0.71 to 6.00	5.18 to 15.00
	Hybrid range	32.50 to 98.00	14.00 to 88.50	25.25 to 90.00	5.99 To 35.99	21.34 to 70.67	15.66 to 52.34	0.71 to 8.00	5.34 to 21.34	3.02 to 11.85	18.00 to 68.00	8.00 to 37.33	20.33 to 46.33	12.00 to 37.34	0.71 to 24.00	9.00 to 21.67
	SE (m)	3.606	4.750	14.911	0.961	2.520	1.512	0.17	0.758	0.564	2.561	1.985	2.215	1.213	0.368	1.592
	CD at 5%	10.293	13.556	42.554	1.903	4.992	2.993	0.33	1.501	1.117	5.073	3.932	4.387	2.406	0.729	3.153

P = Pooled L1= Akola L2= Patancheru Figures in parenthesis indicated arcsin values

Table : 8 Mean values of F_2 progenies for different characters in 10 × 10 diallel of sorghum, Akola and Patancheru, 1996

Sr No	Crosses	Grain hardness Kg/cm^{-2}			Electrical conductivity (millimhose)			Plant height (cm)			Cob length (cm)		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	SPV-1201 x ICSB – 101B	5.81	5.52	5.67	374.50	386.50	380.50	174.00	186.00	180.00	24.65	24.80	24.73
2	SPV-1201 x AKms – 14 B	6.85	3.57	5.21	374.50	413.00	393.75	189.15	248.75	218.95	21.75	22.60	22.17
3	SPV-1201 x SRT – 26B	6.67	4.16	5.41	404.50	454.00	429.25	173.75	235.00	204.38	22.50	23.60	23.05
4	SPV-1201 x GJ-35-15-15	6.97	4.15	5.56	494.50	685.00	589.50	209.40	275.00	242.20	24.25	23.50	23.88
5	SPV-1201 x SPV – 946	5.27	3.75	4.51	310.50	404.00	357.25	200.75	252.00	226.38	23.15	22.35	22.75
6	SPV-1201 x SPV – 104	5.00	3.25	4.12	451.50	488.00	469.75	182.00	196.65	189.32	18.95	23.65	21.30
7	SPV-1201 x IS – 2284	5.63	3.66	4.64	355.50	342.00	348.75	229.15	233.75	231.15	23.25	24.00	23.63
8	SPV-1201 x IS-6335	7.17	3.41	5.29	228.00	222.00	225.00	226.40	230.00	228.20	26.20	26.15	26.17
9	SPV-1201 x IS - 9471	7.31	2.43	4.87	233.50	187.00	210.25	230.15	226.25	228.20	23.10	25.25	24.17
10	ICSB – 101B x AKms 14 B	5.66	3.83	4.74	214.00	488.00	351.00	157.90	184.15	171.02	30.05	27.75	28.90
11	ICSB – 101B x SRT – 26 B	5.81	3.23	4.52	381.50	398.00	389.75	171.50	241.25	206.38	29.00	26.15	27.58
12	ICSB – 101B x GJ-35-15-15	5.90	3.96	4.93	366.50	410.00	388.25	181.50	233.15	207.07	29.60	26.25	27.92
13	ICSB – 101B x SPV – 946	5.79	4.37	5.08	276.50	479.00	377.75	174.00	258.75	216.38	29.30	25.90	27.60
14	ICSB – 101B x SPV – 104	5.72	3.52	4.62	382.00	490.50	436.25	170.50	196.25	183.38	29.50	24.00	25.25
15	ICSB – 101B x IS – 2284	6.41	4.49	5.45	196.00	390.50	293.25	218.75	280.00	249.38	28.20	26.15	27.17
16	ICSB – 101B x IS – 6335	6.03	4.92	5.48	240.00	297.00	268.50	183.50	255.65	219.57	28.40	26.65	27.52
17	ICSB – 101B x IS – 9471	4.90	4.22	4.56	255.50	186.00	220.75	195.75	267.50	231.63	27.45	27.25	27.35
18	AKms–14 B x SRT – 26B	7.23	2.13	4.68	311.00	438.50	374.75	174.50	240.00	207.25	26.80	25.25	26.02
19	AKms–14 B x GJ-35-15-15	6.35	2.62	4.48	334.00	389.50	361.75	166.50	217.50	192.00	28.70	24.25	26.48
20	AKms–14 B x SPV – 946	6.93	2.71	4.82	340.50	481.00	410.75	189.00	233.50	213.25	25.90	23.25	24.58
21	AKms–14 B x SPV – 104	4.62	2.89	3.75	442.50	533.50	488.00	162.75	210.00	186.86	24.80	21.50	23.15
22	AKms–14 B x IS – 2284	5.12	3.01	4.07	255.50	320.00	287.75	172.00	283.75	227.88	25.20	23.50	24.35
23	AKms–14 B x IS – 6335	5.88	3.80	4.84	172.50	205.50	189.00	196.60	261.25	228.93	26.50	25.25	25.88
24	AKms–14 B x IS – 9471	5.72	3.25	4.48	181.00	277.50	229.25	172.25	277.50	224.88	27.40	25.50	26.45

Condt.. .. .. .

Table 8 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10	11	12	13	14
25	SRT – 26B x GJ-35-15-15	4.05	4.01	4.03	310.50	405.00	357.75	181.50	191.25	186.38	26.50	24.25	25.38
26	SRT – 26B x SPV – 946	4.05	3.92	3.97	400.00	495.00	447.50	190.00	265.40	227.70	23.20	23.80	23.50
27	SRT – 26B x SPV – 104	4.17	2.44	3.31	553.00	418.00	485.50	229.40	217.50	223.45	22.80	22.75	22.77
28	SRT – 26B x IS – 2284	4.55	2.55	3.55	308.00	425.00	366.50	218.75	302.50	260.63	21.65	21.50	21.58
29	SRT – 26B x IS – 6335	3.25	3.27	3.26	357.00	227.00	292.00	250.00	267.50	258.75	24.85	28.75	26.80
30	SRT – 26B x IS – 9471	3.73	3.39	3.56	204.00	158.00	181.00	260.00	255.40	257.70	27.75	27.25	27.50
31	GJ-35-15-15 x SPV – 946	4.73	4.79	4.76	523.00	517.00	520.00	180.05	269.55	224.80	27.00	25.15	26.08
32	GJ-35-15-15 x SPV 104	4.88	3.77	4.32	538.00	583.50	561.00	172.50	245.00	208.57	25.60	22.00	23.80
33	GJ-35-15-15 x IS – 2284	4.92	4.90	4.91	263.00	290.00	276.50	204.15	312.50	258.33	28.15	29.50	28.83
34	GJ-35-15-15 x IS – 6335	4.16	4.12	4.14	199.50	378.00	288.75	173.00	282.50	227.75	28.95	24.90	26.92
35	GJ-35-15-15 x IS – 9471	4.01	3.54	3.79	249.00	260.00	254.50	194.75	291.75	243.25	27.85	28.75	28.30
36	SPV – 946 x SPV – 104	4.93	4.00	4.47	496.50	493.50	495.00	185.50	272.50	229.00	22.50	20.00	21.25
37	SPV – 946 x IS – 2284	5.61	6.26	5.93	341.00	341.50	341.25	190.50	274.60	232.55	23.20	24.90	24.05
38	SPV – 946 x IS – 6335	5.11	5.08	5.09	283.50	250.00	266.75	209.00	318.25	263.67	26.90	29.85	24.38
39	SPV – 946 x IS 9471	5.70	4.39	5.05	190.50	227.00	208.75	198.90	283.00	240.95	25.85	26.00	25.92
40	SPV – 104 x IS 2284	4.33	2.59	3.46	345.00	408.50	376.75	189.75	301.25	245.50	21.85	22.50	22.00
41	SPV – 104 x IS 6335	4.49	3.77	4.13	338.50	510.00	424.75	191.25	233.75	212.50	25.55	23.75	24.65
42	SPV – 104 x IS 9471	4.60	3.64	4.12	281.50	298.00	289.75	183.35	242.50	212.93	23.80	25.50	24.65
43	IS 2284 x IS –6335	4.87	3.13	3.99	172.00	317.50	244.75	204.15	269.00	236.57	24.00	25.00	24.50
44	IS 2284 x IS - 9471	4.22	3.24	3.73	170.00	169.00	169.50	196.25	296.25	246.25	24.80	29.50	27.15
45	IS 6335 x IS 9471	5.33	2.87	4.08	155.00	176.00	165.50	212.75	258.35	235.55	25.15	29.85	27.50
	F_2 progenies range	3.25 to 7.31	2.13 to 6.26	3.26 to 5.93	155.00 to 553.00	158.00 to 685.00	165.50 to 589.50	157.90 to 230.15	184.15 to 318.25	171.02 to 263.67	18.95 to 30.05	20.00 to 29.85	21.25 to 28.90
	SE (m)	0.252	0.595	1.149	18.258	26.304	71.160	13.390	16.274	32.926	1.362	1.417	1.217
	CD at 5%	0.721	1.699	3.281	52.107	75.069	208.79	38.214	46.444	93.967	3.888	4.046	3.474

P = Pooled L1 = Akola L2 = Patancheru

Table : 9 Mean values of F_2 progenies for different characters in 10 × 10 diallel of sorghum, Akola and Patancheru, 1996

Sr. No	Crosses	Glume covering (%)			TGMR			Germination (%)		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
1	SPV-1201 x ICSB – 101B	47.50	50.00	48.75	2.05	3.15	2.60	80.40(63.77)	66.45(54.61)	73.43(59.19)
2	SPV-1201 x AKms – 14 B	50.00	50.00	50.00	2.55	3.85	3.20	70.50(57.41)	43.00(40.77)	56.75(49.09)
3	SPV-1201 x SRT – 26B	45.00	50.00	47.50	2.40	3.15	2.78	81.75(64.94)	64.10(56.23)	79.93(60.58)
4	SPV-1201 x GJ-35-15-15	42.50	50.00	46.25	2.50	3.45	2.97	80.00(63.92)	59.15(50.51)	69.58(57.23)
5	SPV-1201 x SPV – 946	37.50	50.00	43.75	2.40	3.55	2.97	74.75(59.91)	56.15(48.55)	65.45(54.23)
6	SPV-1201 x SPV – 104	45.00	37.50	41.25	2.60	3.40	3.00	74.35(59.84)	50.50(45.28)	62.43(52.56)
7	SPV-1201 x IS – 2284	50.00	54.00	52.00	2.20	2.45	2.33	73.85(59.26)	76.15(60.77)	75.00(60.01)
8	SPV-1201 x IS-6335	50.00	47.00	48.75	2.20	2.20	2.20	75.95(80.73)	76.65(61.15)	76.30(60.94)
9	SPV-1201 x IS – 9471	50.00	44.00	47.00	2.10	2.30	2.20	76.50(61.00)	48.50(44.14)	62.50(52.57)
10	ICSB – 101B x AKms 14 B	50.00	50.00	50.00	2.70	3.25	2.97	71.40(57.89)	50.40(45.24)	60.90(51.56)
11	ICSB – 101B x SRT – 26 B	50.00	50.00	50.00	2.25	3.40	2.83	79.60(63.20)	45.40(43.56)	62.50(53.38)
12	ICSB – 101B x GJ-35-15-15	50.00	50.00	50.00	2.35	3.05	2.70	79.50(63.14)	67.75(55.41)	73.63(59.28)
13	ICSB – 101B x SPV – 946	50.00	50.00	50.00	2.45	2.95	2.70	70.50(57.28)	51.00(45.61)	60.75(51.45)
14	ICSB – 101B x SPV – 104	50.00	50.00	50.00	2.25	3.55	2.90	76.95(61.31)	21.50(26.48)	49.23(43.90)
15	ICSB – 101B x IS – 2284	59.00	41.50	50.25	2.35	2.55	2.45	81.50(64.44)	65.25(53.90)	73.38(59.19)
16	ICSB – 101B x IS – 6335	54.00	54.00	54.00	2.40	2.70	2.55	81.40(64.46)	75.50(60.36)	78.45(62.41)
17	ICSB – 101B x IS – 9471	58.00	50.00	54.00	2.20	3.05	2.63	82.50(65.39)	69.50(56.48)	76.00(60.94)
18	AKms–14 B x SRT – 26B	50.00	50.00	50.00	2.50	4.00	3.25	71.20(57.70)	9.75(17.65)	40.48(37.67)
19	AKms–14 B x GJ-35-15-15	50.00	50.00	50.00	2.70	3.10	2.90	69.20(56.71)	60.00(51.16)	64.90(53.93)
20	AKms–14 B x SPV – 946	50.00	58.50	54.25	2.55	3.55	3.05	65.80(54.26)	24.50(29.57)	45.15(41.91)
21	AKms–14 B x SPV – 104	50.00	50.00	50.00	3.05	3.50	3.28	53.00(46.53)	23.00(28.39)	38.00(37.56)
22	AKms–14 B x IS – 2284	47.50	50.00	48.75	2.15	2.65	2.40	80.85(64.05)	52.00(46.17)	66.43(55.11)
23	AKms–14 B x IS – 6335	41.00	50.00	45.50	2.15	2.40	2.28	84.15(66.55)	68.75(56.38)	76.45(61.46)
24	AKms–14 B x IS – 9471	37.50	50.00	43.75	1.75	2.65	2.20	81.10(64.34)	51.25(45.78)	66.18(55.06)

Contd.. .. ..

Table 9 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10	11
25	SRT – 26B x GJ-35-15-15	50.00	50.00	50.00	2.05	3.40	2.72	75.00(65.05)	51.50(45.86)	63.25(55.46)
26	SRT – 26B x SPV – 946	50.00	50.00	50.00	2.60	2.80	2.70	77.65(54.16)	64.55(53.52)	71.10(53.84)
27	SRT – 26B x SPV – 104	54.00	50.00	52.00	2.90	3.25	3.08	63.50(59.56)	23.75(29.11)	43.63(44.34)
28	SRT – 26B x IS – 2284	47.50	50.00	48.75	2.80	2.65	2.72	79.15(46.29)	74.25(58.15)	76.70(52.22)
29	SRT – 26B x IS – 6335	50.00	50.00	50.00	2.20	2.30	2.25	73.40(64.25)	80.25(66.64)	76.83(63.94)
30	SRT – 26B x IS – 9471	50.00	50.00	50.00	2.65	2.50	2.58	76.70(60.07)	60.55(51.15)	68.62(55.61)
31	GJ-35-15-15 x SPV – 946	52.50	50.00	51.25	2.45	3.10	2.78	69.80(57.55)	58.85(50.19)	64.33(53.87)
32	GJ-35-15-15 x SPV 104	50.00	50.00	50.00	2.80	3.65	3.72	66.00(54.80)	25.50(30.31)	45.75(42.55)
33	GJ-35-15-15 x IS – 2284	61.50	62.50	62.00	2.10	2.35	2.17	81.75(64.76)	81.50(64.57)	81.62(64.67)
34	GJ-35-15-15 x IS – 6335	56.00	50.00	52.00	2.15	2.40	2.28	80.45(63.88)	69.00(56.19)	74.73(60.03)
35	GJ-35-15-15 x IS – 9471	50.00	47.50	48.75	1.90	2.50	2.20	67.30(55.88)	61.50(51.68)	64.40(53.76)
36	SPV – 946 x SPV – 104	56.50	50.00	53.25	2.50	3.25	2.88	69.20(57.13)	49.00(44.40)	59.10(50.77)
37	SPV – 946 x IS – 2284	60.00	60.50	60.25	2.30	2.15	2.22	74.80(60.40)	67.10(55.08)	70.95(57.74)
38	SPV – 946 x IS – 6335	66.50	75.00	70.75	2.40	2.25	2.33	86.15(68.21)	83.15(65.79)	84.56(67.00)
39	SPV – 946 x IS 9471	60.00	50.00	55.10	2.00	2.20	2.10	78.60(62.93)	59.00(50.32)	68.80(56.63)
40	SPV – 104 x IS 2284	59.00	69.00	64.00	2.40	3.25	2.83	68.35(55.93)	62.75(52.80)	65.50(54.36)
41	SPV – 104 x IS 6335	56.50	54.00	55.25	2.75	2.15	2.45	65.35(54.36)	54.00(47.53)	59.68(50.95)
42	SPV – 104 x IS 9471	50.00	44.00	47.00	2.30	2.65	2.47	62.55(52.58)	53.75(47.15)	58.15(49.87)
43	IS 2284 x IS –6335	54.00	50.00	52.00	1.75	2.00	1.88	87.90(69.74)	63.50(53.81)	75.70(61.77)
44	IS 2284 x IS - 9471	50.00	50.00	50.00	1.70	2.00	1.85	85.90(68.10)	83.50(66.03)	84.70(67.07)
45	IS 6335 x IS 9471	54.00	66.50	60.25	1.90	2.00	1.95	86.40(68.45)	77.15(63.23)	81.75(65.84)
	F_2 progenies range	37.50 to 66.50	37.50 to 75.00	41.25 to 70.75	1.70 to 3.05	2.00 to 4.00	1.85 to 3.28	53.00 to 87.90	9.75 to 83.50	38.00 to 84.70
	SE (m)	0.173	0.199	3.393	0.172	0.317	0.414	7.161	8.586	13.424
	CD at 5%	0.493	0.568	9.501	0.493	0.905	1.184	20.436	24.505	38.312

P =Pooled L1 = Akola L2 Patancheru

Figures in parenthesis indicate arcsin values.

Table : 10 Mean infection % of F_2 progenies for pathological characters in 10×10 diallel of sorghum, Akola and Patancheru, 1996

Sr. No.	Crosses	*F. moniliforme*			*F. pallidoroseum*			*C. lunata*			Other fungi		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	SPV-1201 x ICSB – 101B	32.22	37.86	35.64	1.50	3.34	2.42	46.52	34.06	40.29	17.40	14.80	16.10
2	SPV-1201 x AKms – 14 B	31.82	44.82	38.32	1.76	4.34	3.05	45.36	27.66	36.51	17.50	10.34	13.92
3	SPV-1201 x SRT – 26B	32.60	46.16	39.38	2.15	6.16	4.16	47.10	38.66	39.88	20.80	13.48	17.14
4	SPV-1201 x GJ-35-15-15	21.40	48.50	34.95	1.56	7.50	4.53	61.02	32.26	46.64	16.60	8.26	12.43
5	SPV-1201 x SPV – 946	22.72	50.20	36.46	1.35	7.10	4.23	47.20	31.60	39.40	18.56	11.10	14.83
6	SPV-1201 x SPV – 104	28.20	58.34	43.27	2.50	2.35	2.43	48.26	28.00	38.13	18.46	9.66	14.06
7	SPV-1201 x IS – 2284	28.32	31.00	29.66	1.56	3.22	2.39	46.66	36.52	41.59	17.46	20.52	18.99
8	SPV-1201 x IS-6335	30.56	39.50	35.03	3.36	7.00	5.18	36.59	38.50	37.53	17.02	11.52	14.27
9	SPV-1201 x IS - 9471	31.70	41.50	31.60	1.56	6.50	4.03	42.00	41.00	41.50	16.70	12.50	14.60
10	ICSB – 101B x AKms 14 B	21.58	46.50	34.04	1.60	4.68	3.14	64.26	39.00	51.33	12.60	11.18	11.89
11	ICSB – 101B x SRT – 26 B	19.00	58.84	38.92	3.40	4.84	4.12	61.80	27.68	44.74	27.00	8.16	17.58
12	ICSB – 101B x GJ-35-15-15	29.40	38.26	33.83	1.60	3.26	2.43	51.20	44.76	47.98	21.40	14.26	17.83
13	ICSB – 101B x SPV – 946	29.80	50.26	40.03	2.76	5.85	4.30	54.20	31.00	42.60	13.20	14.76	13.98
14	ICSB – 101B x SPV – 104	31.30	57.50	44.40	4.20	11.00	7.60	45.60	29.00	37.30	18.70	6.50	12.60
15	ICSB – 101B x IS – 2284	35.10	50.86	42.98	3.25	3.70	3.53	41.82	31.76	36.79	19.50	13.10	16.30
16	ICSB – 101B x IS – 6335	18.50	45.76	32.13	1.66	2.37	2.02	59.30	23.26	41.28	15.76	16.02	15.89
17	ICSB – 101B x IS – 9471	27.36	42.00	34.68	4.26	5.82	5.04	45.82	25.50	35.51	14.40	14.32	14.36
18	AKms-14 B x SRT – 26B	39.40	51.00	40.20	2.40	6.00	4.20	56.60	38.00	47.30	11.40	5.50	8.45
19	AKms-14 B x GJ-35-15-15	26.00	56.34	41.17	1.56	1.50	1.53	61.20	35.00	48.35	12.00	6.00	9.00
20	AKms-14 B x SPV – 946	23.40	50.00	36.70	1.35	7.50	4.43	61.80	43.50	52.65	13.80	7.00	10.40
21	AKms-14 B x SPV – 104	41.06	67.50	54.25	2.15	5.50	3.83	45.00	20.00	32.50	12.82	7.00	9.91
22	AKms-14 B x IS – 2284	29.06	53.50	41.28	1.56	6.50	4.03	49.72	24.50	32.11	21.30	10.50	15.90
23	AKms-14 B x IS – 6335	27.82	41.00	34.41	1.35	7.50	4.43	42.34	26.00	34.17	26.76	7.50	16.83
24	AKms-14 B x IS – 9471	29.30	38.00	32.15	1.35	3.00	2.18	39.30	34.50	36.90	18.40	19.50	18.95

Contd.....

Table 10 Condt.......

1	2	3	4	5	6	7	8	9	10	11	12	13	14
25	SRT – 26B x GJ-35-15-15	33.40	50.50	41.95	3.60	4.35	3.98	42.60	31.00	36.80	16.00	15.50	15.75
26	SRT – 26B x SPV – 946	18.70	40.76	29.76	1.10	6.30	3.70	63.30	38.66	50.98	18.10	6.06	17.08
27	SRT – 26B x SPV – 104	24.00	52.50	38.25	1.75	3.50	2.63	58.60	37.50	48.05	16.60	8.00	12.30
28	SRT – 26B x IS – 2284	25.62	37.50	31.56	0.96	6.50	3.73	47.36	35.00	41.18	19.76	9.00	14.38
29	SRT – 26B x IS – 6335	22.06	50.02	36.04	2.56	4.26	3.41	59.34	27.76	43.50	15.74	14.26	15.0
30	SRT – 26B x IS – 9471	34.00	47.82	40.91	3.15	4.34	3.75	43.20	35.82	39.51	17.80	7.68	12.74
31	GJ-35-15-15 x SPV – 946	25.70	45.60	35.65	0.77	2.52	1.64	48.50	34.50	41.50	19.08	14.16	16.62
32	GJ-35-15-15 x SPV 104	30.86	67.00	48.93	2.86	5.00	3.93	66.36	24.50	45.33	15.06	3.00	9.03
33	GJ-35-15-15 x IS – 2284	33.06	45.00	39.03	4.40	8.00	6.23	47.92	28.00	37.96	9.34	16.00	12.67
34	GJ-35-15-15 x IS – 6335	30.26	48.16	39.21	2.20	5.00	3.60	37.06	31.50	34.28	14.06	11.84	12.95
35	GJ-35-15-15 x IS – 9471	38.92	38.26	38.59	3.58	5.26	4.42	37.90	30.26	34.08	14.26	11.26	12.76
36	SPV – 946 x SPV – 104	27.00	60.50	43.75	2.20	6.50	4.35	54.60	19.00	36.80	13.20	7.50	10.35
37	SPV – 946 x IS – 2284	38.00	47.26	42.63	4.60	4.50	4.55	38.80	36.66	37.73	23.20	12.34	17.77
38	SPV – 946 x IS – 6335	20.42	33.34	26.88	3.42	3.00	3.21	42.42	22.16	32.29	18.02	21.68	19.85
39	SPV – 946 x IS 9471	36.26	42.00	39.13	3.6	5.60	4.68	30.26	33.40	31.83	11.06	13.40	12.23
40	SPV – 104 x IS 2284	33.82	53.50	43.66	2.56	6.16	4.36	47.02	29.16	38.09	10.06	11.50	10.78
41	SPV – 104 x IS 6335	44.06	47.50	45.18	4.96	8.00	6.48	34.86	33.50	34.18	12.76	11.50	12.13
42	SPV – 104 x IS 9471	52.52	53.00	52.76	5.92	7.50	6.71	28.04	26.50	27.27	10.72	12.50	11.61
43	IS 2284 x IS –6335	33.66	59.00	46.33	6.04	8.00	7.02	22.20	20.00	21.10	12.12	12.35	12.74
44	IS 2284 x IS - 9471	34.42	48.50	41.46	3.74	4.50	4.12	20.92	18.50	19.71	12.00	14.50	13.25
45	IS 6335 x IS 9471	38.92	25.34	32.13	5.84	5.34	5.59	19.26	25.32	22.29	10.60	12.66	11.63
	F_2 progenies range	18.50 to 52.52	25.34 to 67.50	26.28 to 54.25	0.77 to 6.04	1.50 to 11.00	1.53 to 7.60	16.26 to 66.36	18.50 to 44.76	19.71 to 52.65	9.34 to 27.00	3.00 20.52	8.45 to 19.85
	SE (m)	1.788	2.097	2.249	0.88	1.154	1.606	2.670	1.253	2.095	0.648	0.384	0.549
	CD at 5%	3.554	1.541	4.455	1.75	2.861	3.181	5.298	2.482	4.150	1.283	0.760	1.087

P = Pooled L1 = Akola L2 = Patancheru

III – 13

Table : 11 Mean value of parents and F_1 crosses for biochemical characters in 10×10 diallel of sorghum, Akola, 1995

Sr.No	Parents/Crosses	Protein (%)	Soluble sugars (%)	Tannins (CE %)	Flavan-4-ols A_{550} (a)
1	2	3	4	5	6
1	SPV-1201	12.35(3.59)	1.70(1.49)	0.06(0.75)	0.00(0.71)
2	ICSB-101B	12.94(3.66)	1.50(1.41)	0.02(0.72)	0.00(0.71)
3	AKMS-14B	11.78(3.51)	2.30(1.67)	0.06(0.75)	0.00(0.71)
4	SRT-26B	12.41(3.59)	2.20(1.64)	0.05(0.74)	0.00(0.71)
5	GJ-35-15-15	10.51(3.32)	1.40(1.38)	0.06(0.75)	0.00(0.71)
6	SPV-946	11.01(3.39)	1.40(1.38)	0.06(0.75)	0.00(0.71)
7	SPV-104	11.81(3.51)	1.20(1.30)	0.06(0.75)	0.00(0.71)
8	IS-2284	9.93(3.23)	2.00(1.58)	5.84(2.52)	7.90(2.90)
9	IS-6335	11.11(3.41)	1.70(1.48)	4.93(2.33)	7.60(2.85)
10	IS-9471	8.93(3.01)	1.60(1.45)	2.53(1.74)	18.00(4.30)
11	SPV-1201 x ICSB – 101B	9.11(3.10)	1.30(1.34)	0.03(0.73)	0.00(0.71)
12	SPV-1201 x AKms – 14 B	6.35(2.62)	1.20(1.30)	0.01(0.71)	0.00(0.71)
13	SPV-1201 x SRT – 26B	6.62(2.67)	1.40(1.38)	0.03(0.73)	0.00(0.71)
14	SPV-1201 x GJ-35-15-15	8.27(2.96)	1.60(1.45)	0.03(0.73)	0.00(0.71)
15	SPV-1201 x SPV – 946	7.68(2.88)	1.40(1.38)	0.03(0.73)	0.00(0.71)
16	SPV-1201 x SPV – 104	8.90(3.07)	1.20(1.30)	0.04(0.73)	0.00(0.71)
17	SPV-1201 x IS – 2284	9.87(3.22)	1.60(1.45)	2.25(1.66)	4.20(2.17)
18	SPV-1201 x IS-6335	8.08(2.93)	1.80(1.52)	2.70(1.79)	3.90(2.10)
19	SPV-1201 x IS - 9471	10.11(3.26)	1.70(1.48)	2.16(1.63)	11.40(3.45)
20	ICSB – 101B x AKms 14 B	7.01(2.74)	1.00(1.22)	0.03(0.73)	0.00(0.71)
21	ICSB – 101B x SRT – 26 B	8.01(2.92)	1.10(1.26)	0.02(0.72)	0.00(0.71)
22	ICSB – 101B x GJ-35-15-15	7.32(2.80)	1.30(1.34)	0.01(0.71)	0.00(0.71)
23	ICSB – 101B x SPV – 946	6.61(2.67)	1.20(1.30)	0.04(0.73)	0.00(0.71)
24	ICSB – 101B x SPV – 104	7.61(2.85)	1.00(1.22)	0.01(0.71)	0.00(0.71)
25	ICSB – 101B x IS – 2284	7.19(2.77)	1.50(1.41)	2.25(1.66)	3.20(1.92)
26	ICSB – 101B x IS – 6335	7.75(2.87)	1.40(1.38)	1.78(1.51)	4.20(2.17)
27	ICSB – 101B x IS – 9471	6.80(2.70)	1.30(1.34)	1.41(1.38)	6.50(2.65)
28	AKms – 14 B x SRT – 26B	6.13(2.8)	0.90(1.18)	0.02(0.72)	0.00(0.71)
29	AKms – 14 B x GJ-35-15-15	6.10(2.57)	1.00(1.22)	0.02(0.72)	0.00(0.71)
30	AKms – 14 B x SPV – 946	5.79(2.51)	1.40(1.38)	0.03(0.73)	0.01(0.92)
31	AKms – 14 B x SPV – 104	6.53(2.65)	1.00(1.22)	0.01(0.71)	0.00(0.71)
32	AKms – 14 B x IS – 2284	6.24(2.60)	1.70(1.48)	3.41(1.98)	6.70(2.68)
33	AKms – 14 B x IS – 6335	8.88(3.06)	1.30(1.34)	2.83(1.82)	4.70(2.28)
34	AKms – 14 B x IS – 9471	5.56(2.46)	1.70(1.48)	2.40(1.70)	10.30(3.29)

Contd.. .. .. ..

Table 11 Contd.. .. .. .

1	2	3	4	5	6
35	SRT – 26B x GJ-35-15-15	6.25(2.60)	1.30(1.34)	0.05(0.74)	0.00(0.71)
36	SRT – 26B x SPV – 946	6.58(2.66)	1.40(1.38)	0.03(0.73)	0.50(1.00)
37	SRT – 26B x SPV – 104	8.49(3.00)	1.00(1.22)	0.06(0.75)	0.00(0.71)
38	SRT – 26B x IS – 2284	5.98(2.55)	1.80(1.52)	2.78(1.81)	5.10(2.37)
39	SRT – 26B x IS – 6335	7.10(2.76)	1.60(1.45)	3.13(1.90)	6.80(2.70)
40	SRT – 26B x IS – 9471	5.76(2.50)	1.70(1.48)	2.46(1.72)	11.60(3.33)
41	GJ-35-15-15 x SPV – 946	6.99(2.74)	0.90(1.31)	0.05(0.74)	0.60(1.05)
42	GJ-35-15-15 x SPV 104	7.78(288)	1.30(1.34)	0.02(0.72)	0.30(0.89)
43	GJ-35-15-15 x IS – 2284	6.23(2.59)	1.60(1.45)	2.26(1.66)	3.50(2.00)
44	GJ-35-15-15 x IS – 6335	6.26(2.60)	1.50(1.41)	1.78(1.51)	3.10(1.90)
45	GJ-35-15-15 x IS – 9471	5.23(2.39)	1.60(1.45)	1.38(1.37)	7.70(2.86)
46	SPV – 946 x SPV – 104	8.96(3.08)	0.80(1.14)	0.02(0.72)	0.00(0.71)
47	SPV – 946 x IS – 2284	6.68(2.68)	1.20(1.30)	2.18(1.64)	3.90(2.32)
48	SPV – 946 x IS – 6335	6.72(2.69)	1.30(1.34)	2.43(1.71)	6.80(2.70)
49	SPV – 946 x IS 9471	6.12(2.57)	1.10(1.26)	1.43(1.39)	9.40(3.15)
50	SPV – 104 x IS 2284	9.54(3.17)	1.10(1.26)	2.31(1.68)	5.50(2.45)
51	SPV – 104 x IS 6335	10.56(3.32)	0.80(1.14)	2.78(1.81)	6.40(2.63)
52	SPV – 104 x IS 9471	8.22(2.95)	0.90(1.18)	2.13(1.62)	10.50(3.32)
53	IS 2284 x IS –6335	7.42(2.81)	1.30(1.34)	2.09(1.61)	5.60(2.47)
54	IS 2284 x IS - 9471	7.97(2.91)	1.40(1.38)	2.66(1.78)	11.90(3.52)
55	IS 6335 x IS 9471	9.42(3.15)	1.30(1.34)	2.99(1.87)	12.00(3.54)
	Parental range	8.93 to 12.94	1.20 to 2.30	0.02 to 5 84	0.00 to 18.00
	Hybrid range	5.23 to 10.56	0.80 to 1.80	0.01 to 3.41	0.00 to 12.00
	SE (m)	0.132	0.107	0.111	0.208
	CD at 5%	0.377	0.305	0.389	0.595

Figures in parenthesis indicate square root values.

Table : 12 Heterosis (H_1) and Heterobeltiosis (H_2) in % for F_1 crosses in 10 ×10 diallel of sorghum (Pooled), Akola and Patancheru, 1996

Sr. No.	Crossess	100 grain weight		Grain hardness		Endosperm texture		Electrical conductivity		DTF	
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
1	2	3	4	5	6	7	8	9	10	11	12
1	SPV-1201 x ICSB – 101B	6.26	-5.74	4.22	-3.50	7.11	4.51	-26.59	-30.02*	6.76*	4.64
2	SPV-1201 x AKms – 14 B	-3.46	-16.01	-12.86	-26.50*	20.00	12.72	-16.52	-27.65*	9.50*	4.97
3	SPV-1201 x SRT – 26B	20.61*	0.28	-2.88	-15.10	27.98	15.69	-32.05**	-40.64**	9.86**	6.95*
4	SPV-1201 x GJ-35-15-15	-4.96	-18.36*	11.84	3.95	-6.07	-14.40	-26.62	-26.85	4.07	2.24
5	SPV-1201 x SPV – 946	-12.30	-23.82**	7.76	- 5.82	14.91	11.24	-10.74	-13.80	2.12	0.64
6	SPV-1201 x SPV – 104	9.30	8.00	7.64	-13.74	18.42	-5.70	-33.63**	-50.11**	4.07	2.24
7	SPV-1201 x IS – 2284	-5.11	-23.92**	-5.54	-19.39	23.04	-6.58	-28.32	42.64*	2.86	1.32
8	SPV-1201 x IS-6335	-6.64	-24.48**	-5.97	-13.98	12.02	-14.58	-30.12	-43.99**	11.23**	1.66
9	SPV-1201 x IS - 9471	7.32	-9.60	-13.47	-23.10*	23.88	-6.29	-26.25	-40.84*	5.46*	2.32
10	ICSB – 101B x AKms 14 B	-5.35	-7.42	-4.51	-13.74	48.31**	36.15*	-25.11*	-32.26**	-1.94	-4.14
11	ICSB – 101B x SRT – 26 B	-1.97	-9.00	-22.87*	-27.56*	18.99	5.23	-33.60**	-39.44**	-3.82	-4.48
12	ICSB – 101B x GJ-35-15-15	-5.81	- 9.25	-6.46	- 6.85	8.79	1.43	-28.26*	-31.41*	-3.15	-6.71*
13	ICSB – 101B x SPV – 946	5.92	3.41	9.93	3.23	25.09	18.26	-23.46	-24.49	-0.50	-2.89
14	ICSB – 101B x SPV – 104	14.14	0.18	-1.31	-15.73	5.49	-17.52	-36.03**	-50.25**	-4.48	-7.99**
15	ICSB – 101B x IS – 2284	17.02	4.14	-3.54	-11.74	19.79	-10.56	-42.36*	-55.49**	-3.60	-4.10
16	ICSB – 101B x IS – 6335	11.50	0.24	2.29	0.96	12.38	-15.74	-53.50**	-64.04**	-9.63**	-15.86**
17	ICSB – 101B x IS – 9471	11.94	5.47	-8.52	-12.50	26.89*	-5.59	-46.79**	-58.83**	-4.88	-5.86
18	AKms – 14 B x SRT – 26B	8.72	3.05	-35.50**	-38.14**	52.31**	46.18**	-23.85*	-24.56*	-2.66	-4.20
19	AKms – 14 B x GJ-35-15-15	-7.88	-9.29	-34.35**	-40.91**	44.14*	24.18	-24.24*	-34.17**	-6.10*	-11.50**
20	AKms – 14 B x SPV – 946	16.25	16.03	-5.66	-9.50	63.01**	58.01**	-26.63*	-34.43**	-7.14**	-12.22**
21	AKms – 14 B x SPV – 104	8.75	-6.34	-12.03	-17.43	36.87**	14.59	-29.05**	-40.17**	-5.42*	-10.86**
22	AKms – 14 B x IS – 2284	16.05	5.34	6.98	5.49	35.94**	8.08	-47.62**	-62.28**	-3.86	-6.48*
23	AKms – 14 B x IS – 6335	23.72*	13.49	-1.82	-10.25	43.11**	14.31	-59.65**	-70.90**	-9.30**	-13.72**
24	AKms – 14 B x IS – 9471	20.95*	16.41	-12.77	-17.85	33.46**	5.68	-57.12**	-69.06**	-10.87**	-11.97**

Contd.. .. ..

Table 12 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10	11	12
25	SRT – 26B x GJ-35-15-15	2.32	-1.57	-2.90	-9.15	23.27	2.62	-14.78	-25.35*	-4.51	-8.63**
26	SRT – 26B x SPV – 946	18.36	12.39	-5.71	-5.73	30.40	21.47	-34.28**	-40.78**	-1.51	-5.47
27	SRT – 26B x SPV – 104	8.15	-10.94	5.09	-5.14	20.21	4.19	-46.49**	-55.22**	-7.85**	-11.82**
28	SRT – 26B x IS – 2284	21.34	15.91	-3.83	-6.50	12.40	-7.73	-52.04**	-65.26*	-8.81**	-9.90**
29	SRT – 26B x IS – 6335	22.94*	18.75	-11.49	-15.83	29.90*	7.16	61.63**	-72.17**	-10.82**	-16.43**
30	SRT – 26B x IS – 9471	20.20	18.29	-18.32	-19.86	5.29	-13.94	-41.96**	-57.88**	-0.70	-1.05
31	GJ-35-15-15 x SPV - 946	9.26	-7.79	-3.01	-9.27	20.00	6.22	-13.16	-15.89	-0.96	-1.28
32	GJ-35-15-15 x SPV 104	-5.30	-19.49*	3.42	-12.00	21.41	-9.69	-31.25**	-48.22**	-6.39*	-6.39*
33	GJ-35-15-15 x IS – 2284	-0.93	-8.79	-1.80	-10.50	30.53*	-6.89	-33.63	-47.01**	-5.94*	-8.95**
34	GJ-35-15-15 x IS – 6335	0.00	-6.96	-20.79	-22.14	34.85**	-3.44	-49.47**	-59.59**	-7.64**	-16.93**
35	GJ-35-15-15 x IS – 9471	3.69	1.31	-15.61	-19.60	28.42*	-8.69	-26.64	-41.30*	-3.85	-8.31**
36	SPV – 946 x SPV – 104	5.29	-9.47	3.40	-6.64	8.44	-11.46	-28.01**	-44.55**	-3.53	-3.83
37	SPV – 946 x IS – 2284	18.26	7.54	0.40	-2.36	3.70	-19.43	-52.06**	-62.63**	-8.94**	-11.58**
38	SPV – 946 x IS – 6335	2.99	-5.36	0.99	-3.98	2.98	-19.63	-48.18**	-59.53**	7.66**	-2.29
39	SPV – 946 x IS 9471	8.87	4.98	-3.95	-5.77	15.72	-10.44	-56.23**	-65.80**	-10.25**	-14.15**
40	SPV – 104 x IS 2284	0.64	-20.04*	-16.57	-22.71	21.18*	13.60	-48.51**	-66.47**	-5.94*	-8.95**
41	SPV – 104 x IS 6335	-0.80	-20.50*	-16.74	-28.13*	31.14**	23.66*	-60.62**	-74.33**	-13.32**	-22.04**
42	SPV – 104 x IS 9471	16.69	-2.67	-18.48	-27.65*	23.42*	15.12	-70.69**	-80.89**	-17.59**	-21.41**
43	IS 2284 x IS –6335	4.55	3.35	-0.95	-8.28	-3.07	-3.67	-11.56	-11.76	-2.39	-9.56**
44	IS 2284 x IS - 9471	8.48	2.06	-4.81	-9.14	1.65	1.09	10.28	-10.55	-0.17	-1.71
45	IS 6335 x IS 9471	14.10	8.53	-17.87	-20.54	-2.72	-3.84	-25.95	-26.00	-9.36**	-14.79**
	SE (m)	0.193	0.223	0.671	0.755	5.274	6.091	39.798	45.955	1.972	2.277
	CD at 5%	0.382	0.441	1.330	1.536	10.456	12.073	78.887	91.090	3.908	4.513

* Significant at 5%

** Significant at 1%

Table : 13 Heterosis (H_1) and Heterobeltiosis (H_2) in % for F_1 crosses in 10 x10 diallel of sorghum (Pooled) Akola and Patancheru, 1996

Sr. No.	Crossess	Plant height		Cob length		Glume covering		Mesocarp thickness		TGMR	
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
1	2	3	4	5	6	7	8	9	10	11	12
1	SPV-1201 x ICSB – 101B	54.40**	31.63**	-3.34	-13.43	-20.00	-33.33**	-28.25**	-38.02**	-20.69*	-23.33*
2	SPV-1201 x AKms – 14 B	56.81**	24.49**	-2.42	-6.33	-12.50	-12.50	32.60**	30.20**	-12.50	-22.22**
3	SPV-1201 x SRT – 26B	33.71**	14.70*	-4.23	-9.07	-12.50	-12.50	17.42**	8.85	-13.79	-16.67
4	SPV-1201 x GJ-35-15-15	22.66**	19.04**	12.94	8.19	0.00	0.00	21.58**	20.50**	-17.86*	-17.86
5	SPV-1201 x SPV – 946	-3.93	-10.78*	9.05	5.11	-12.50	-12.50	5.25	-7.11	-3.70	-7.14
6	SPV-1201 x SPV – 104	33.49**	23.11**	2.44	-3.90	5.88	0.00	2.68	-7.91	-3.23	-11.76
7	SPV-1201 x IS – 2284	26.44**	22.94**	7.83	6.74	-11.11	-20.00	-23.06**	-31.31**	-27.27*	-42.86**
8	SPV-1201 x IS-6335	36.51**	32.86**	14.93	7.37	10.00	-8.33	-40.10**	-41.51**	-27.27*	-42.86**
9	SPV-1201 x IS – 9471	34.98**	25.90**	16.22	6.27	0.00	0.00	-40.67**	-43.88**	-23.81*	-42.86**
10	ICSB – 101B x Akms 14 B	20.59*	10.57	16.10*	7.99	-20.00	-33.33**	-3.08	-17.32**	3.03	-5.56
11	ICSB – 101B x SRT – 26 B	32.53**	31.55**	13.71	6.90	10.00	-8.33	-3.03	-10.21	6.67	6.67
12	ICSB – 101B x GJ-35-15-15	23.37**	2.61	11.59	3.99	-10.00	-25.00*	9.49	-5.94	-10.34	-13.33
13	ICSB – 101B x SPV – 946	33.86**	7.40	5.58	-2.18	-10.00	-25.00*	8.52	-15.54**	-17.86*	-23.33**
14	ICSB – 101B x SPV – 104	15.88*	6.31	8.25	-8.35	-23.81	-33.33**	-9.99*	-13.74**	-12.50	-17.65*
15	ICSB – 101B x IS – 2284	48.79**	23.94**	10.24	-0.36	-18.18	-25.00*	-47.56**	-49.50**	-30.43**	-46.67**
16	ICSB – 101B x IS – 6335	46.67**	22.28**	11.87	6.90	0.00	0.00	-56.61**	-61.74**	-30.43**	-46.67**
17	ICSB – 101B x IS – 9471	37.15**	10.41	14.39	11.80	-20.00	-33.33**	-37.69**	-48.63**	-27.27*	-46.67**
18	AKms – 14 B x SRT – 26B	32.68**	20.83*	6.57	5.36	0.00	0.00	29.88**	18.76**	3.03	-5.56
19	AKms – 14 B x GJ-35-15-15	13.29*	-12.02*	19.79*	19.54*	25.00	25.00	-5.20	-6.00	0.00	-11.11
20	AKms – 14 B x SPV – 946	36.49**	2.65	13.77	13.29	25.00	25.00	4.11	-6.91	9.68	-5.56
21	AKms – 14 B x SPV – 104	18.51*	0.50	9.58	-1.05	-5.88	-11.11	-23.45**	-32.25**	-2.86	-5.56
22	AKms – 14 B x IS – 2284	43.21**	11.37	9.03	5.70	-22.22	-30.00*	-27.12**	-35.78**	-38.46**	-55.56**
23	AKms – 14 B x IS – 6335	41.71**	10.28	8.20	5.18	0.00	-16.67	-35.05**	-37.49**	-46.15**	-61.11**
24	AKms – 14 B x IS – 9471	43.19**	8.02	13.60	7.98	-12.50	-12.50	-19.95**	-23.20**	-44.00**	-61.11**

Contd.. .. ..

Table 13 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10	11	12
25	SRT – 26B x GJ-35-15-15	-3.23	-19.04**	6.97	5.98	0.00	0.00	-16.77**	-23.30**	10.34	6.67
26	SRT – 26B x SPV – 946	14.77*	-7.40	7.64	5.98	0.00	0.00	31.30**	8.55	-3.57	-10.00
27	SRT – 26B x SPV – 104	16.59*	7.69	8.19	-3.30	-5.88	-11.11	1.12	-2.45	0.00	-5.88
28	SRT – 26B x IS – 2284	46.10**	22.43**	10.54	5.98	-11.11	-20.00	-27.11**	-30.03**	-21.74*	-40.00**
29	SRT – 26B x IS – 6335	25.72**	5.44	1.22	- 0.50	0.00	-16.67	-21.87**	-25.93**	-21.74*	-40.00**
30	SRT – 26B x IS – 9471	23.39**	-0.09	5.64	1.52	0.00	0.00	-26.60**	-35.35**	-27.27*	-46.67**
31	GJ-35-15-15 x SPV – 946	-0.43	-4.84	-4.02	-4.62	12.50	12.50	10.79	-1.68	11.11	7.14
32	GJ-35-15-15 x SPV 104	24.85**	12.02*	1.66	0.63	-5.88	-11.11	-6.68	-16.78**	-6.45	-14.71
33	GJ-35-15-15 x IS – 2284	28.51**	28.26**	17.92*	14.08	11.11	0.00	-37.52**	-44.53**	-27.27*	-42.86**
34	GJ-35-15-15 x IS – 6335	27.14**	26.75**	14.93	11.95	10.00	-8.33	-49.84**	-51.32**	-27.27*	-42.86**
35	GJ-35-15-15 x IS – 9471	15.12**	10.51*	13.27	7.89	0.00	0.00	-37.86**	-40.86**	-23.81*	-42.86**
36	SPV – 946 x SPV – 104	27.12**	9.59	17.61	6.63	17.65	11.11	-17.29**	-33.54**	0.00	-11.76
37	SPV – 946 x IS – 2284	10.48*	5.39	8.42	5.53	-22.22	-30.00*	-25.21**	-40.93**	-14.29	-30.77**
38	SPV – 946 x IS – 6335	18.74**	13.15*	9.26	5.78	10.00	-8.33	-35.63**	-44.35**	-23.81*	-38.46**
39	SPV – 946 x IS 9471	13.12**	12.60*	11.04	5.13	12.50	12.50	-40.72**	-44.93**	-20.00	-38.46**
40	SPV – 104 x IS 2284	32.18**	18.81**	9.55	1.80	-5.26	-10.00	-57.19**	-57.41**	-20.00*	-41.18**
41	SPV – 104 x IS 6335	27.06**	14.31*	22.40*	7.77	14.29	0.00	-61.14**	-64.39**	-36.00	-52.94**
42	SPV – 104 x IS 9471	14.91**	-0.55	18.28*	2.09	-17.65	-22.22	-38.19**	-47.22**	-33.33**	-52.94**
43	IS 2284 x IS –6335	17.42**	17.30**	9.61	3.39	9.09	0.00	-24.18**	-30.84**	-12.50	-12.50
44	IS 2284 x IS - 9471	9.86*	5.25	0.10	-7.60	-33.33*	-40.00**	-13.99*	-26.87**	6.67	0.00
45	IS 6335 x IS 9471	8.14	3.50	12.74	10.17	-20.00	-33.33**	-51.82**	-55.43**	-6.67	-12.50
	SE (m)	12.443	14.368	1.998	2.307	8.616	9.424	4.370	5.046	0.303	0.350
	CD at 5%	24.663	28.479	3.961	4.574	16.177	18.679	8.662	10.002	0.600	0.693

* Significant at 5%

** Significant at 1%

Table : 14 Heterosis (H_1) and Heterobeltiosis (H_2) in % for F_1 crosses in 10 ×10 diallel of sorghum (Pooled) Akola and Patancheru, 1996

Sr. No.	Crossess	Germination		*F. moniliforme*		*F. pullidoroseum*		*C. lunata*		Other fungi	
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
1	2	3	4	5	6	7	8	9	10	11	12
1	SPV-1201 x ICSB – 101B	49.62**	37.70**	-7.75	-10.08	4.96	2.36	-2.64	-5.15	28.42	20.47
2	SPV-1201 x AKms – 14 B	35.77**	-0.46	-23.69	-34.39*	67.48	36.74	-1.97	-8.82	92.08	36.88
3	SPV-1201 x SRT – 26B	43.45**	40.56**	-32.75	-33.62	-14.54	-15.74	-12.32	-13.57	175.93**	138.19**
4	SPV-1201 x GJ-35-15-15	19.77*	17.05	-5.45	-7.96	2.34	-2.53	-14.39	-14.71	61.01	57.88
5	SPV-1201 x SPV – 946	16.37	14.44	-0.02	-3.32	-19.85	-27.45	-12.64	-16.17	45.34	38.16
6	SPV-1201 x SPV – 104	31.00**	9.25	-32.37	-43.03**	-31.30	-36.70	20.32	2.21	104.60*	72.51
7	SPV-1201 x IS – 2284	39.30**	22.50**	-36.24	-39.34	0.93	-19.02	-25.62	-33.82	10.38	-00.02
8	SPV-1201 x IS-6335	32.73**	17.43*	-27.53	-37.16	28.32	25.31	-25.25	-45.59*	15.41	13.16
9	SPV-1201 x IS - 9471	35.01**	23.13*	-39.55	-53.99*	23.60	15.38	-33.01	-49.26**	5.76	-0.02
10	ICSB – 101B x AKms 14 B	65.32**	28.51*	-18.11	-28.02	52.71	22.28	-7.32	-11.63	59.89	18.75
11	ICSB – 101B x SRT – 26 B	18.13	10.80	0.41	-0.84	50.64	44.90	-8.55	-12.14	16.16	6.23
12	ICSB – 101B x GJ-35-15-15	36.30**	28.17*	-14.15	-18.48	21.88	18.97	2.27	0.00	25.71	15.89
13	ICSB – 101B x SPV – 946	43.25**	33.89**	-9.17	-9.92	35.48	25.50	-15.75	-17.05	48.90	33.23
14	ICSB – 101B x SPV – 104	31.11*	17.65	10.57	-4.85	83.06	64.82	-23.21	-33.33	-5.14	-15.42
15	ICSB – 101B x IS – 2284	51.76**	24.28**	-36.66	-41.19	-64.85*	-71.25*	-25.11	-31.78	63.63	40.00
16	ICSB – 101B x IS – 6335	51.44**	24.69**	-53.47*	-60.51**	-42.42	-42.56	-36.13	-52.72**	77.12	63.13
17	ICSB – 101B x IS – 9471	57.68**	33.45**	-43.81	-57.98**	-20.56	-27.55	-26.63	-43.41*	42.47	26.83
18	AKms – 14 B x SRT – 26B	31.60*	-2.23	-8.43	-20.38	27.70	5.42	-12.06	-19.29	75.90	39.43
19	AKms – 14 B x GJ-35-15-15	27.61*	-5.03	-12.88	-26.76	75.01	37.63	-5.55	-11.85	38.19	-2.66
20	AKms – 14 B x SPV – 946	32.64*	-1.70	-28.05	-36.30*	29.62	-1.94	11.56	7.99	53.39	6.09
21	AKms – 14 B x SPV – 104	19.20	1.20	-16.16	-18.19	148.84*	117.88	-3.77	-12.82	33.01	7.72
22	AKms – 14 B x IS – 2284	50.44**	1.83	-39.76*	-50.31**	33.02	-8.04	5.84	0.86	85.03	24.45
23	AKms – 14 B x IS – 6335	76.76**	20.08*	-50.81**	-62.41**	12.25	-10.01	-15.08	-35.04	142.84*	71.05
24	AKms – 14 B x IS – 9471	71.44**	18.65*	-24.99	-48.40**	36.59	18.15	-0.55	-20.52	59.19	9.75

Contd.. .. ..

Table 14 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10	11	12
25	SRT – 26B x GJ-35-15-15	27.36**	27.02*	7.63	3.45	31.63	23.71	-26.55	-27.86	75.20	48.77
26	SRT – 26B x SPV – 946	16.70	16.26	12.23	9.92	23.93	10.77	-17.73	-22.14	0.00	-17.26
27	SRT – 26B x SPV – 104	27.29*	7.95	-11.75	-24.85	47.63	37.80	2.14	-14.28	12.41	9.30
28	SRT – 26B x IS – 2284	27.74**	10.38	-28.46	-32.78	-29.96	-44.40	-16.25	-26.42	64.96	31.12
29	SRT – 26B x IS – 6335	33.03**	15.63	-33.66	-43.11	-16.67	-20.02	-22.78	-44.29*	45.66	23.63
30	SRT – 26B x IS – 9471	33.73**	19.74*	-30.28	-47.42*	5.67	-00.04	-34.29	-50.71**	-2.28	-19.52
31	GJ-35-15-15 x SPV - 946	4.14	3.47	5.27	-0.83	-25.87	-29.74	-6.16	-9.63	14.60	11.03
32	GJ-35-15-15 x SPV 104	25.03*	6.26	-9.56	-25.46	45.38	28.12	-8.69	-22.22	20.49	-0.02
33	GJ-35-15-15 x IS – 2284	25.58**	8.26	-29.17	-30.82	-12.55	-27.06	-31.11	-38.51*	-15.66	-22.22
34	GJ-35-15-15 x IS – 6335	38.09**	19.76*	-7.36	-17.76	26.63	23.42	-21.82	-42.96*	18.41	18.41
35	GJ-35-15-15 x IS – 9471	20.00*	7.18	-1.22	-23.37	48.93	32.89	-21.95	-40.74*	13.92	9.75
36	SPV – 946 x SPV – 104	24.63*	5.36	-16.09	-27.28	-36.73	-46.76	9.09	-4.00	57.12	27.15
37	SPV – 946 x IS – 2284	19.14*	3.27	-12.10	-19.00	19.89	4.66	-31.60	-36.80	2.89	-2.22
38	SPV – 946 x IS – 6335	27.96**	11.58	-5.88	-20.67	63.27	51.04	-19.78	-40.00*	14.60	11.03
39	SPV – 946 x IS 9471	10.13	-1.06	-8.90	-32.24	49.78	27.51	-24.10	-40.80*	12.85	12.20
40	SPV – 104 x IS 2284	49.62**	12.72	-42.33*	-53.34**	30.23	-1.71	-8.45	-13.20	48.45	15.57
41	SPV – 104 x IS 6335	50.32**	13.79	-48.39**	-61.22**	8.34	-2.32	12.11	-7.37	74.43	44.74
42	SPV – 104 x IS 9471	53.27**	18.82*	-30.36	-52.73**	19.83	18.15	0.61	-12.62	27.14	2.43
43	IS 2284 x IS –6335	6.33	5.59	-30.79	-37.24	-28.08	-41.24	-7.14	-26.41	6.01	-2.23
44	IS 2284 x IS - 9471	19.83**	15.09	-14.27	-32.34	24.62	-4.88	-3.40	-19.80	13.96	8.90
45	IS 6335 x IS 9471	11.29	7.61	-23.92	-34.92	-25.93	-32.36	3.02	-2.87	-13.94	-17.08
	SE (m)	4.412	4.783	7.588	8.762	2.762	3.190	7.181	8.292	5.230	6.039
	CD at 5%	8.211	9.481	15.042	15.369	5.476	6.323	14.235	16.437	10.368	11.971

* Significant at 5%

** Significant at 1%

ıble : 15 Heterosis (H_1) and Heterobeltiosis (H_2) in % F_2 progenies 10 × 10 diallel (Pooled), Akola and Patancheru, 1996

	Crosses	Grain hardness		Ele. Conductivity		Plant height		Cob length		Glume covering		TGMR	
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
	2	3	4	5	6	7	8	9	10	11	12	13	14
	SPV-1201 x ICSB –101B	16.69	-22.89*	29.92**	23.84	-10.06	-23.32*	0.20	-10.25	-8.24	-13.33	-28.28**	-30.67**
	SPV-1201 x AKms – 14 B	-16.01	-29.15**	19.64	3.69	17.48	- 6.73	- 2.53	- 6.43	0.00	0.00	-20.00*	-28.89**
	SPV-1201 x SRT – 26B	-15.76	-26.37**	13.82**	15.16	1.49	-12.94	0.11	- 4.95	- 5.00	- 5.00	-23.45**	-26.00**
	SPV-1201 x GJ-35-15-15	-15.31	-24.35*	104.95**	98.65**	2.52	1.87	6.70	-4.03	- 7.50	- 7.50	-17.93*	-20.67*
	SPV-1201 x SPV – 946	-31.43**	-38.67**	19.68	12.17	- 7.60	-11.31	1.22	-1.73	-12.50	-12.50	-15.00	-15.00
	SPV-1201 x SPV – 104	-30.01**	-43.91**	12.95	-15.09*	-12.55	-19.35*	4.16	2.29	-17.50	-17.50	-22.58**	-29.41**
	SPV-1201 x IS – 2284	-25.95**	-36.80**	56.48**	25.22	- 4.34	- 6.98	7.26	6.18	- 2.12	- 7.56	-15.45	-33.57**
	SPV-1201 x IS-6335	- 21.29*	-27.99**	0.78	-19.21	-5.46	- 7.98	11.62	4.28	-22.00*	-35.00**	-20.00	-37.14**
	SPV-1201 x IS – 9471	-25.45**	-33.74**	- 5.88	-24.51	-9.80	-15.87*	0.52	-8.08	- 6.00	- 6.00	-16.19	-37.14**
	ICSB- 101B x AKms 14 B	-16.10	-24.18*	2.18	- 7.57	12.70	3.34	12.78	4.90	- 5.88	-11.11	-27.88**	-33.89**
	ICSB – 101B x SRT – 26 B	-23.10*	-27.74*	14.63	4.56	23.76*	22.84	6.47	0.09	- 5.88	-11.11	-24.67**	-24.67*
	ICSB – 101B x GJ-35-15-15	-18.07	-21.18	28.56*	26.36*	2.70	-12.90	10.59	1.36	- 5.88	-11.11	-28.00**	-28.00**
	ICSB – 101B x SPV – 946	-15.70	-18.78	20.74	18.60	0.85	-15.23	8.88	0.18	- 5.88	-11.11	-25.52**	-28.00**
	ICSB – 101B x SPV – 104	-13.52	-26.14*	1.39	-21.15**	0.82	- 7.50	8.25	- 8.35	- 5.88	-11.11	-27.50**	-31.76**
5	ICSB – 101B x IS – 2284	-4.80	-12.87	23.60	-4.56	20.47*	0.35	9.14	- 1.36	-10.67	-10.67	-14.78	-34.67**
	ICSB – 101B x IS – 6335	-11.31	-12.43	12.99	-12.61	6.20	-11.46	4.56	- 0.09	-17.71*	-28.00**	-11.30	-32.00**
7	ICSB – 101B x IS – 9471	-23.81*	-27.10*	- 7.15	-28.15*	6.07	-14.61	1.58	- 0.73	1.65	- 4.00	- 4.55	-30.00**
8	AKms – 14 B x SRT – 26B	-11.28	-14.91	-0.40	- 1.32	35.46**	23.36	8.55	7.32	0.00	0.00	-28.21**	-27.78**
9	AKms – 14 B x GJ-35-15-15	-17.27	-22.49	0.95	-4.74	2.20	-19.24*	13.50	11.71	0.00	0.00	-29.70**	-35.56**
0	AKms – 14 B x SPV – 946	-11.13	-16.86	17.65	8.16	8.46	-16.45	4.91	3.69	8.50	8.50	-23.75**	-32.22**
1	AKms – 14 B x SPV – 104	-20.83	-25.69	4.61	-11.79	10.86	- 5.99	8.18	-2.32	0.00	0.00	-25.14**	-27.22**
2	AKms – 14 B x IS – 2284	-20.60	-21.70	5.21	-24.23*	17.92	- 8.30	5.95	2.74	-8.24	-13.33	-26.15**	-46.67**
3	AKms – 14 B x IS – 6335	-13.16	-20.62	-30.99*	-50.23**	18.61	- 7.69	6.05	3.09	-27.20**	-39.33**	-30.00**	-49.44**
4	AKms – 14 B x IS – 9471	-16.72	-21.57	-16.33	-39.63**	9.90	-17.10*	5.80	0.57	-12.50	-12.50	-29.60**	-51.11**

Contd.....

III – 22

able 15 Contd ......

1	2	3	4	5	6	7	8	9	10	11	12	13	14
5	SRT – 26B x GJ-35-15-15	-28.55**	-30.28*	6.87	-4.02	- 8.13	-21.61*	7.52	4.64	0.00	0.00	-27.33**	-27.33**
6	SRT – 26B x SPV – 946	-29.76**	-31.57*	29.48**	20.05	7.60	-10.79	- 0.84	- 3.09	0.00	0.00	-25.52**	-28.00**
7	SRT – 26B x SPV – 104	-33.43**	-39.91**	4.86	-12.25	22.02*	12.71	5.07	- 6.08	4.00	4.00	-23.12**	-27.65**
8	SRT – 26B x IS – 2284	-33.57**	-35.41**	35.74**	- 1.68	25.15**	4.88	-7.20	-11.03	- 8.24	-13.33	- 5.22	-27.33**
9	SRT – 26B x IS – 6335	-43.87**	-46.62**	8.00	-21.66*	24.40**	4.33	8.61	6.77	-20.00*	-33.33**	-21.74	-40.00**
0	SRT – 26B x IS – 9471	-36.47**	-37.66**	-33.09**	-51.44**	17.34*	- 5.00	8.80	4.56	0.00	0.00	- 6.36	-31.33**
1	GJ-35-15-15 x SPV – 946	-17.73	-17.85	69.04**	63.27**	- 8.80	-11.93	13.12	12.63	2.50	2.50	-23.45**	-26.00**
2	GJ-35-15-15 x SPV 104	-15.33	-25.22*	32.00**	1.40	- 4.32	-12.27	13.20	3.70	0.00	0.00	-19.38*	-24.12**
3	GJ-35-15-15 x IS – 2284	-10.52	-15.05	19.18	-6.82	6.25	3.95	27.54**	25.60**	16.71	10.22	-24.35*	-42.00**
4	GJ-35-15-15 x IS – 6335	-30.25**	-32.06**	24.26	-2.70	- 6.23	- 8.17	12.07	7.27	-16.80	-30.67**	-20.87	-39.33**
5	GJ-35-15-15 x IS – 9471	-34.36**	-34.73*	9.46	-14.24	- 4.42	-10.32	14.92*	7.60	- 2.50	- 2.50	-20.00	-41.33**
36	SPV – 946 x SPV – 104	-12.64	-22.94	13.56	-10.53	0.99	-10.28	0.59	- 8.21	6.50	6.50	-25.81**	-32.35**
37	SPV – 946 x IS – 2284	7.94	2.33	40.50**	7.14	7.67	- 8.89	5.95	3.89	13.41	7.11	-19.09	-36.43**
38	SPV – 946 x IS – 6335	-14.38	-16.48	9.66	-16.25	4.79	3.30	17.62*	13.05	13.20	5.67	-15.45	-33.57**
39	SPV – 946 x IS 9471	-12.31	-12.94	-14.23	-34.46**	- 8.47	-11.17	4.85	- 1.43	10.00	10.00	-2.00	-40.00**
40	SPV – 104 x IS 2284	-28.16*	-33.45*	4.58	-31.90**	9.90	- 1.21	17.26	- 0.34	20.47	13.78	- 9.60	-33.53**
41	SPV – 104 x IS 6335	-21.49	-32.23**	17.64	-23.32**	- 4.76	-14.31	11.54	- 1.79	-11.60	-26.33**	-21.60*	-42.35**
42	SPV – 104 x IS 9471	-18.83	-27.95*	-19.68*	-47.63**	- 9.30	-21.50**	8.59*	- 6.27	- 6.00	- 6.00	-17.50	-41.76**
43	IS 2284 x IS –6335	-29.25**	-34.48**	46.01*	-45.68*	- 4.70	- 4.80	3.48	- 2.39	-20.76*	-30.67**	- 6.25	- 6.25
44	IS 2284 x IS - 9471	-31.67**	-34.78**	1.04	0.74	- 5.24	- 9.22	11.84	3.23	- 5.88	-11.11	- 1.33	- 7.50
45	IS 6335 x IS 9471	-30.88**	-33.05**	- 1.56	- 1.63	- 9.27	-13.16	7.00	4.56	- 3.60	-19.67*	4.00	- 2.50
	SE	0.613	0.708	32.899	37.988	18.553	21.423	1.684	1.944	5.548	6.406	0.322	0.372
	CD at 5%	1.216	1.404	65.210	75.299	36.775	42.464	3.337	3.854	10.997	12.699	0.638	0.737

* Significant at 5%

** Significant at 1%

Table : 16 Heterosis (H_1) and Heterobeltiosis (H_2) in % F_2 progenies 10 ×10 diallel (Pooled), Akola and Patancheru, 1996

Sr. No	Crosses	Germination		*F. moniliforme*		*F. pallidoroseum*		*C. lunata*		Other fungi	
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
1	2	3	4	5	6	7	8	9	10	11	12
1	SPV-1201 x ICSB – 101B	45.67**	34.06*	8.37	-0.83	-62.90	-65.54	-16.64	-18.88	47.42	20.70
2	SPV-1201 x AKms – 14 B	5.66**	11.18	13.26	-0.04	-41.22	-49.36	-24.98	-27.46	36.94	4.43
3	SPV-1201 x SRT – 26B	40.03**	37.20*	20.54	9.37	-35.38	-39.26	-15.45	-15.74	46.94	28.58
4	SPV-1201 x GJ-35-15-15	57.41**	25.31	17.15	15.23	-15.45	-24.82	- 4.17	-7.34	-12.25	-17.13
5	SPV-1201 x SPV – 946	29.78**	22.81	18.89	13.94	-40.46	-48.30	-14.66	-16.17	2.28	-5.35
6	SPV-1201 x SPV – 104	42.74**	19.04	21.31	3.02	-58.55	-59.69	-13.99	-18.87	17.18	5.48
7	SPV-1201 x IS – 2284	17.27	3.13	14.08	1.11	-51.61	-60.36	0.22	-11.51	34.05	26.58
8	SPV-1201 x IS-6335	20.03	6.20	60.46	19.41	0.02	-13.99	3.77	-20.15	7.04	7.03
9	SPV-1201 x IS - 9471	7.57	-1.90	40.44	7.72	-30.11	-33.08	10.18	-11.70	13.78	9.53
10	ICSB – 101B x AKms 14 B	78.73**	38.93*	- 7.59	-11.20	-44.85	-55.32	3.26	2.58	53.30	39.68
11	ICSB – 101B x SRT – 26 B	34.31*	25.98	9.11	8.10	-40.58	-41.33	- 7.75	-9.92	89.93	75.80
12	ICSB – 101B x GJ-35-15-15	43.24**	29.84*	3.04	- 4.26	-58.50	-65.40	-4.04	-4.68	51.66	18.87
13	ICSB – 101B x SPV – 946	34.45*	30.53	18.90	13.29	-43.36	-47.36	-10.32	-14.23	15.63	-10.77
14	ICSB – 101B x SPV – 104	31.81	18.27	14.83	5.71	-19.57	8.22	-18.32	-24.90	31.39	18.12
15	ICSB – 101B x IS – 2284	24.22	1.72	48.21	21.64	-35.08	-49.77	-14.11	-25.92	38.63	8.65
16	ICSB – 101B x IS – 6335	32.08*	8.76	29.39	-9.07	-64.47	-71.27	10.08	-16.88	45.48	19.18
17	ICSB – 101B x IS – 9471	34.36**	13.71	36.00	- 1.85	19.57	-28.23	-8.95	-28.50	37.78	16.44
18	AKms – 14 B x SRT – 26B	19.68	-11.09	8.15	4.87	-25.00	-38.64	-3.14	-6.02	-0.59	-15.50
19	AKms – 14 B x GJ-35-15-15	62.84**	18.13	19.92	7.40	-66.22	-67.41	--3.94	-3.94	-18.18	-40.00
20	AKms – 14 B x SPV – 946	39.71*	6.34	4.36	- 4.27	-29.34	-45.86	10.07	4.60	-8.24	-33.62
21	AKms – 14 B x SPV – 104	50.03*	27.37	35.13	29.24	-23.79	-32.73	-29.35	-35.43	12.18	-7.10
22	AKms – 14 B x IS – 2284	39.91**	- 5.30	35.34	7.68	- 1.71	- 7.46	-25.61	-36.20	44.53	5.98
23	AKms – 14 B x IS – 6335	57.66**	7.11	30.69	-10.24	1.90	1.66	-9.68	-32.11	65.55	26.23
24	AKms – 14 B x IS – 9471	48.48**	2 76	19.07	-16.13	-55.85	-60.48	-6.18	-26.69	96.04	53.66

Contd.......

Table 16 Contd.......

1	2	3	4	5	6	7	8	9	10	11	12
25	SRT – 26B x GJ-35-15-15	26.00	21.47	26.48	16.51	-31.02	-41.89	-24.64	-26.89	26.00	5.00
26	SRT – 26B x SPV – 946	31.66*	27.07	-12.57	-17.43	-50.74	-54.75	10.03	7.71	33.09	9.02
27	SRT – 26B x SPV – 104	23.40	4.64	- 1.93	- 8.93	-58.08	-61.61	7.98	1.52	19.03	15.30
28	SRT – 26B x IS – 2284	3.85	-10.27	7.58	-12.35	-30.26	-45.54	-1.17	-13.00	15.03	-4.15
29	SRT – 26B x IS – 6335	28.19*	11.43	43.21	0.10	-39.04	-50.22	19.87	-7.99	28.58	12.51
30	SRT – 26B x IS – 9471	15.90	3.77	58.35	13.62	-39.34	-45.25	4.43	-16.33	14.09	3.30
31	GJ-35-15-15 x SPV – 946	26.64	17.99	14.39	11.41	-74.43*	-79.88*	-13.24	-17.55	8.39	6.08
32	GJ-35-15-15 x SPV 104	13.24	- 6.80	35.30	16.50	-24.26	-30.93	-1.24	-9.74	-29.64	-39.80
33	GJ-35-15-15 x IS – 2284	24.54*	11.12	47.30	28.68	46.03	32.91	-12.06	-24.54	-15.54	-15.55
34	GJ-35-15-15 x IS – 6335	16.53	4.62	75.60	29.28	-20.20	-23.20	-9.39	-31.90	-8.59	-13.67
35	GJ-35-15-15 x IS – 9471	8.35	0.33	67.80	27.23	-13.31	-19.78	-13.36	-32.29	-6.63	-14.93
36	SPV – 946 x SPV – 104	47.35**	28.80	18.24	4.17	-37.26	-46.81	-15.40	-10.83	-21.40	-33.94
37	SPV – 946 x IS – 2284	18.30	-0.79	55.97	33.22	-24.31	-44.36	-7.22	-16.78	15.88	13.42
38	SPV – 946 x IS – 6335	38.44**	16.76	16.04	-16.00	-48.69	-60.75	-8.61	-28.77	36.90	26.70
39	SPV – 946 x IS 9471	21.78	5.67	64.19	22.28	-31.62	-42.77	-13.58	-29.79	-12.64	-21.94
40	SPV – 104 x IS 2284	24.00	-6.58	35.03	3.95	-8.55	-23.57	-1.91	-8.58	-16.01	-28.15
41	SPV – 104 x IS 6335	17.29	-11.21	62.55	9.00	29.28	13.88	2.03	-17.96	1.08	-9.02
42	SPV – 104 x IS 9471	20.04	- 6.95	82.99*	25.62	19.82	17.93	-22.08	-34.55	0.96	-5.86
43	IS 2284 x IS –6335	6.89	6.15	150.48**	104.41**	71.64	61.94	-31.19	-41.39	-10.09	-15.10
44	IS 2284 x IS - 9471	20.00	15.26	116.33*	82.93	-11.92	-25.23	-38.72	-45.25	-3.05	-11.68
45	IS 6335 x IS 9471	18.66	14.74	114.25	105.11	13.56	1.45	-16.93	-21.33	-9.37	-12.77
	SE	5.899	6.800	9.56	11.03	2.40	2.77	8.42	9.72	4.72	5.46
	CD at 5%	11.673	13.478	18.94	21.87	4.76	5.50	16.68	19.26	9.37	10.81

* Significant at 5%

** Significant at 1%

III – 25

Table 17 Heterosis (H_1) and heterobeltiosis (H_2) in % for 10 × 10 diallel of sorghum biochemical character Akola, 1995

Sr. No.	Crosses	Protein		Soluble sugars		Tannins		Flavan-4-ols	
		H1	H2	H1	H2	H1	H2	H1	H2
1	2	3	4	5	6	7	8	9	10
1	SPV-1201 x ICSB – 101B	-14.49**	-15.44**	-7.34*	-9.51*	-0.88	-2.67	0.00	0.00
2	SPV-1201 x AKms – 14 B	-26.15**	-26.99**	-17.40**	-22.09**	-4.58*	-4.61*	0.00	0.00
3	SPV-1201 x SRT – 26B	-25.65**	-25.73**	-11.82**	-16.10**	-2.25	-2.67	0.00	0.00
4	SPV-1201 x GJ-35-15-15	-14.20**	-17.39**	1.31	-2.33	-2.67	-2.67	0.00	0.00
5	SPV-1201 x SPV – 946	-18.01**	-20.21**	-3.67	-7.08	-2.71	-2.74	0.00	0.00
6	SPV-1201 x SPV – 104	-13.57**	-14.49**	-6.44	-12.10**	-1.80	-1.80	0.00	0.00
7	SPV-1201 x IS – 2284	-5.50**	-10.18**	-5.50	-8.42*	1.53	-34.15**	20.28**	-25.19**
8	SPV-1201 x IS-6335	-16.22**	-18.30**	2.29	2.29	16.23**	-23.24**	18.04**	-26.32**
9	SPV-1201 x IS – 9471	-2.13**	-9.15**	1.06	-0.10	31.08**	-6.29**	37.72**	-19.82**
10	ICSB – 101B x AKms 14 B	-23.56**	-25.25**	-20.82**	-26.96**	-0.92	-2.74	0.00	0.00
11	ICSB – 101B x SRT – 26 B	-19.62**	-20.42**	-17.38**	-23.14**	-1.40	-2.76	0.00	0.00
12	ICSB – 101B x GJ-35-15-15	-19.92**	-23.72**	-3.87	-5.13	-2.79	-4.55*	0.00	0.00
13	ICSB – 101B x SPV – 946	-24.45**	-27.26**	-6.75	-7.92	-0.03	-1.87	0.00	0.00
14	ICSB – 101B x SPV – 104	-20.62**	-22.33**	-9.90**	-13.41**	-2.79	-4.55*	0.00	0.00
15	ICSB – 101B x IS – 2284	-19.57**	-24.36**	-5.54	-10.53**	2.38*	-34.15	6.69*	-33.64**
16	ICSB – 101B x IS – 6335	-18.78**	-21.64**	-4.85	-7.08	-1.03	-35.21**	22.04**	-23.82**
17	ICSB – 101B x IS – 9471	-19.80**	-26.31**	-6.31	-7.45	12.29**	-20.60**	5.67**	-38.48**
18	AKms – 14 B x SRT – 26B	-27.43**	-28.36**	-28.67**	-29.32**	-3.22	-3.67	0.00	0.00
19	AKms – 14 B x GJ-35-15-15	-24.68**	-26.68**	-19.72**	-26.84**	-3.64	-3.67	30.62**	30.62**
20	AKms – 14 B x SPV – 946	-27.27**	-28.42**	-9.67**	-17.63**	-2.74	-2.74	0.00	0.00
21	AKms – 14 B x SPV – 104	-24.38**	-24.43**	-17.76**	-26.84**	-4.58*	-4.61	0.00	0.00
22	AKms – 14 B x IS – 2284	-22.89**	-25.91**	-8.84**	-11.36**	21.05**	-21.49**	48.88**	-7.40**
23	AKms – 14 B x IS – 6335	-11.38**	-12.60**	-14.96**	-19.78**	18.51**	-21.71**	28.34**	-19.89**
24	AKms – 14 B x IS – 9471	-25.19**	-29.81**	-5.0	-11.36**	36.84**	-2.15*	31.23**	-23.60**

Contd.. ...

Table 17 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10
25	SRT – 26B x GJ-35-15-15	-24.82**	-27.69**	-11.10**	-18.30**	-0.37	-0.80	0.00	0.00
26	SRT – 26B x SPV – 946	-23.81**	-25.94**	-8.86**	-16.19**	-2.28	-2.74	41.30**	41.30**
27	SRT – 26B x SPV – 104	-15.57**	-16.56**	-16.90**	-25.48**	0.50	0.07	0.00	0.00
28	SRT – 26B x IS – 2284	-25.38**	-29.15**	-5.86	-7.64**	11.12**	-28.08**	31.26**	-18.36**
29	SRT – 26B x IS – 6335	-21.23**	-23.27**	-7.31*	-11.81**	24.02**	-18.26**	52.10**	-5.06**
30	SRT – 26B x IS – 9471	-24.91**	-30.36**	-4.06	-9.71**	38.64**	-1.15	33.03**	-22.55**
31	GJ-35-15-15 x SPV – 946	-18.43**	-19.32**	-14.14**	-14.79**	-0.84	-0.87	48.37**	48.37**
32	GJ-35-15-15 x SPV 104	-15.70**	-17.98**	-0.04	-2.69	-3.61	-3.61	26.45**	26.45**
33	GJ-35-15-15 x IS – 2284	-20.75**	-21.81**	-2.00	-8.32*	1.71	-34.03**	10.96**	-30.99**
34	GJ-35-15-15 x IS – 6335	-22.68**	-23.70**	-1.14	-4.69	-1.90*	-35.21**	6.81*	-33.33**
35	GJ-35-15-15 x IS – 9471	-25.07**	-27.86**	2.53	-0.03	10.19**	-21.23**	14.38**	-33.41**
36	SPV – 946 x SPV – 104	-10.87**	-12.34**	-15.5**	-17.34**	-3.64	-3.67	0.00	0.00
37	SPV – 946 x IS – 2284	-19.07**	-21.02**	-11.88**	-17.53**	0.23	-34.99**	28.88**	-19.84**
38	SPV – 946 x IS – 6335	-20.97**	-21.14**	-6.19	-9.51*	11.17**	-26.56**	52.07**	-5.08**
39	SPV – 946 x IS 9471	-20.38**	-24.16**	-10.54**	-12.73**	11.61**	-20.20**	25.64**	-26.85**
40	SPV – 104 x IS 2284	-5.95**	-9.69**	-12.31**	-19.99	2.63**	-33.44**	35.87**	-15.49**
41	SPV – 104 x IS 6335	-3.88**	-5.26**	18.18**	-23.13**	17.65**	-22.29**	47.85**	-7.71**
42	SPV – 104 x IS 9471	-10.24**	-15.83**	-14.08**	-18.39**	30.36**	-6.81**	32.17**	-22.88**
43	IS 2284 x IS –6335	-15.19**	-17.40**	-12.39**	-15.09**	-33.63**	-36.10**	-14.01**	-14.79**
44	IS 2284 x IS - 9471	-7.61**	-9.88**	-9.03**	-12.81**	-16.54**	-29.43**	-2.18	-18.14**
45	IS 6335 x IS 9471	-2.77**	-7.57**	-8.53*	-9.58*	-6.23**	-19.85**	-1.08	-17.80**
	SE (m)	0.028	0.032	0.049	0.057	0.014	0.017	0.046	0.053
	CD at 5%	0.056	0.064	0.098	0.114	0.028	0.033	0.092	0.106

* Significant at 5% H1 Heterosis over mean of parents

** Significant at 1% H2 Heterosis over mean of better parents ble :18 Mean values of parents and F_1 crosses for different characters in 10 × 10 diallel of sorghum, Akola 1995 and Patancheru, 1996

).	Parents/ Crosses	100 grain weight (g)			Grain hardness kg/cm^{-2}			Endosperm texture (%)			Ele. conductivity (millimhose)			DTF		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	SPV-1201	3.04	2.81	2.92	9.10	8.67	8.88	27.75	30.80	29.28	194.50	159.50	177.00	80.50	73.00	76.75
	ICSB-101B	2.51	2.51	2.51	7.74	6.94	7.34	30.30	26.15	28.23	287.50	242.50	265.00	72.00	72.00	72.00
	Akms-14B	2.03	2.57	2.30	8.00	6.95	7.48	29.70	32.80	31.25	335.00	188.50	261.75	67.00	68.50	67.75
	SRT-26B	2.54	2.06	2.30	7.44	6.56	7.00	33.70	32.10	32.90	275.00	300.50	287.75	76.00	69.50	72.75
	GJ-35-15-15	2.01	2.14	2.07	8.44	7.04	7.74	27.60	18.00	22.80	135.00	251.00	193.00	79.00	79.00	79.00
	SPV-946	2.27	2.03	2.15	8.77	7.85	8.31	24.10	19.90	22.00	125.00	190.50	157.75	79.00	77.00	78.00
	SPV-104	2.60	2.90	2.75	6.60	6.08	6.34	51.60	46.80	49.20	350.00	260.00	305.00	80.50	80.00	80.25
	IS-2284	1.61	1.76	1.69	6.82	5.91	6.37	58.55	56.95	57.75	185.50	108.00	146.75	71.50	70.00	70.75
	IS-6335	1.64	1.69	1.67	6.97	6.68	6.83	66.95	55.85	61.40	198.00	122.00	160.00	60.00	66.00	63.00
	IS-9471	2.06	1.91	1.99	5.29	6.11	5.70	61.40	55.30	58.35	97.00	105.00	101.00	74.00	71.50	72.75
	SPV-1201 x ICSB-101B	2.50	2.62	2.56	8.18	7.14	7.66	30.05	32.10	31.08	257.50	138.00	197.75	84.00	74.50	79.25
	SPV-1201 x Akms-14 B	2.40	2.61	2.51	6.90	5.57	6.23	40.00	38.75	39.38	295.00	150.00	222.50	88.00	75.00	81.50
	SPV-1201 x SRT – 26B	2.43	3.25	2.84	6.90	7.23	7.06	33.30	43.25	38.28	262.50	155.00	208.75	89.00	76.00	82.50
	SPV-1201 x GJ-35-15-15	2.13	2.54	2.33	7.70	7.85	7.78	27.25	21.15	24.20	235.00	135.00	185.00	87.00	74.50	80.75
	SPV-1201 x SPV –946	2.50	1.99	2.25	6.95	6.97	6.96	35.15	33.95	34.55	247.50	237.50	242.50	84.00	76.00	80.00
	SPV-1201 x SPV- 104	3.16	3.41	3.29	5.95	6.46	6.21	48.10	45.05	46.58	397.50	144.00	270.75	86.00	74.50	80.25
	SPV-1201 x IS –2284	2.36	2.27	2.31	6.61	7.30	6.95	59.50	48.00	53.75	184.00	118.00	151.00	82.00	71.00	76.50
	SPV-1201 x IS-6335	2.33	2.29	2.31	7.28	7.60	7.44	57.45	45.35	51.40	209.00	102.50	155.75	82.00	71.50	76.75
	SPV-1201 x IS – 9471	2.59	2.71	2.65	6.54	6.08	6.31	60.10	51.05	55.58	230.00	112.50	171.25	82.00	73.00	77.50
	ICSB – 101B x AKms 14 B	2.18	1.93	2.05	6.75	6.86	6.80	35.75	45.00	40.38	293.00	156.00	224.50	63.00	68.00	65.50
	ICSB – 101B x SRT- 26 B	2.54	1.95	2.25	6.45	5.27	5.86	29.25	41.30	35.28	412.50	167.00	289.75	69.00	68.50	68.75
	ICSB – 101B x GJ-35-15-15	2.20	1.96	2.08	7.60	6.64	7.12	25.40	31.10	28.25	277.00	164.00	220.50	71.00	72.00	71.50
	ICSB – 101B x SPV – 946	2.25	2.44	2.34	7.23	7.32	7.28	29.45	35.80	32.63	280.00	124.50	202.25	69.00	70.50	69.75
	ICSB – 101B x SPV – 104	3.11	2.88	2.99	6.69	6.65	6.67	40.00	39.75	39.88	303.50	150.50	227.00	88.00	71.00	79.50
5	ICSB – 101B x IS – 2284	2.08	2.08	2.08	7.27	6.44	6.86	52.25	46.10	49.18	129.00	106.50	117.75	57.00	69.50	63.25
5	ICSB – 101B x IS – 6335	2.10	2.08	2.09	7.73	6.70	7.21	49.75	43.55	46.65	112.50	99.00	105.75	57.00	62.00	59.50
7	ICSB –101B x IS – 9471	2.25	2.17	2.21	6.13	5.89	6.01	57.55	54.90	56.23	99.00	99.00	99.00	63.00	66.00	64.50
3	AKms – 14 B x SRT – 26B	2.14	2.11	2.13	6.40	3.96	5.18	51.70	54.00	52.85	313.50	230.00	271.75	63.00	66.50	64.75
9	AKms – 14 B x GJ-35-15-15	1.88	1.80	1.84	5.57	4.64	5.10	49.10	38.25	43.68	320.00	157.50	238.75	61.00	68.00	64.50
0	AKms –14 B x SPV – 946	2.55	2.50	2.52	6.98	6.32	6.65	48.15	55.35	51.75	167.50	150.50	159.00	68.00	66.00	67.00
1	AKms – 14 B x SPV – 104	3.10	2.88	2.99	5.59	4.89	5.24	54.95	56.30	55.63	178.00	177.00	177.50	69.00	68.00	68.50
2	AKms – 14 B x IS – 2284	2.12	2.38	2.25	6.09	6.19	6.14	68.10	55.75	61.93	180.00	114.00	147.00	63.00	65.50	64.25
3	AKms – 14 B x IS – 6335	2.30	2.42	2.36	6.91	6.73	6.82	64.25	64.55	64.40	175.00	98.50	136.75	57.00	60.50	58.75
4	AKms – 14 B x IS – 9471	1.96	2.25	2.11	6.16	5.35	5.76	66.55	58.80	62.68	121.50	100.50	111.00	59.00	65.00	62.00

Contd.. .. ..

able 18 Contd.. .. .

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	SRT- 26B x GJ-35-15-15	2.28	2.16	2.22	7.42	6.95	7.19	33.15	41.30	37.23	253.50	149.50	201.50	70.50	70.00	70.25
	SRT - 26B x SPV - 946	2.19	2.38	2.29	6.26	5.84	6.05	39.35	46.35	42.85	270.00	174.00	222.00	70.00	72.00	71.00
	SRT - 26B x SPV -104	3.01	2.72	2.87	6.60	6.45	6.53	50.85	52.55	51.70	189.50	166.50	178.00	68.00	66.50	67.25
	SRT - 26B x IS – 2284	1.96	2.27	2.12	5.98	5.36	5.67	53.35	46.75	50.05	282.50	119.00	200.75	63.00	60.50	61.75
	SRT - 26B x IS – 6335	1.63	2.31	1.97	6.03	6.09	6.06	69.45	59.65	64.55	209.00	123.00	166.00	58.00	59.50	58.75
	SRT - 26B x IS – 9471	1.93	2.31	2.12	6.05	4.44	5.24	61.50	49.75	55.63	183.00	123.00	153.00	60.00	61.00	60.50
	GJ-35-15-15 x SPV - 946	2.58	2.13	2.35	8.48	8.71	8.59	27.40	26.50	26.95	235.00	213.00	224.00	72.00	75.50	73.75
	GJ-35-15-15 x SPV- 104	2.69	2.70	2.70	6.53	7.08	6.81	47.40	46.55	46.98	250.00	202.50	226.25	73.00	76.50	74.75
	GJ-35-15-15 x IS - 2284	1.80	2.00	1.90	6.91	6.90	6.90	60.35	49.60	54.98	181.00	130.50	155.75	68.00	68.50	68.25
	GJ-35-15-15 x IS - 6335	1.87	1.91	1.89	6.31	7.26	6.78	57.25	41.80	49.53	121.50	90.00	105.75	62.00	62.00	62.00
	GJ-35-15-15 x IS - 9471	1.79	2.16	1.97	5.18	4.45	4.82	61.25	58.95	60.10	105.00	125.50	115.25	63.00	66.00	64.50
	SPV - 946 x SPV- 104	3.17	3.28	3.23	7.37	6.65	7.01	44.30	37.30	40.80	387.50	118.50	253.00	72.00	64.00	68.00
	SPV - 946 x IS - 2284	1.78	1.94	1.86	7.57	5.52	6.54	53.00	34.40	43.70	139.50	118.50	129.00	68.00	67.00	67.50
	SPV - 946 x IS- 6335	1.92	2.10	2.01	7.13	7.92	7.52	54.20	39.70	46.95	118.00	117.50	117.75	58.00	69.00	63.50
	SPV - 946 x IS 9471	1.92	2.13	2.02	5.91	6.28	6.10	57.85	49.90	53.88	115.00	135.50	125.25	62.50	79.00	70.75
	SPV - 104 x IS 2284	2.60	2.32	2.46	5.28	4.45	4.86	64.15	72.25	68.20	318.50	118.50	218.50	65.00	68.50	66.75
	SPV - 104 x IS 6335	2.39	2.34	2.36	3.59	5.33	4.46	67.05	74.00	70.53	262.50	114.50	188.50	57.50	63.00	60.25
	SPV - 104 x IS 9471	2.71	2.71	2.71	4.23	4.69	4.46	73.85	68.55	71.20	270.00	107.50	188.75	67.00	64.00	65.50
	IS 2284 x IS-6335	1.62	1.77	1.69	6.39	6.83	6.61	44.10	53.20	48.65	129.50	108.00	118.75	58.00	62.00	60.00
	IS 2284 x IS -9471	1.82	1.95	1.88	5.32	5.64	5.48	59.85	53.65	56.75	98.50	114.00	106.25	66.00	70.00	68.00
	IS 6335 x IS 9471	1.95	2.20	2.07	5.53	5.32	5.43	54.30	53.40	53.85	107.50	90.00	98.75	58.00	62.00	60.00
	Parental range	1.61 to 3.04	1.69 to 2.80	1.66 to 2.92	5.29 to 9.09	5.91 to 8.67	5.97 To 8.88	24.10 to 66.95	18.00 to 56.95	22.00 to 61.40	97.00 to 350.00	105.00 to 300.50	101.00 to 305.00	60.00 to 80.50	66.00 to 80.00	63.00 to 80.25
	Hybrid range	1.62 to 3.17	1.76 to 3.41	1.69 to 3.28	3.58 to 4.47	4.45 to 8.70	4.45 To 8.59	27.25 to 73.85	21.15 to 74.00	24.20 to 71.20	98.50 to 412.50	90.00 to 235.50	98.75 to 289.75	57.00 to 89.00	59.50 to 79.00	58.75 to 82.50
	SE (m)	0.033	0.155	0.273	0.444	0.479	0.938	5.090	2.628	4.370	26.060	17.909	29.520	1.034	0.852	1.565
	CD at 5%	0.094	0.442	0.707	1.269	1.367	2.559	14.530	7.502	12.150	74.404	51.110	85.212	2.940	2.433	4.179

L_1 = Akola 1995 L_2 = Akola 1996

ıble :19 Mean values of parents and F_1 crosses for different characters in 10 × 10 diallel of sorghum, Akola, 1995 and 1996

ır. lo.	Parents / Crosses	Plant height (cm)			Cob length (cm)			TGMR			Germination (%)					
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1		L2		Pooled	
1	2	3	4	5	6	7	8	9	10	11	12		13		14	
	SPV-1201	225.00	226.00	225.50	23.60	21.10	22.35	2.50	3.00	2.75	95.50	(78.26)	67.50	(55.24)	81.50	(66.75)
	ICSB-101B	155.00	164.50	159.75	26.60	26.20	26.40	3.00	3.00	3.00	74.00	(59.34)	47.00	(43.25)	60.50	(51.30)
	AKms-14B	142.50	136.00	139.25	24.60	24.10	24.35	4.00	4.00	4.00	51.00	(45.58)	29.00	(32.53)	40.00	(39.05)
	SRT-26B	165.00	157.00	161.00	24.90	23.10	24.00	3.00	3.00	3.00	79.00	(62.73)	81.50	(64.62)	80.25	(63.67)
	GJ-35-15-15	225.00	238.50	231.75	23.90	21.60	22.75	2.50	3.00	2.75	97.00	(80.16)	72.50	(58.42)	84.75	(69.29)
	SPV-946	245.00	246.50	245.75	23.70	22.60	23.15	3.00	2.50	2.75	78.00	(62.05)	65.00	(53.73)	71.50	(57.89)
	SPV-104	200.00	218.00	209.00	21.10	21.20	21.15	4.00	3.50	3.75	69.50	(56.48)	50.00	(45.00)	59.75	(50.74)
	IS-2284	265.00	214.50	239.75	22.70	22.30	22.50	2.00	2.00	2.00	87.00	(68.87)	81.50	(65.03)	84.25	(66.95)
	IS-6335	245.00	241.50	243.25	24.80	23.20	24.00	2.00	2.00	2.00	94.00	(76.28)	86.00	(68.04)	90.00	(72.16)
0	IS-9471	247.50	257.00	252.25	25.30	24.90	25.10	1.50	2.00	1.75	94.50	(76.56)	79.00	(63.04)	86.75	(69.80)
1	SPV-1201 x ICSB-101B	217.00	299.50	258.25	24.40	23.70	24.05	3.00	2.75	2.88	67.00	(54.94)	85.00	(67.26)	76.00	(61.10)
2	SPV-1201 x Akms-14 B	196.00	301.00	248.50	22.30	22.30	22.30	3.00	3.00	3.00	67.50	(55.26)	62.50	(52.25)	65.00	(53.76)
3	SPV-1201 x SRT - 26B	206.00	269.50	237.75	22.40	21.30	21.85	2.00	2.75	2.38	62.00	(51.95)	85.00	(67.63)	73.50	(59.79)
4	SPV-1201 x GJ-35-15-15	229.00	281.00	255.00	26.80	24.80	25.80	3.00	2.75	2.88	91.00	(72.56)	64.50	(53.47)	77.75	(63.02)
5	SPV-1201 x SPV -946	201.00	233.50	217.25	27.00	25.80	26.40	2.50	2.50	2.50	90.50	(72.05)	57.00	(49.05)	73.75	(60.55)
6	SPV-1201 x SPV- 104	219.00	280.50	249.75	23.40	20.40	21.90	3.50	3.00	3.25	63.00	(52.54)	78.00	(62.12)	70.50	(57.33)
7	SPV-1201 x IS -2284	243.00	293.00	268.00	23.00	22.90	22.95	2.00	2.00	2.00	91.00	(72.56)	98.00	(82.14)	94.50	(77.35)
8	SPV-1201 x IS-6335	231.00	340.00	285.50	27.10	26.30	26.70	2.00	2.00	2.00	81.50	(64.55)	97.00	(80.17)	89.25	(72.36)
9	SPV-1201 x IS - 9471	194.00	343.00	268.50	28.40	27.30	27.85	2.00	2.00	2.00	81.00	(64.17)	94.00	(76.72)	87.50	(70.44)
20	ICSB - 101B x AKms 14 B	160.00	183.00	171.50	29.80	29.30	29.55	3.50	3.50	3.50	61.00	(51.35)	66.50	(54.70)	63.75	(53.03)
21	ICSB - 101B x SRT- 26 B	188.50	222.00	205.25	28.50	28.90	28.70	3.00	3.00	3.00	52.00	(46.15)	67.50	(55.25)	59.75	(50.70)
22	ICSB - 101B x GJ-35-15-15	178.00	266.00	222.00	29.70	28.50	29.10	3.00	3.00	3.00	57.00	(49.02)	72.50	(58.42)	64.75	(53.72)
23	ICSB - 101B x SPV - 946	235.00	298.00	266.50	28.00	28.10	28.05	3.00	2.75	2.88	64.00	(53.13)	77.50	(61.75)	70.75	(57.44)
24	ICSB - 101B x SPV - 104	150.50	217.50	184.00	23.10	24.10	23.60	4.00	3.00	3.50	68.00	(55.56)	58.50	(49.89)	63.25	(52.72)
25	ICSB - 101B x IS - 2284	254.50	306.00	280.25	27.70	27.30	27.50	2.00	2.00	2.00	90.50	(72.05)	95.00	(77.14)	92.75	(74.60)
26	ICSB - 101B x IS - 6335	263.50	312.00	287.75	29.90	28.50	29.20	2.00	2.00	2.00	91.00	(72.54)	91.00	(72.50)	91.00	(72.55)
27	ICSB -101B x IS - 9471	261.50	305.00	283.25	29.40	29.50	29.45	2.00	2.00	2.00	91.00	(72.56)	96.50	(79.24)	93.75	(75.90)
28	AKms - 14 B x SRT - 26B	167.50	196.00	181.75	24.50	24.00	24.25	3.50	3.50	3.50	75.00	(60.11)	62.50	(52.23)	68.75	(56.17)
29	AKms - 14 B x GJ-35-15-15	190.00	208.00	199.00	27.90	27.20	27.55	3.00	3.00	3.00	59.00	(50.18)	49.50	(44.71)	54.25	(47.45)
30	AKms -14 B x SPV - 946	227.50	286.00	256.75	27.00	26.80	26.90	3.50	3.50	3.50	78.00	(62.05)	64.00	(54.93)	71.00	(58.49)
31	AKms - 14 B x SPV - 104	172.50	191.00	181.75	23.40	22.80	23.10	3.50	3.50	3.50	76.00	(60.67)	32.50	(34.66)	54.25	(47.60)
32	AKms - 14 B x IS - 2284	220.00	279.00	249.50	26.00	24.80	25.40	2.00	2.00	2.00	78.00	(62.08)	89.00	(70.65)	83.50	(66.36)
33	AKms - 14 B x IS - 6335	247.50	293.50	270.50	25.00	25.30	25.15	2.00	2.00	2.00	88.50	(70.22)	94.00	(76.28)	91.25	(73.25)
34	AKms - 14 B x IS - 9471	230.00	299.00	264.50	28.00	27.80	27.90	2.00	2.00	2.00	86.00	(68.08)	83.00	(65.69)	84.50	(66.88)

Contd.. .. ..

Table 19 Contd.. ... ..

1	2	3	4	5	6	7	8	9	10	11	12		13		14	
35	SRT- 26B x GJ-35-15-15	155.00	206.50	180.75	27.00	26.70	26.85	3.50	3.00	3.25	92.00	(73.69)	88.50	(70.13)	90.25	(71.93)
36	SRT - 26B x SPV - 946	209.50	253.00	231.25	24.50	23.90	24.20	2.50	2.75	2.63	84.00	(66.43)	71.00	(57.44)	77.50	(61.94)
37	SRT - 26B x SPV -104	177.50	213.50	195.50	22.10	22.10	22.10	3.50	3.00	3.25	91.00	(72.56)	58.50	(49.93)	74.75	(61.24)
38	SRT - 26B x IS – 2284	247.50	301.50	274.50	25.30	24.10	24.70	2.00	2.50	2.25	82.50	(65.28)	93.50	(75.24)	88.00	(70.26)
39	SRT - 26B x IS – 6335	250.00	274.50	262.25	23.50	23.40	23.45	2.00	2.50	2.25	78.00	(62.05)	92.00	(73.57)	85.00	(67.81)
40	SRT - 26B x IS – 9471	227.50	284.00	255.75	26.40	25.70	26.05	2.00	2.00	2.00	84.00	(66.47)	89.00	(70.80)	86.50	(68.63)
41	GJ-35-15-15 x SPV - 946	207.50	283.50	245.50	25.70	22.80	24.25	2.50	2.00	2.25	85.00	(67.22)	52.00	(46.16)	68.50	(56.69)
42	GJ-35-15-15 x SPV- 104	205.00	278.50	241.75	25.40	24.50	24.95	3.50	2.75	3.13	45.00	(42.11)	69.00	(56.40)	57.00	(49.26)
43	GJ-35-15-15 x IS - 2284	277.50	325.00	301.25	22.90	23.00	22.95	2.00	2.00	2.00	82.00	(64.91)	86.50	(68.47)	84.25	(66.69)
44	GJ-35-15-15 x IS - 6335	282.50	311.50	297.00	30.90	30.60	30.75	2.00	2.00	2.00	93.00	(75.01)	90.00	(72.15)	91.50	(73.58)
45	GJ-35-15-15 x IS - 9471	280.00	342.00	311.00	29.60	29.60	29.60	2.00	2.00	2.00	78.00	(62.12)	89.00	(70.65)	83.50	(66.38)
46	SPV - 946 x SPV- 104	197.50	312.00	254.75	21.20	20.70	20.95	3.50	3.00	3.25	49.00	(59.42)	81.50	(64.62)	65.25	(62.02)
47	SPV - 946 x IS - 2284	242.50	250.50	246.50	23.60	23.50	23.55	2.00	2.00	2.00	92.00	(73.60)	87.50	(69.48)	89.75	(71.54)
48	SPV - 946 x IS- 6335	280.00	345.50	312.75	27.10	26.20	26.65	2.00	2.00	2.00	93.00	(74.69)	96.00	(78.85)	94.50	(76.77)
49	SPV - 946 x IS 9471	237.50	314.00	275.75	26.50	25.60	26.05	2.00	2.00	2.00	88.00	(69.79)	85.00	(67.26)	86.50	(68.53)
50	SPV - 104 x IS 2284	267.50	288.50	278.00	24.20	22.70	23.45	2.00	2.00	2.00	79.00	(62.73)	90.50	(72.10)	84.75	(67.42)
51	SPV - 104 x IS 6335	257.50	297.50	277.50	27.40	26.50	26.95	2.00	2.00	2.00	60.00	(50.80)	89.50	(71.09)	74.75	(60.95)
52	SPV - 104 x IS 9471	265.00	283.50	274.25	26.30	25.30	25.80	2.00	2.00	2.00	81.00	(64.18)	91.50	(73.41)	86.25	(68.79)
53	IS 2284 x IS-6335	262.50	280.50	271.50	29.80	25.60	27.70	2.00	2.00	2.00	88.00	(69.79)	85.50	(67.65)	86.75	(68.72)
54	IS 2284 x IS -9471	262.50	270.00	266.25	24.40	23.30	23.85	2.00	2.00	2.00	86.50	(68.72)	90.50	(72.20)	88.50	(70.46)
55	IS 6335 x IS 9471	245.00	287.50	266.25	29.60	29.40	29.50	2.00	2.00	2.00	91.00	(72.56)	89.00	(70.65)	90.00	(71.60)
	Parental range	142.50 to 265.00	136.00 to 251.00	139.25 to 252.25	21.10 to 26.60	21.10 To 26.20	21.15 to 26.40	1.50 to 4.00	2.00 to 4.00	1.75 to 4.00	51.00 to 97.00		29.00 to 86.00		40.00 To 90.00	
	Hybrid range	150.50 to 282.50	183.00 to 345.50	171.50 to 312.75	21.20 to 30.90	20.40 To 30.60	20.95 to 30.75	2.00 to 3.50	2.00 to 3.50	2.00 to 3.50	45.00 to 93.00		49.50 to 98.00		54.25 To 94.50	
	SE (m)	5.113	3.708	5.147	0.690	1.634	1.273	0.263	0.207	0.470	2.170		3.606		5.092	
	CD at 5%	14.580	10.582	14.950	1.982	4.664	3.239	0.751	0.593	1.339	6.203		10.293		14.905	

L_1 = Akola 1995 L_2 = Akola 1996

Table : 20 Mean infection % of parents and F_1 crosses for pathological characters in 10 × 10 diallel of sorghum, Akola, 1995 and 1996

Sr. No.	Parents / Crosses	*F. moniliforme* (%)			*F. pallidoroseum* (%)			*C. lunata* (%)			Other fungi (%)		
		L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled	L1	L2	Pooled
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	SPV-1201	8.89	20.67	14.78	0.71	0.71	0.71	1.46	56.00	28.73	16.67	23.33	20.00
2	ICSB-101B	31.11	26.67	28.89	0.71	0.71	0.71	43.34	58.00	50.67	25.56	15.33	20.45
3	AKms-14B	8.89	46.00	27.44	0.71	0.71	0.71	12.22	44.00	28.11	62.23	9.33	35.78
4	SRT-26B	34.45	26.01	30.23	0.71	2.36	1.54	31.11	56.00	43.56	21.11	16.00	18.56
5	GJ-35-15-15	0.00	18.66	9.33	0.71	0.71	0.71	6.67	60.00	33.33	88.89	21.33	55.11
6	SPV-946	17.78	18.00	17.89	0.71	1.02	0.87	38.89	57.33	48.11	26.67	26.00	26.33
7	SPV-104	6.67	38.67	22.67	0.71	0.71	0.71	45.56	44.67	45.11	41.11	16.00	28.56
8	IS-2284	0.00	19.99	10.00	0.71	1.69	1.20	20.00	46.67	33.33	47.78	24.67	36.22
9	IS-6335	1.11	7.99	4.55	0.71	2.67	1.69	7.78	26.00	16.89	40.00	20.00	30.00
10	IS-9471	3.33	5.33	4.33	0.71	1.02	0.87	7.78	24.00	15.89	63.34	20.00	41.67
11	SPV-1201 x ICSB-101B	18.89	18.01	18.45	0.71	1.69	1.20	31.11	56.67	43.89	47.78	24.00	35.89
12	SPV-1201 x Akms-14 B	23.33	13.34	18.34	0.71	0.71	0.71	44.45	61.33	52.89	32.22	25.33	28.78
13	SPV-1201 x SRT – 26B	17.78	15.34	16.56	0.71	0.71	0.71	57.78	50.67	54.22	22.22	34.00	28.11
14	SPV-1201 x GJ-35-15-15	11.11	29.33	20.22	0.71	1.69	1.20	51.11	50.67	50.89	37.78	19.33	28.56
15	SPV-1201 x SPV –946	24.45	35.99	30.22	0.71	0.71	0.71	40.00	50.00	45.00	32.22	16.00	24.11
16	SPV-1201 x SPV- 104	21.11	14.67	17.89	0.71	0.71	0.71	51.11	55.33	53.22	28.89	32.67	30.78
17	SPV-1201 x IS –2284	5.56	8.01	6.78	2.22	2.35	2.29	14.45	28.00	21.22	35.56	21.33	28.45
18	SPV-1201 x IS-6335	11.11	7.34	9.23	0.71	0.71	0.71	22.22	18.00	20.11	37.78	18.67	28.22
19	SPV-1201 x IS – 9471	14.45	8.66	11.55	0.71	2.00	1.36	20.00	18.00	19.00	43.34	17.33	30.33
20	ICSB - 101B x Akms 14 B	23.33	19.33	21.33	0.71	1.69	1.20	50.00	59.33	54.67	25.56	19.33	22.45
21	ICSB - 101B x SRT- 26 B	23.33	11.99	17.66	0.71	0.71	0.71	58.89	68.00	63.45	16.67	21.33	19.00
22	ICSB - 101B x GJ-35-15-15	22.22	9.33	15.78	0.71	0.71	0.71	52.22	67.33	59.78	26.67	23.33	25.00
23	ICSB - 101B x SPV - 946	14.45	14.67	14.56	0.71	3.02	1.87	55.56	49.33	52.45	26.67	34.00	30.33
24	ICSB - 101B x SPV - 104	35.56	34.01	34.78	0.71	0.71	0.71	42.22	49.33	45.78	22.22	17.33	19.78
25	ICSB - 101B x IS – 2284	10.00	14.66	12.33	0.71	0.71	0.71	38.89	38.00	38.45	40.00	33.33	36.67
26	ICSB - 101B x IS – 6335	13.33	9.99	11.66	0.71	1.02	0.87	32.22	26.67	29.45	32.22	34.00	33.11
27	ICSB -101B x IS – 9471	4.44	10.67	7.56	0.71	1.69	1.20	20.00	27.33	23.67	37.78	26.67	32.22
28	AKms - 14 B x SRT - 26B	73.34	28.67	51.01	0.71	1.69	1.20	17.78	50.67	34.22	8.89	19.33	14.11
29	AKms - 14 B x GJ-35-15-15	24.45	23.33	23.89	0.71	4.00	2.36	56.67	52.67	54.67	18.89	19.33	19.11
30	AKms -14 B x SPV - 946	16.67	17.33	17.00	0.71	0.71	0.71	54.45	59.33	56.89	30.00	23.33	26.67
31	AKms - 14 B x SPV - 104	17.78	35.33	26.55	0.71	4.67	2.69	57.78	48.00	52.89	22.22	12.00	17.11
32	AKms - 14 B x IS – 2284	23.33	15.34	19.34	0.71	6.00	3.36	38.89	47.33	43.11	23.33	27.33	25.33
33	AKms - 14 B x IS – 6335	8.89	14.01	11.45	0.71	3.33	2.02	23.33	30.67	27.00	17.78	37.33	27.56
34	AKms - 14 B x IS – 9471	11.11	16.67	13.89	0.71	2.35	1.53	35.56	39.33	37.45	32.22	22.00	27.11

Contd.. .. ..

Table 20 Contd.. ... .

1	2	3	4	5	6	7	8	9	10	11	12	13	14
35	SRT- 26B x GJ-35-15-15	41.11	12.67	26.89	0.71	0.71	0.71	46.67	55.33	51.00	12.22	34.00	23.11
36	SRT - 26B x SPV – 946	35.56	26.01	30.78	0.71	0.71	0.71	44.45	54.00	49.22	17.78	20.67	19.22
37	SRT - 26B x SPV –104	10.00	30.67	20.33	0.71	1.69	1.20	15.56	53.33	34.44	45.56	15.33	30.45
38	SRT - 26B x IS – 2284	5.56	11.33	8.44	0.71	1.69	1.20	18.89	46.00	32.44	31.11	34.00	32.56
39	SRT - 26B x IS – 6335	11.11	10.01	10.56	0.71	3.34	2.03	24.45	36.67	30.56	17.78	25.33	21.56
40	SRT - 26B x IS – 9471	8.89	9.34	9.11	0.71	3.02	1.87	31.11	31.33	31.22	27.78	17.33	22.56
41	GJ-35-15-15 x SPV - 946	15.56	20.00	17.78	0.71	1.02	0.87	31.11	56.00	43.56	46.67	24.67	35.57
42	GJ-35-15-15 x SPV- 104	43.34	22.67	33.00	0.71	2.67	1.69	35.56	50.00	42.78	20.00	18.67	19.33
43	GJ-35-15-15 x IS – 2284	7.78	9.34	8.56	0.71	4.67	2.69	26.67	38.67	32.67	43.34	18.67	31.00
44	GJ-35-15-15 x IS – 6335	3.33	13.99	8.66	0.71	4.67	2.69	15.56	32.00	23.78	24.45	22.00	23.22
45	GJ-35-15-15 x IS – 9471	8.89	7.99	8.44	0.71	1.33	1.02	30.00	32.00	31.00	30.00	22.67	26.33
46	SPV - 946 x SPV- 104	21.11	11.33	16.22	0.71	1.02	0.87	57.78	58.00	57.89	21.11	32.00	26.56
47	SPV - 946 x IS – 2284	6.67	15.34	11.00	0.71	4.67	2.69	24.45	30.67	27.56	28.89	23.33	26.11
48	SPV - 946 x IS- 6335	6.67	11.99	9.33	0.71	2.35	1.53	14.45	29.33	21.89	35.56	26.00	30.78
49	SPV - 946 x IS 9471	11.11	11.99	11.55	0.71	3.33	2.02	13.33	30.67	22.00	34.45	23.33	28.89
50	SPV - 104 x IS 2284	14.45	15.99	15.22	0.71	7.33	4.02	35.56	34.67	35.11	43.34	27.33	35.33
51	SPV - 104 x IS 6335	37.78	5.99	21.89	0.71	1.69	1.20	35.56	36.00	35.78	25.56	29.33	27.45
52	SPV - 104 x IS 9471	10.00	7.99	9.00	0.71	2.35	1.53	17.78	38.67	28.22	37.78	22.67	30.22
53	IS 2284 x IS-6335	8.89	6.01	7.45	0.71	3.02	1.87	22.22	31.33	26.78	18.89	24.67	21.78
54	IS 2284 x IS -9471	6.67	12.01	9.34	0.71	8.00	4.36	25.56	30.00	27.78	27.78	26.00	26.89
55	IS 6335 x IS 9471	3.34	6.01	4.67	0.71	2.35	1.53	26.67	23.33	25.00	32.22	17.33	24.78
	Parental range	0.71 to 34.45	5.33 to 46.00	4.51 to 30.23	0.71 to 0.71	0.71 to 2.36	0.71 to 1.69	1.46 to 45.55	24.00 to 60.00	15.89 to 50.66	16.67 to 88.89	9.33 to 26.00	18.55 to 55.11
	Hybrid range	3.34 to 73.34	18.50 to 52.52	4.67 to 51.08	0.71 to 0.71	0.71 to 8.00	0.71 to 4.35	13.34 to 58.90	18.00 to 68.00	19.00 to 63.45	8.88 to 46.67	12.00 to 37.34	14.11 to 36.66
	SE (m)	1.103	1.203	1.644	0.148	0.163	0.220	1.430	1.630	2.132	1.111	1.213	1.657
	CD at 5%	2.185	2.383	3.256	0.293	0.322	0.435	2.832	3.229	4.223	2.200	2.402	3.282

L_1 = Akola, 1995 L_2 = Akola, 1996

Table 21 Analysis of variance for combining ability of F_1 crosses in 10 ×10 diallel of sorghum (Pooled)Akola and Patancheru, 1996

Sr. No.	Characters	Sources and degrees of freedom								
		GCA (9)	SCA (45)	Enviorments (1)	GCA ×Env. (9)	SCA × Env. (45)	Error (108)	δ^2 gca	δ^2 sca	δ^2 gca/ δ^2 sca
1	100 grain weight	31.84**	2.33*	170.27**	2.63**	1.76**	0.04	0.032	0.016	1.936
2	Grain hardness	19.16**	1.89*	302.43**	2.88**	1.36	0.30	0.227	0.134	1.700
3	Endosperm texture	60.26**	3.86**	11.71**	1.87	1.80**	18.55	45.807	26.496	1.729
4	Electrical conductivity	53.24**	6.98**	419.70**	21.92**	3.53**	1055.92	2298.515	3156.782	0.728
5	DTF	104.18**	9.83**	122.67**	14.92**	3.95**	2.60	11.141	11.439	0.974
6	Plant height	120.33**	23.45**	0.26	6.22**	1.82**	103.22	513.178	1178.673	0.443
7	Cob length	16.73**	2.04*	17.43**	1.22	0.80	2.66	1.746	1.390	1.256
8	Glume covering	15.11**	1.91	19.99**	1.17	1.31	44.40	26.121	20.202	1.293
9	Mesocarp thickness	142.02**	37.08**	0.67	1.61	1.65*	12.73	74.811	229.710	0.326
10	TGMR	131.78**	6.55**	192.86**	32.92**	3.33**	0.06	0.333	0.170	1.961
11	Germination	89.27**	12.40**	726.47**	6.30**	4.33**	11.43	42.075	65.226	0.646
12	*F. moniliforme*	18.69**	1.94**	697.64**	2.45*	1.49*	38.39	28.293	17.981	1.573
13	*F. pallidoroseum*	1.48	1.92**	603.45**	2.02*	1.64*	5.09	0.101	2.327	0.043
14	*C. lunata*	14.56**	1.28	333.63**	10.13**	1.22	34.38	19.425	4.774	4.068
15	Other fungi	1.79	1.81**	426.93**	1.71	1.37	18.24	0.603	7.379	0.082

Figures in parenthesis indicates degree of freedom

* Significant at 5%

** Significant at 1%

Table 22 Analysis of variance for combining ability of F_2 progenies in 10 × 10 diallel of sorghum (Pooled) Akola and Patancheru, 1996

Sr No	Characters	Sources of degrees of freedom								
		GCA (9)	SCA (45)	Environments (1)	GCA × Env. (9)	SCA × Env. (45)	Error (108)	δ^2gca	δ^2sca	δ^2gca/ δ^2sca
1	Grain hardness	13.61**	3.78**	341.10**	7.07**	2.76**	0.25	0.131	0.349	0.378
2	Ele. conductivity	157.86**	8.61**	269.45**	11.43**	9.43**	721.54	4710.639	2744.384	1.716
3	Plant height	27.00**	2.77**	308.94**	5.49**	2.68**	229.47	248.582	202.530	1.227
4	Cob length	22.97**	1.93**	0.30	3.74	1.12	1.89	1.730	0.880	1.967
5	Glume covering	8.62**	2.32**	0.11	1.09	0.83	20.52	6.517	13.580	0.480
6	TGMR	41.70**	3.86**	140.15**	7.02**	1.42	0.07	0.117	0.099	1.187
7	Germinaton	26.83**	3.79**	215.10**	4.34**	2.21**	23.11	24.882	32.248	0.772
8	*F. moniliforme*	4.07**	1.35	130.25**	1.33	0.94	60.88	7.777	10.732	0.725
9	*F. pallidoroseum*	0.88	1.22	101.49**	1.02	1.49*	3.84	0.019	0.420	0.045
10	*C. lunata*	10.45**	1.02	116.14**	3.22**	1.12	47.21	18.588	0.373	49.780
11	Other fungi	2.15*	0.95	70.46**	0.71	1.69*	14.88	0.714	0.387	1.845

Figures in parenthesis indicate degrees of freedom
* Significant at 5%
** Significant at 1%

IV – 3

Table 23 Analysis of variance for combining ability of F_1 crosses in 10 × 10 diallel of sorghum for biochemical characters Akola ,1995

Sr.No	Characters	Sources and degree of freedom					
		GCA (9)	SCA (44)	Error (54)	δ^2 gca	δ^2 sca	δ^2 gca / δ^2 sca
1	Protein	248.02**	204.51**	0.0005	0.0111	0.105	0.101
2	Soluble sugars	20.63**	6.23**	0.0016	0.003	0.008	0.313
3	Tannins	10938.26**	286.57**	0.0001	0.127	0.040	3.192
4	Flavan-4-ols	4668.30**	81.69**	0.0014	0.546	0.113	4.821

Figures in parenthesis indicate degree of freedom.

* Significant at 5%
** Significant at 1%

V – 1

Table : 24 Estimates of general combining ability effects for parents from F_1 crosses (Pooled) Akola and Patancheru, 1996

Parents	100 grain weigh	Grain hardness	Endosperm texture	Electrical conductivity	DTF	Plant height	Cob length	Glume covering	Mesocarp thickness	TGMR	Germination	*F. m.*	*F. p.*	*C. lunata*	Other fungi
SPV-1201	0.045	-0.151	-3.104**	39.208**	-8.375**	-68.667**	-0.466	3.220**	-2.605**	0.483**	-12.270**	7.593**	0.156	3.893**	-6.727**
ICSB-101B	-0.090**	0.051	-4.233**	81.792**	1.292**	-66.042**	-2.207**	10.511**	14.871**	0.420**	-17.589**	4.790**	-0.289	5.672**	-3.792**
AKMS-14B	-0.149**	0.784**	-17.316**	91.792**	2.875**	-57.167**	-2.191**	1.136	-3.499**	0.389**	-13.773**	10.955**	-3.555**	-1.328	-6.336**
SRT-26B	-0.282**	0.677**	-7.858**	112.000**	2.083**	-33.458**	-0.686*	0.095	-6.767**	0.004	-8.869**	2.238	-0.487	6.949**	-4.896**
GJ-35-15-15	0.132**	0.429**	-6.212**	44.042**	2.708**	-21.042**	-2.578**	-5.114**	4.185**	0.129**	-6.234**	-0.934	-1.412**	5.783**	-1.762*
SPV-946	-0.130**	-0.298**	-4.516**	65.792**	1.250**	-19.750**	-1.466**	-4.072**	-3.475**	-0.038	-3.858**	-0.708	-0.985*	3.727**	-1.897**
SPV-104	-0.132**	0.122	-8.400**	184.667**	5.917**	-36.875**	-2.349**	1.136	19.099**	0.316**	-10.361**	9.238**	-2.195**	-2.941**	-3.475**
IS-2284	-0.138**	0.020	-5.033**	67.792**	2.958**	-59.167**	-1.607**	8.428**	29.971**	0.587**	-13.293**	11.647**	1.164**	6.114**	-2.511**
IS-6335	-0.113**	0.464**	-6.225**	98.958**	3.333**	-55.208**	-2.641**	-5.114**	37.614**	0.795**	-15.705**	11.174**	0.431	4.171**	-3.777**
IS-9471	-0.266**	0.843**	-5.908**	85.208**	4.708**	-39.625**	-2.774**	7.386**	26.037**	0.629**	-13.676**	5.846**	-1.002**	4.895**	-0.066
SE (Gi)	0.030	0.106	0.834	6.293	0.312	1.967	0.316	1.290	0.691	0.048	0.655	1.200	0.437	1.135	0.927
SE(Gi-Gj)	0.045	0.158	1.243	9.380	0.465	2.933	0.471	1.924	1.030	0.071	0.976	1.789	0.651	1.693	1.232
CD at (Gi) 5%	0.060	0.210	1.652	12.466	0.618	3.897	0.626	2.556	1.369	0.095	1.297	2.377	0.865	2.249	1.638

* Significant at 5%
** Significant at 1%

F.m. = *F. moniliforme*
F.p. = *F. pallidoroseum*

V – 2

Table :25 Estimates of general combining ability effects for parents from F_2 progenies (Pooled), Akola and Patancheru, 1996

S. N	Parents	Grain hardness	Ele. Conductivity	Plant height	Cob length	Glume covering	TGMR	Germin-ation	*F. moniliforme*	*F. pallidoroseum*	*C. lunata*	Other fungi
1	SPV-1201	1.301**	-101.451**	16.737**	0.072	5.576**	0.560**	-11.000**	-3.558*	2.216**	3.804**	-2.463**
2	ICSB-101B	0.610**	-32.617**	-15.434**	-1.458**	4.451**	0.714**	-14.845**	-1.614	2.518**	2.805*	-5.706**
3	AKms-14B	0.470**	19.049**	-34.722**	-1.349**	2.742**	1.014**	-16.211**	-2.364	1.372**	4.250**	-3.168**
4	SRT-26B	1.568**	-25.284**	-41.734**	-0.349	1.742*	0.619**	-7.298**	-1.316	2.555**	-1.061	-3.696**
5	GJ-35-15-15	0.983**	-121.617**	11.808**	-3.499**	-0.258	0.777**	-9.063**	-7.828**	1.346**	4.102**	1.534*
6	SPV-946	0.534**	-78.284**	9.420**	-1.070**	-4.966**	0.648**	-11.000**	-2.989*	3.205**	1.975	-0.366
7	SPV-104	0.852**	-21.992**	2.028	-1.253**	-0.674	0.752**	-7.520**	-10.343**	0.344	4.200**	1.357
8	IS-2284	0.789**	-59.117**	-14.005**	-1.558**	-0.716	0.127**	-5.933**	-13.818**	-0.493	5.672**	-0.754
9	IS-6335	1.295**	-1.867	-1.551	-2.141**	11.701**	0.244**	-10.174**	-14.268**	-0.329	-0.508	-1.619*
10	IS-9471	1.388**	70.841**	12.312**	-1.453**	0.492	0.073	-6.538**	-15.954**	0.523	3.504**	0.760
	SE (Gi)	0.097	5.202	2.933	0.266	0.877	0.051	0.931	1.511	0.380	1.331	0.747
	SE (Gi-Gj)	0.145	7.754	4.373	0.397	1.308	0.076	1.388	2.252	0.566	1.983	1.114
	CD (Gi)at 5%	0.192	10.304	5.811	0.527	1.738	0.101	1.845	2.993	0.740	2.263	1.479

* Significant at 5%

** Significant at 1%

V – 3

Table 26 Estimates of general combining ability effects of parents from F_1 crosses in 10 x 10 diallel of sorghum, biochemical character Akola, 1995

Sr.No.	Parents	Proteins	Soluble sugars	Tannins	Flavan-4-ols
1	SPV – 1201	0.372**	0.027*	-0.055**	-0.084**
2	ICSB-101B	0.637**	0.109**	0.018**	0.078**
3	AKms-14B	0.801**	0.280**	-0.120**	-0.210**
4	SRT – 26B	0.787**	0.197**	-0.124**	-0.247
5	GJ-35-15-15	0.619**	0.024*	0.033**	-0.050**
6	SPV-946	0.616**	0.112**	-0.002	-0.266**
7	SPV-104	0.274**	0.167**	-0.059**	-0.229**
8	IS – 2284	0.365**	0.092**	0.815**	0.469**
9	IS – 6335	0.334***	0.083**	0.796**	0.578**
10	IS – 9471	0.326**	0.037**	0.590**	1.858**
SE (Gi)		0.006	0.011	0.003	0.010
SE (Gi-Gj)		0.009	0.016	0.005	0.015
CD (Gi) 5%		0.012	0.022	0.006	0.021

* Significant at 5%

** Significant at 1%

VI – 1

Table : 27 Estimates of specific combing ability effects for F_1 crosses in 10 x 10 diallel (Pooled) Akola and Patancheru, 1996

Sr. No.	Crosses	100 grain weight	Grain hardness	Endosperm texture	Electrical conductivity	DTF	Plant height	Cob length	Glume covering
1	2	3	4	5	6	7	8	9	10
1	SPV-1201 x ICSB – 10B	0.125	0.238	-1.631	-17.375	1.458	41.521**	-2.161*	-5.634
2	SPV-1201 x AKms – 14 B	-0.132	-0.481	-3.935	11.125	4.125**	42.958**	-1.878	-4.072
3	SPV-1201 x SRT – 26B	0.336**	0.078	3.707	- 28.771	4.104**	16.813**	-1.551	-4.593
4	SPV-1201 x GJ-35-15-15	-0.024	0.948**	-6.283*	- 32.750	0.292	10.021	1.428	-0.947
5	SPV-1201 x SPV – 946	-0.326**	0.274	0.715	21.500	-1.938	-54.208**	1.084	-6.676
6	SPV-1201 x SPV – 104	0.207*	0.435	1.511	- 27.938	1.896	19.721**	-0.907	5.303
7	SPV-1201 x IS – 2284	-0.155	-0.413	5.832*	- 9.625	-0.583	-0.042	0.989	-0.426
8	SPV-1201 x IS-6335	-0.176	-0.245	0.461	1.833	5.229**	26.188**	1.947	5.303
9	SPV-1201 x IS - 9471	0.054	-0.534	5.832*	3.583	2.167*	34.354**	2.280*	5.303
10	ICSB – 101B x AKms 14 B	-0.227*	0.163	4.038	0.542	0.708	-30.359**	1.926	-6.676
11	ICSB – 101B x SRT – 26 B	-0.224*	-0.981**	0.055	-17.354	-1.063	4.500	2.103*	11.553**
12	ICSB – 101B x GJ-35-15-15	-0.094	-0.166	-2.935	-20.083	-0.375	4.958	0.582	-3.551
13	ICSB – 101B x SPV – 946	0.009	0.460	3.063	2.667	1.646	37.479**	-0.411	-3.030
14	ICSB – 101B x SPV – 104	0.227*	0.016	-4.191	-21.771	0.229	-22.583**	-0.353	-9.801*
15	ICSB – 101B x IS – 2284	0.198	-0.167	3.730	-25.708	-0.500	38.396**	0.643	-3.030
16	ICSB – 101B x IS – 6335	0.111	0.399	-0.041	-36.750	-4.188**	35.875**	0.701	2.699
17	ICSB – 101B x IS – 9471	0.054	-0.063	6.380**	-27.750	-0.500	28.292**	1.384	-3.551
18	AKms – 14 B x SRT – 26B	-0.053	-1.420**	5.650	12.146	0.604	4.688	0.137	0.616
19	AKms – 14 B x GJ-35-15-15	-0.161	-1.345**	0.936	-12.083	-1.708	-13.354*	2.316*	10.511**
20	AKms – 14 B x SPV – 946	0.179	-0.056	9.484**	-11.583	-3.188**	36.667**	1.422	11.032**
21	AKms – 14 B x SPV – 104	0.065	-0.117	2.430	2.729	0.396	-15.896**	- 0.220	-1.989
22	AKms – 14 B x IS – 2284	0.143	0.760*	5.000	-50.458**	0.167	25.333**	0.176	-1.718
23	AKms – 14 B x IS – 6335	0.296**	0.523	7.480**	-68.000**	-3.021**	24.313**	-0.416	-1.989
24	AKms – 14 B x IS – 9471	0.189	0.126	3.550	-68.000**	-3.833**	39.979**	0.918	-1.989

Contd.. .. ..

VI – 2

Table 27 Contd.. .. ..

1	2	3	4	5	6	7	8	9	10
25	SRT – 26B x GJ-35-15-15	-0.033	0.382	0.002	29.771	-0.979	-34.000*	0.043	-2.509
26	SRT – 26B x SPV – 946	0.135	-0.124	4.100	-26.229	0.542	6.021	0.749	-1.989
27	SRT – 26B x SPV – 104	-0.025	0.652	0.546	-66.917**	-1.875	-4.792	0.257	-2.509
28	SRT – 26B x IS – 2284	0.149	0.144	-6.830	-50.604**	-3.854**	49.688**	1.303	-1.989
29	SRT – 26B x IS – 6335	0.192	-0.096	6.746**	-61.146**	-4.542**	9.167	-1.363	-2.509
30	SRT – 26B x IS – 9471	0.087	-0.268	-4.408	-14.896	2.896**	14.833*	-0.305	3.741
31	GJ-35-15-15 x SPV - 946	0.179	-0.112	0.186	16.792	1.229	-21.521**	-2.972**	1.657
32	GJ-35-15-15 x SPV 104	-0.122	0.459	0.582	-15.896	-0.688	26.667**	0.037	-5.114
33	GJ-35-15-15 x IS – 2284	-0.019	0.121	6.702**	-19.333	-1.667	30.896**	2.032	7.907
34	GJ-35-15-15 x IS – 6335	0.009	-0.843*	7.732**	-39.375	-2.354*	29.375**	1.041	1.936
35	GJ-35-15-15 x IS – 9471	0.002	-0.303	5.502	4.875	0.833	9.042	0.649	1.136
36	SPV – 946 x SPV – 104	-0.007	0.080	-3.045	5.854	0.833	35.688**	1.843	7.907
37	SPV – 946 x IS – 2284	0.191	-0.118	-3.150	-54.583**	-4.646**	-12.083	0.389	-10.322
38	SPV – 946 x IS – 6335	0.068	0.140	-4.070	-30.125	7.667**	11.396	0.197	1.677
39	SPV – 946 x IS 9471	-0.031	0.051	1.750	-55.875**	-4.646**	6.063	0.630	7.907
40	SPV – 104 x IS 2284	-0.121	-0.726*	4.521	-48.521**	-0.063	23.854**	-0.003	1.657
41	SPV – 104 x IS 6335	-0.140	-0.588	9.100**	-76.813**	-4.750**	14.333*	2.455**	7.356
42	SPV – 104 x IS 9471	0.180	-0.455	5.346	-120.063**	-7.813**	-3.250	1.589	-5.114
43	IS 2284 x IS –6335	-0.052	-0.189	-7.354**	64.000**	1.521	-13.938*	0.151	7.907
44	IS 2284 x IS - 9471	-0.057	-0.179	-4.533	59.250**	3.708**	-23.771**	-2.166*	-10.843**
45	IS 6335 x IS 9471	0.054	-0.408	-7.604**	48.458**	-2.229*	-26.292**	-0.568	-11.364**
	SE (Sij)	0.102	0.357	2.805	21.165	1.049	6.617	1.063	4.340
	SE (Sij – Sik)	0.151	0.525	4.124	31.112	1.541	9.727	1.562	6.380
	SE (Sij – Skm)	0.144	0.500	3.932	29.644	1.470	9.274	1.489	6.083
	CD (Sij) at 5%	0.203	0 707	5.557	41.928	2.077	13.109	2.102	8.598

* Significant at 5%

** Significant at 1%

Table : 28 Estimates of specific combing ability effects for F_1 crosses in 10 × 10 diallel of sorghum (Pooled), Akola and Patancheru ,1996 (Mesocarp thickness, TGMR, Germination, *F. moniliforme*, *F. pallidoroseum*, *C. lunata*, and other fungi

SN	Crosses	Meso thickness	TGMR	Germination	*F. moniliforme*	*F. pallidoroseum*	*C. lunata*	Other fungi
1	2	3	4	5	6	7	8	9
1	SPV-1201 x ICSB – 101B	-17.545**	-0.298	5.235**	3.194	0.257	3.616	-2.013
2	SPV-1201 x AKms – 14 B	19.318**	-0.069	-1.442	-1.388	1.802	0.452	1.457
3	SPV-1201 x SRT – 26B	8.660**	-0.257	8.229**	-7.585	-1.077	-0.245	12.679**
4	SPV-1201 x GJ-35-15-15	15.930**	-0.319*	-0.720	1.332	-0.472	-1.663	3.334
5	SPV-1201 x SPV – 946	0.231	0.098	-0.956	3.437	-1.823	-1.690	1.511
6	SPV-1201 x SPV – 104	10.385**	0.275	0.100	-6.584	-2.852	8.312*	5.637*
7	SPV-1201 x IS – 2284	-4.847*	-0.215	7.330**	-3.365	0.739	-5.329	-3.209
8	SPV-1201 x IS-6335	-11.506**	-0.111	2.629	0.390	2.137	-4.299	-3.288
9	SPV-1201 x IS – 9471	-15.447**	-0.069	4.135	-4.617	0.977	-6.940	-2.653
10	ICSB – 101B x Akms 14 B	3.139	0.525**	3.164	-0.460	0.901	-0.828	-0.319
11	ICSB – 101B x SRT – 26 B	1.328	0.462**	-6.025**	3.676	2.869	2.478	-2.768
12	ICSB – 101B x GJ-35-15-15	17.438**	-0.100	2.476	-3.402	0.649	6.727	0.233
13	ICSB – 101B x SPV – 946	12.132**	-0.434**	6.534**	-1.625	1.941	-1.967	3.067
14	ICSB – 101B x SPV – 104	7.691**	-0.132	-3.614	12.017**	3.579**	-7.300	-4.122
15	ICSB – 101B x IS – 2284	-22.031**	-0.371*	9.225**	-5.284	-5.140**	-3.941	5.015
16	ICSB – 101B x IS – 6335	-22.195**	-0.267	7.657**	-10.017**	-2.761	-6.579	5.263
17	ICSB – 101B x IS – 9471	-9.699**	-0.225	10.526**	-7.678	-1.899	-3.549	3.238
18	AKms – 14 B x SRT – 26B	17.451**	0.316	-1.373	2.762	-0.608	-2.357	-0.295
19	AKms – 14 B x GJ-35-15-15	-3.252	0.254	-1.344	-0.657	1.659	-1.105	-0.641
20	AKms – 14 B x SPV – 946	-0.971	0.545**	1.512	-7.875	-0.512	5.864	0.872
21	AKms – 14 B x SPV – 104	-10.666**	0.223	-7.261**	1.424	4.104**	-3.467	-2.672
22	AKms – 14 B x IS – 2284	-8.239**	-0.767**	6.336**	-5.861	1.205	4.562	4.155
23	AKms – 14 B x IS – 6335	-7.933**	-0.913**	15.185**	-9.259**	-0.907	-3.078	7.738**
24	AKms – 14 B x IS – 9471	-1.849	-0.871**	12.769**	-0.596	-0.535	1.614	2.376

Contd.. .. ..

VI – 4

Table 28 Contd .. .. ..

1	2	3	4	5	6	7	8	9
25	SRT – 26B x GJ-35-15-15	-14.070**	0.441**	4.010	3.489	1.138	-5.802	4.760
26	SRT – 26B x SPV – 946	16.269**	-0.142	0.740	5.596	0.941	-2.493	-3.396
27	SRT – 26B x SPV – 104	7.131**	0.160	0.192	0.233	1.405	-2.841	-3.118
28	SRT – 26B x IS – 2284	-11.786**	-0.330*	2.866	-3.398	-2.162	-0.132	4.042
29	SRT – 26B x IS – 6335	-1.718	-0.225	4.188	-4.458	-1.118	-2.108	0.625
30	SRT – 26B x IS – 9471	-9.731**	-0.434**	4.912	-4.792	-0.413	-6.078	-2.737
31	GJ-35-15-15 x SPV - 946	7.026**	0.420**	-3.291	1.180	-3.121*	2.086	0.082
32	GJ-35-15-15 x SPV 104	6.343**	-0.027	0.666	-0.180	1.005	-1.123	-0.465
33	GJ-35-15-15 x IS – 2284	-12.857**	-0.392**	3.068	-4.803	-1.224	-6.548	-4.303
34	GJ-35-15-15 x IS – 6335	-14.928**	-0.288	7.987**	2.789	1.332	-2.188	-0.387
35	GJ-35-15-15 x IS – 9471	-10.001**	-0.246	-0.384	2.120	1.859	-2.161	0.919
36	SPV – 946 x SPV – 104	-4.551	0.139	1.779	-3.403	-4.014**	3.727	3.559
37	SPV – 946 x IS – 2284	-4.893*	-0.100	1.078	0.973	1.915	-7.244	-1.791
38	SPV – 946 x IS – 6335	-5.755**	-0.246	4.207	3.233	4.313**	-2.215	-0.876
39	SPV – 946 x IS 9471	-12.538**	-0.205	-3.888	-0.101	2.330	-3.523	0.765
40	SPV – 104 x IS 2284	-26.604**	-0.173	9.925**	-8.392*	1.883	-1.245	2.664
41	SPV – 104 x IS 6335	-21.485**	-0.569**	8.824**	-9.795**	-0.381	3.782	4.248
42	SPV – 104 x IS 9471	-6.449**	-0.527**	10.111**	-3.794	-0.521	1.144	1.218
43	IS 2284 x IS –6335	13.972**	0.441**	10.839**	1.919	-1.615	3.144	-2.263
44	IS 2284 x IS - 9471	17.312**	0.733**	-2.402	4.918	2.070	4.506	0.713
45	IS 6335 x IS 9471	-3.680	0.587**	-8.426**	2.850	-1.864	5.198	-3.707
	SE (Sij)	2.324	0.161	2.203	0.436	1.459	3.819	2.782
	SE (Sij – Sik)	3.416	0.237	3.238	5.932	2.159	5.614	4.089
	SE (Sij – Skm)	3.257	0.226	3.088	5.656	2.059	5.352	3.898
	CD (Sij) at 5%	4.604	0.319	4.364	7.994	2.910	7.566	5.510

* Significant at 5%

** Significant at 1%

Table: 29 Estimate of specific combining ability effects for F_2 progenies in 10 × 10 diallel (Pooled) Akola and Patancheru, 1996

Sr. No	Crosses	Grain hardness	Ele. conductivity	Plant height	Cob length	Glume covering	TGMR	Germination	*F.m.*	*F.p.*	*C. lunata*	Other fungi
1	2	3	4	5	6	7	8	9	10	11	12	13
1	SPV-1201 x ICSB – 101B	-0.179	20.591**	-19.474	-0.643	0.638	-0.388**	5.635	0.119	-1.735	-4.738	1.194
2	SPV-1201 x AKms – 14 B	-0.107	23.424	23.583**	-1.214	4.159	-0.013	3.117	1.524	-0.345	-8.129	0.140
3	SPV-1201 x SRT – 26B	0.422	40.258**	- 9.499	-0.114	1.159	-0.261	8.270**	4.273	0.110	-5.915	2.395
4	SPV-1201 x GJ-35-15-15	0.137	190.341**	20.222*	-0.189	-1.091	0.019	2.276	-0.575	0.954	1.925	-2.200
5	SPV-1201 x SPV – 946	-1.149**	-31.117	- 5.547	-0.224	-5.945*	0.079	1.442	2.519	-0.162	-3.878	-1.183
6	SPV-1201 x SPV – 104	-0.691*	-7.847	-17.792	0.259	-6.299*	-0.219	6.478*	0.652	-2.149	-2.200	1.508
7	SPV-1201 x IS – 2284	-0.583	45.591**	- 9.109	0.857	1.305	-0.081	0.372	-5.028	-1.684	4.828	3.215
8	SPV-1201 x IS-6335	-0.133	-49.909**	- 5.582	1.690	-5.112	-0.148	-0.418	4.286	0.945	3.012	-1.102
9	SPV-1201 x IS - 9471	-0.318	-28.430	-10.276	-0.566	0.034	-0.109	-5.071	-0.656	-0.366	7.488	0.158
10	ICSB – 101B x AKms 14 B	-0.370	0.716	- 5.803	1.872*	0.472	-0.286	7.184**	-4.784	-0.606	5.159	-0.303
11	ICSB – 101B x SRT – 26 B	-0.269	20.799	11.041	0.772	-0.028	-0.259	2.565	1.785	-0.277	-2.887	3.123
12	ICSB – 101B x GJ-35-15-15	-0.291	9.133	3.667	0.222	-1.028	-0.304	5.941	-3.723	-1.493	1.434	3.188
13	ICSB – 101B x SPV – 946	-0.374	9.424	2.993	0.986	-3.383	-0.244	0.260	4.061	-0.433	-2.510	-1.146
14	ICSB – 101B x SPV – 104	-0.009	-20.305	- 5.203	0.570	-1.237	-0.367*	-0.589	-0.246	2.675*	-4.862	0.135
15	ICSB – 101B x IS – 2284	-0.425	10.133	27.655**	0.767	-4.133	-0.004	1.152	6.264	-0.894	-1.804	1.312
16	ICSB – 101B x IS – 6335	0.254	13.633	4.333	-0.599	-3.549	0.154	2.649	-0.642	-2.567*	4.930	1.305
17	ICSB – 101B x IS – 9471	-0.426	2.112	11.689	-1.030	3.347	0.269	4.892	0.396	0.295	-0.334	0.705
18	AKms – 14 B x SRT – 26B	0.424	-4.617	16.022	1.201	2.242	-0.059	-5.558	1.190	0.563	0.062	-3.482
19	AKms – 14 B x GJ-35-15-15	-0.209	-27.784	- 7.332	0.751	1.242	-0.329	8.175**	1.742	-1.635	2.193	-2.117
20	AKms – 14 B x SPV – 946	-0.102	32.008	3.974	-0.060	3.138	-0.119	-1.693	-1.144	0.450	7.929	-2.701
21	AKms – 14 B x SPV – 104	-0.327	20.028	1.903	0.449	1.034	-0.217	0.660	7.759	-0.337	-9.273*	0.171
22	AKms – 14 B x IS – 2284	-0.426	- 5.784	10.362	-0.078	-3.362	-0.279	4.647	2.689	0.370	-6.095	2.138
23	AKms – 14 B x IS – 6335	0.149	-76.284**	17.789	-0.270	-9.778	-0.346*	9.286**	-0.237	0.604	-1.791	4.170
24	AKms – 14 B x IS – 9471	0.029	0.195	9.045	0.049	-4.633	-0.381*	6.604*	-4.009	-1.807	1.745	7.320**

Condt.. .. ..

Table 29 Condt. .....

1	2	3	4	5	6	7	8	9	10	11	12	13
25	SRT – 26B x GJ-35-15-15	-0.335	-50.451**	-31.463**	-0.124	0.748	-0.327	3.263	4.211	0.162	-10.513*	2.169
26	SRT – 26B x SPV – 946	-0.631	50.091**	-0.082	-0.910	-1.612	-0.292	3.800	-6.425	-0.931	5.103	2.215
27	SRT – 26B x SPV – 104	-0.450	-1.138	20.472*	0.299	2.534	-0.240	0.998	-6.582	-2.190	5.121	0.797
28	SRT – 26B x IS – 2284	-0.617	54.299**	24.505**	-2.628**	-3.862	0.223	-4.681	-5.342	-0.586	1.819	-0.346
29	SRT – 26B x IS – 6335	-1.112**	8.049	29.108**	0.880	-5.778	-0.194	5.327	3.042	-1.070	6.433	0.676
30	SRT – 26B x IS – 9471	-0.567*	-66.722**	23.364**	1.324	1.117	0.171	0.712	6.440	-0.891	2.899	-0.654
31	GJ-35-15-15 x SPV – 946	-0.268	112.424**	-11.086	0.765	-1.362	-0.138	1.301	-0.923	-2.512	-3.296	1.870
32	GJ-35-15-15 x SPV 104	0.135	64.195**	- 2.507	0.424	-0.466	-0.011	-3.315	3.680	-0.414	3.581	-2.358
33	GJ-35-15-15 x IS – 2284	0.309	-45.867**	14.101	3.722**	8.388**	-0.248	5.247	1.710	2.391	-0.320	-1.941
34	GJ-35-15-15 x IS – 6335	-0.657*	- 5.367	- 9.997	0.105	-4.778	-0.090	-1.102	5.834	-0.403	-1.757	-1.259
35	GJ-35-15-15 x IS – 9471	-0.789	- 3.388	0.810	1.224	-1.133	-0.125	-3.657	3.702	0.256	-1.451	-0.519
36	SPV – 946 x SPV – 104	0.047	8.987	7.974	-1.037	0.430	-0.300	7.053*	0.084	-0.809	-3.612	-2.322
37	SPV – 946 x IS – 2284	1.098**	29.674	-21.617*	0.036	4.284	-0.138	0.464	6.894	-0.105	0.886	1.875
38	SPV – 946 x IS – 6335	0.059	-16.576	50.985**	2.645**	11.617**	0.021	8.017**	-4.912	-1.608	-2.310	4.357
39	SPV – 946 x IS 9471	0.252	-38.347*	-11.434	-0.062	2.763	-0.165	1.357	5.826	-0.299	-2.264	-2.333
40	SPV – 104 x IS 2284	-0.535	-24.055	16.137	0.095	10.180**	0.139	3.796	-0.753	-0.482	4.194	-1.753
41	SPV – 104 x IS 6335	-0.058	51.695**	-10.386	0.853	-1.737	-0.177	-1.337	5.311	1.475	2.528	-0.001
42	SPV – 104 x IS 9471	0.165	-46.576**	-14.655	0.597	-3.091	-0.113	1.296	10.779*	1.544	-3.877	0.409
43	IS 2284 x IS –6335	-0.609	46.633**	-19.453	-1.024	-8.133**	0.060	-4.031	13.791**	2.519	-6.984	-2.617
44	IS 2284 x IS - 9471	-0.639	7.612	-14.472	1.370	-3.237	0.075	4.944	7.409	-0.542	-7.868	-1.174
45	IS 6335 x IS 9471	-0.482	31.862	-18.695	0.003	3.847	0.233	1.999	2.023	0.565	-3.045	-2.392
	SE (Sij)	0.326	17.496	9.867	0.895	2.951	0.171	3.132	5.082	1.277	4.475	2.513
	SE (Sij- Sik)	0.480	25.718	14.503	1.316	4.337	0.252	4.604	7.471	1.877	6.578	3.694
	SE (Sij – Skm)	0.457	24.521	13.828	1.255	4.135	0.240	4.389	7.123	1.790	6.272	3.522
	CD (Sij) at 5%	0.646	34.659	19.546	1.774	5.845	0.339	6.204	10.068	2.530	8.822	4.978

* Significant at 5% *F.m.* = *F. moniliforme*

** Significant at 1% *F.p.* = *F. pallidoroseum*

Table : 30 Estimates of specific combining ability effects for F_1 crosses in 10 × 10 diallel of sorghum biochemical charcter Akola, 1995.

Sr.No.	Crosses	Protein	Soluble sugars	Tannins	Flavan- 4-ols
1	2	3	4	5	6
1	SPV-1201 x ICSB – 101 B	-0.021	-0.038	-0.125**	-0.003
2	SPV-1201 x AKms – 14 B	-0.340**	-0.121**	-0.122**	-0.147**
3	SPV-1201 x SRT – 26B	-0.341**	-0.073	-0.106**	-0.166**
4	SPV-1201 x GJ-35-15-15	0.006	0.044	-0.031**	-0.067**
5	SPV-1201 x SPV – 946	-0.134**	0.017	-0.049**	-0.175**
6	SPV-1201 x SPV – 104	-0.158**	0.007	-0.071**	-0.157**
7	SPV-1201 x IS – 2284	0.181**	-0.025	0.058**	0.182**
8	SPV-1201 x IS-6335	-0.214**	0.089*	0.214**	0.072*
9	SPV-1201 x IS – 9471	0.278**	0.047	0.244**	0.063
10	ICSB – 101B x AKms 14 B	-0.125**	-0.127**	-0.058**	-0.066
11	ICSB – 101B x SRT – 26 B	-0.000	-0.112**	-0.063**	-0.085*
12	ICSB – 101B x GJ-35-15-15	-0.067**	0.013	0.005	0.014
13	ICSB – 101B x SPV – 946	-0.237**	0.017	0.008	-0.094**
14	ICSB – 101B x SPV – 104	-0.284**	0.004	-0.041**	-0.075*
15	ICSB – 101B x IS – 2284	-0.174**	0.018	0.108**	0.019
16	ICSB – 101B x IS – 6335	-0.179**	0.026	-0.015	0.225**
17	ICSB – 101B x IS – 9471	-0.186**	-0.017	0.045**	-0.091
18	AKms – 14 B x SRT – 26B	-0.179	-0.237*	-0.146**	-0.229**
19	AKms – 14 B x GJ-35-15-15	-0.132**	-0.149**	-0.071**	0.087*
20	AKms – 14 B x SPV – 946	-0.232	0.048	-0.081**	-0.238**
21	AKms – 14 B x SPV – 104	-0.317**	-0.041	-0.124**	-0.219**
22	AKms – 14 B x IS – 2284	0.188**	0.042	0.344**	0.635**
23	AKms – 14 B x IS – 6335	0.175**	-0.055	0.216**	0.192**
24	AKms – 14 B x IS – 9471	-0.264**	0.080*	0.283**	0.405**

Contd.. .. ..

VI – 8

Table 30 Contd.....

1	2	3	4	5	6
25	SRT – 26B x GJ-35-15-15	-0.154**	-0.057	-0.048**	-0.149**
26	SRT – 26B x SPV – 946	-0.130**	0.021	-0.080**	0.035
27	SRT – 26B x SPV – 104	-0.022	-0.067	-0.088**	-0.238**
28	SRT – 26B x IS – 2284	-0.290**	0.050	0.179**	0.299**
29	SRT – 26B x IS – 6335	-0.183**	0.026	0.299**	0.596**
30	SRT – 26B x IS – 9471	-0.274**	0.054	0.302**	0.431**
31	GJ-35-15-15 x SPV - 946	-0.001	-0.126**	0.009	0.184**
32	GJ-35-15-15 x SPV 104	-0.089**	0.095*	-0.040*	0.048
33	GJ-35-15-15 x IS – 2284	-0.187**	0.029	0.105**	0.032
34	GJ-35-15-15 x IS – 6335	-0.286**	0.037	-0.021	0.110**
35	GJ-35-15-15 x IS – 9471	-0.328**	0.066	0.028*	0.062
36	SPV – 946 x SPV – 104	0.070**	-0.062	-0.058**	-0.248**
37	SPV – 946 x IS – 2284	-0.141**	-0.074*	0.063**	0.246**
38	SPV – 946 x IS – 6335	-0.238**	0.009	0.163**	0.586**
39	SPV – 946 x IS 9471	-0.188**	-0.074*	0.028*	0.236**
40	SPV – 104 x IS 2284	0.119**	-0.048	0.074**	0.391**
41	SPV – 104 x IS 6335	0.170**	-0.129**	0.234**	0.530**
42	SPV – 104 x IS 9471	-0.037	-0.092*	0.233**	0.426**
43	IS 2284 x IS –6335	-0.153**	-0.103**	0.763**	-0.749**
44	IS 2284 x IS - 9471	0.106**	-0.072	-0.408**	-0.492**
45	IS 6335 x IS 9471	0.240**	-0.065	-0.291**	-0.517**
SE (Sij)		0.021	0.037	0.011	0.035
SE (Sij – Sik)		0.031	0.054	0.016	0.051
CD (Sij) 5 %		0.041	0.074	0.022	0.069

* Significant at 5%

** Significant at 1%

Table : 31 Protein fractions % of parents and F_1 crosses, Akola, 1995

Sr.No	Cross No.	Parents/Crosses	Albumin & Globlin	Prolamin	Cross link prolamin	Glutelin like	Glutelin	Residues
1	1	SPV-1201	14.41	6.96	10.41	2.51	28.74	10.68
2	2	ICSB-101B	15.84	5.49	8.57	3.01	27.90	8.82
3	3	AKms-14B	14.09	9.08	12.14	2.46	28.95	11.46
4	4	SRT-26B	20.63	5.88	10.18	3.22	32.47	6.78
5	5	GJ-35-15-15	15.60	6.47	13.39	3.33	35.11	9.12
6	6	SPV-946	13.62	6.36	13.62	3.18	37.06	9.78
7	7	SPV-104	12.62	4.88	14.92	3.98	32.51	8.64
8	8	IS-2284	1.81	0.70	5.24	12.39	6.27	7.26
9	9	IS-6335	1.96	2.79	10.53	12.79	57.25	10.20
10	10	IS-9471	8.73	1.90	6.83	9.07	56.43	8.04
11	13	SPV-1201 x SPV-946	14.19	3.65	12.89	2.86	23.81	1.14
12	12	SPV-1201 x SPV-104	14.94	3.15	13.03	4.04	30.67	20.70
13	11	SPV-1201 x IS-9471	9.00	1.17	8.90	10.88	38.48	4.41
14	16	ICSB-101B x SPV-946	15.13	2.42	12.10	3.33	39.18	9.96
15	15	ICSB-101B x SPV-104	10.91	1.71	13.40	3.81	37.58	6.30
16	14	ICSB-101 B x IS-9471	8.82	0.75	9.12	7.65	46.91	6.18
17	19	AKms-14B x SPV-946	15.89	3.97	10.19	3.80	35.58	9.30
18	18	AKms-14B x SPV-104	13.63	4.13	12.10	4.13	36.60	10.80
19	17	AKms-14B x IS-9471	8.63	0.54	5.94	7.73	45.32	5.40
20	22	SRT-26B x SPV-946	18.09	4.10	9.73	4.40	28.88	6.36
21	21	SRT-26B x SPV-104	14.37	3.53	9.78	5.54	26.62	7.80
22	20	SRT-26B x IS-9471	10.07	0.52	3.99	10.24	46.18	11.46
23	25	GJ-35-15-15 x SPV-946	15.88	4.72	10.59	3.00	32.76	3.42
24	24	GJ-35-15-15 x SPV-104	15.67	4.24	8.87	3.73	30.98	10.02
25	23	GJ-35-15-15 x IS-9471	15.30	1.34	5.54	7.65	51.05	4.56
26	27	SPV-946 x SPV-104	16.74	3.79	9.38	4.46	33.93	4.68
27	26	SPV-946 x IS-9471	13.89	1.80	7.19	7.02	51.96	3.90
28	28	SPV-104 x IS-9471	15.94	1.58	7.54	7.66	36.01	8.76
29	29	IS-2284 x IS-9471	7.90	0.38	4.39	8.66	47.05	8.28
30	30	IS-6335 x IS-9471	9.77	2.55	6.58	0.96	49.68	10.80
		SE (m)	0.217	0.035	0.048	0.070	0.279	0.133
		CD at 5%	0.620	0.101	0.139	0.210	0.798	0.381

VII – 2

Table : 32 Observation on glume colour, grain color and testa

Sr. No.	Parents/ Crosses	Glume color	Grain color	Testa	Sr. No.	Parents/ Crosses	Glume color	Grain color	Testa
1	SPV-1201	Light red	White	A	29	AKms - 14 B x GJ-35-15-15	Light red	White	A
2	ICSB-101B	Light red	White	A	30	AKms -14 B x SPV - 946	Light red	White	A
3	AKms-14B	Light red	White	A	31	AKms - 14 B x SPV - 104	Light red	White	A
4	SRT-26B	Red	White	A	32	AKms - 14 B x IS - 2284	Purple	Red	P
5	GJ-35-15-15	Red	White	A	33	AKms - 14 B x IS - 6335	Black	Red	P
6	SPV-946	Light red	White	A	34	AKms - 14 B x IS - 9471	Purple	Red	P
7	SPV-104	Light red	White	A	35	SRT- 26B x GJ-35-15-15	Light red	White	A
8	IS-2284	Purple	Light red	P	36	SRT - 26B x SPV - 946	Light red	White	A
9	IS-6335	Black	Dark red	P	37	SRT - 26B x SPV -104	Light red	White	A
10	IS-9471	Purple	Dark red	P	38	SRT - 26B x IS – 2284	Purple	Light red	P
11	SPV-1201 x ICSB-101B	Tan	White	A	39	SRT - 26B x IS – 6335	Black	Light red	P
12	SPV-1201 x Akms-14 B	Tan	White	A	40	SRT - 26B x IS – 9471	Red	Red	P
13	SPV-1201 x SRT - 26B	Light red	White	A	41	GJ-35-15-15 x SPV - 946	Light red	White	A
14	SPV-1201 x GJ-35-15-15	Light red	White	A	42	GJ-35-15-15 x SPV- 104	Light red	White	A
15	SPV-1201 x SPV -946	Tan	White	A	43	GJ-35-15-15 x IS - 2284	Purple	Dark red	P
16	SPV-1201 x SPV- 104	Tan	White	A	44	GJ-35-15-15 x IS - 6335	Black	Dark red	P
17	SPV-1201 x IS –2284	Purple	Light red	P	45	GJ-35-15-15 x IS - 9471	Red	Red	P
18	SPV-1201 x IS-6335	Partly straw purple	Dark red	P	46	SPV - 946 x SPV- 104	Light red	White	A
19	SPV-1201 x IS - 9471	Red	Light red	P	47	SPV - 946 x IS - 2284	Purple	Red	P
20	ICSB - 101B x AKms 14 B	Light red	White	A	48	SPV - 946 x IS- 6335	Black	Light red	P
21	ICSB - 101B x SRT- 26 B	Red	White	A	49	SPV - 946 x IS 9471	Red	Red	P
22	ICSB - 101B x GJ-35-15-15	Red	White	A	50	SPV - 104 x IS 2284	Purple	Red	P
23	ICSB - 101B x SPV - 946	Light Red	White	A	51	SPV - 104 x IS 6335	Black	Red	P
24	ICSB - 101B x SPV - 104	White	White	A	52	SPV - 104 x IS 9471	Black	Red	P
25	ICSB - 101B x IS - 2284	Purple	Light red	P	53	IS 2284 x IS-6335	Black	Light red	P
26	ICSB - 101B x IS - 6335	Black	Light red	P	54	IS 2284 x IS -9471	Black	Red	P
27	ICSB -101B x IS - 9471	Purple	Red	P	55	IS 6335 x IS 9471	Black	Dark red	P
28	AKms - 14 B x SRT - 26B	Light Red	White	A					

A = Absent P = Present

VIII – 1

Table 33. Effect of pre-treatment on germination (%) of parents, F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	78.00	76.00	77.00	49.33	52.00	50.67	63.67	64.00	63.83
2	ICSB-101B	76.67	80.00	78.33	35.33	28.67	32.00	56.00	54.33	55.17
3	Akms-14B	54.00	68.67	61.33	4.67	5.33	5.00	29.33	37.00	33.17
4	SRT-26B	86.67	85.33	86.00	22.00	18.00	20.00	54.33	51.67	53.00
5	GJ-35-15-15	81.33	77.33	79.33	24.67	12.00	18.33	53.00	44.67	48.83
6	SPV-946	87.33	81.33	84.33	32.67	22.67	27.67	60.00	52.00	56.00
7	SPV-104	61.33	58.00	59.67	4.00	8.67	6.33	32.67	33.33	33.00
8	IS-2284	93.33	90.67	92.00	66.67	82.00	74.33	80.00	86.33	83.17
9	IS-6335	93.33	93.33	93.33	78.00	83.33	80.67	85.67	88.33	87.00
10	IS-9471	93.33	94.00	93.67	71.33	76.67	74.00	82.33	85.33	83.83
11	SPV-1201 x ICSB-101B	85.33	88.00	86.67	52.67	52.67	52.67	69.00	70.33	69.67
12	SPV-1201 x Akms-14 B	82.67	85.33	84.00	52.67	61.33	57.00	67.67	73.33	70.50
13	SPV-1201 x SRT - 26B	94.00	90.00	92.00	80.67	82.67	81.67	87.33	86.33	86.83
14	SPV-1201 x GJ-35-15-15	60.67	94.67	77.67	71.33	84.00	77.67	66.00	89.33	77.67
15	SPV-1201 x SPV -946	65.33	74.67	70.00	68.00	81.33	74.67	66.67	78.00	72.33
16	SPV-1201 x SPV- 104	84.67	87.33	86.00	43.33	62.00	52.67	64.00	74.67	69.33
17	SPV-1201 x IS -2284	91.33	96.00	93.67	74.67	79.33	77.00	83.00	87.67	85.33
18	SPV-1201 x IS-6335	96.00	93.33	94.67	70.00	68.67	69.33	83.00	81.00	82.00
19	SPV-1201 x IS - 9471	95.33	92.67	94.00	76.67	72.67	74.67	86.00	82.67	84.33
20	ICSB - 101B x AKms 14 B	78.67	76.00	77.33	45.33	42.67	44.00	62.00	59.33	60.67
21	ICSB - 101B x SRT- 26 B	88.00	91.33	89.67	39.33	41.33	40.33	63.67	66.33	65.00
22	ICSB - 101B x GJ-35-15-15	88.00	94.00	91.00	78.67	78.67	78.67	83.33	86.33	84.83
23	ICSB - 101B x SPV - 946	92.00	89.33	90.67	58.67	49.33	54.00	75.33	69.33	72.33
24	ICSB - 101B x SPV - 104	76.67	80.67	78.67	37.33	45.33	41.33	57.00	63.00	60.00
25	ICSB - 101B x IS - 2284	88.67	90.67	89.67	87.33	89.33	88.33	88.00	90.00	89.00
26	ICSB - 101B x IS - 6335	90.00	93.33	91.67	94.00	90.00	92.00	92.00	91.67	91.83
27	ICSB -101B x IS - 9471	92.00	94.00	93.00	86.00	93.33	89.67	89.00	93.67	91.33
28	AKms - 14 B x SRT - 26B	72.00	82.00	77.00	26.00	28.67	27.33	49.00	55.33	52.17
29	AKms - 14 B x GJ-35-15-15	82.00	81.33	81.67	26.67	32.67	29.67	54.33	57.00	55.67
30	AKms -14 B x SPV - 946	77.33	81.33	79.33	34.67	22.67	28.67	56.00	52.00	54.00
31	AKms - 14 B x SPV - 104	53.33	66.00	59.67	22.00	24.00	23.00	37.67	45.00	41.33
32	AKms - 14 B x IS - 2284	80.00	94.00	87.00	66.67	82.67	74.67	73.33	88.33	80.83
33	AKms - 14 B x IS - 6335	93.33	97.33	95.33	88.00	88.00	88.00	90.67	92.67	91.67
34	AKms - 14 B x IS - 9471	88.00	94.00	91.00	80.67	76.67	78.67	84.33	85.33	84.83

Contd.. ...

VIII - 2

Table 33. Contd.. ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	92.67	90.00	91.33	40.67	40.67	40.67	66.67	65.33	66.00
36	SRT - 26B x SPV - 946	84.00	86.00	85.00	64.00	62.67	63.33	74.00	74.33	74.17
37	SRT - 26B x SPV -104	69.33	72.00	70.67	24.67	40.00	32.33	47.00	56.00	51.50
38	SRT - 26B x IS – 2284	88.00	78.67	83.33	80.67	95.33	88.00	84.33	87.00	85.67
39	SRT - 26B x IS – 6335	90.00	89.33	89.67	88.67	93.33	91.00	89.33	91.33	90.33
40	SRT - 26B x IS – 9471	90.00	95.33	92.67	86.00	90.67	88.33	88.00	93.00	90.50
41	GJ-35-15-15 x SPV - 946	85.33	88.00	86.67	56.00	73.33	64.67	70.67	80.67	75.67
42	GJ-35-15-15 x SPV- 104	83.33	86.00	84.67	50.67	42.67	46.67	67.00	64.33	65.67
43	GJ-35-15-15 x IS - 2284	90.67	88.00	89.33	82.67	84.00	83.33	86.67	86.00	86.33
44	GJ-35-15-15 x IS - 6335	92.00	90.00	91.00	83.33	88.00	85.67	87.67	89.00	88.33
45	GJ-35-15-15 x IS - 9471	92.67	92.00	92.33	74.00	71.33	72.67	83.33	81.67	82.50
46	SPV - 946 x SPV- 104	84.67	80.00	82.33	27.33	42.67	35.00	56.00	61.33	58.67
47	SPV - 946 x IS - 2284	86.67	92.67	89.67	79.33	84.00	81.67	83.00	88.33	85.67
48	SPV - 946 x IS- 6335	93.33	95.33	94.33	77.33	83.33	80.33	85.33	89.33	87.33
49	SPV - 946 x IS 9471	92.00	89.33	90.67	78.00	82.00	80.00	85.00	85.67	85.33
50	SPV - 104 x IS 2284	88.67	89.33	89.00	80.67	87.33	84.00	84.67	88.33	86.50
51	SPV - 104 x IS 6335	92.67	93.33	93.00	84.67	93.33	89.00	88.67	93.33	91.00
52	SPV - 104 x IS 9471	92.00	94.00	93.00	78.00	92.00	85.00	85.00	93.00	89.00
53	IS 2284 x IS-6335	91.33	92.67	92.00	86.00	85.33	85.67	88.67	89.00	88.83
54	IS 2284 x IS -9471	88.00	84.00	86.00	77.33	92.67	85.00	82.67	88.33	85.50
55	IS 6335 x IS 9471	96.00	94.67	95.33	78.67	78.67	78.67	87.33	86.67	87.00
	Mean	84.80	86.78	85.79	60.62	64.05	62.29	72.66	75.41	74.01
	% increase (+)/decrease(-) over untreated			(+)2.33			(+)5.51			(+)3.64
	% increase over location			27.39						

Patancheru.

	SE (m)±	CD 5%	SE (m)±	CD 5%	SE (m)	CD 5%
A	0.430	1.191	0.639	1.557	0.578	1.681
B	2.254	6.250	3.324	9.213	3.030	8.847
A x B	3.389	8.840	4.700	13.029	4.286	12.471

VIII – 3

Table 34. Effect of pre-treatment on *F. moniliforme* (%) (GS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	12.67	10.01	11.34	27.33	16.00	21.67	20.00	13.00	16.50
2	ICSB-101B	18.01	16.67	17.34	18.00	11.33	14.67	18.00	14.00	16.00
3	Akms-14B	24.67	17.99	21.33	2.67	2.67	2.67	13.67	10.33	12.00
4	SRT-26B	20.67	19.33	20.00	14.00	7.33	10.67	17.34	13.33	15.34
5	GJ-35-15-15	11.99	18.67	15.33	16.67	7.33	12.00	14.33	13.00	13.67
6	SPV-946	12.00	22.67	17.34	18.00	8.67	13.33	15.00	15.67	15.34
7	SPV-104	20.01	27.33	23.67	4.00	4.67	4.33	12.00	16.00	14.00
8	IS-2284	15.99	8.67	12.33	28.00	16.00	22.00	22.00	12.34	17.17
9	IS-6335	5.33	3.33	4.33	32.00	12.67	22.33	18.66	8.00	13.33
10	IS-9471	3.33	3.33	3.33	20.67	15.33	18.00	12.00	9.33	10.67
11	SPV-1201 x ICSB-101B	12.67	9.34	11.01	28.67	11.33	20.00	20.67	10.34	15.50
12	SPV-1201 x Akms-14 B	8.67	10.01	9.34	26.00	12.67	19.33	17.34	11.34	14.34
13	SPV-1201 x SRT - 26B	12.01	12.67	12.34	24.67	20.00	22.33	18.34	16.33	17.34
14	SPV-1201 x GJ-35-15-15	12.67	11.34	12.00	25.33	16.67	21.00	19.00	14.00	16.50
15	SPV-1201 x SPV -946	16.66	13.99	15.33	21.33	20.67	21.00	19.00	17.33	18.16
16	SPV-1201 x SPV- 104	10.00	9.99	10.00	22.67	8.67	15.67	16.33	9.33	12.83
17	SPV-1201 x IS -2284	5.34	3.33	4.34	25.33	9.33	17.33	15.34	6.33	10.84
18	SPV-1201 x IS-6335	5.34	3.99	4.67	26.00	10.00	18.00	15.67	7.00	11.33
19	SPV-1201 x IS - 9471	6.66	4.67	5.67	17.33	12.00	14.67	12.00	8.34	10.17
20	ICSB - 101B x AKms 14 B	13.33	9.99	11.66	24.00	13.33	18.67	18.67	11.66	15.17
21	ICSB - 101B x SRT- 26 B	7.99	5.34	6.67	26.67	12.67	19.67	17.33	9.00	13.17
22	ICSB - 101B x GJ-35-15-15	5.33	14.01	9.67	38.00	16.00	27.00	21.67	15.00	18.34
23	ICSB - 101B x SPV - 946	11.33	12.01	11.67	33.33	10.00	21.67	22.33	11.00	16.67
24	ICSB - 101B x SPV - 104	22.67	10.67	16.67	27.33	14.00	20.67	25.00	12.34	18.67
25	ICSB - 101B x IS - 2284	8.66	3.99	6.33	24.00	10.67	17.33	16.33	7.33	11.83
26	ICSB - 101B x IS - 6335	6.66	5.34	6.00	16.67	12.00	14.33	11.66	8.67	10.17
27	ICSB -101B x IS - 9471	6.67	3.33	5.00	16.67	22.67	19.67	11.67	13.00	12.34
28	AKms - 14 B x SRT - 26B	14.67	14.67	14.67	16.00	8.00	12.00	15.34	11.33	13.34
29	AKms - 14 B x GJ-35-15-15	15.99	11.33	13.66	16.67	10.67	13.67	16.33	11.00	13.67
30	AKms -14 B x SPV - 946	9.33	9.99	9.66	14.00	8.67	11.33	11.67	9.33	10.50
31	AKms - 14 B x SPV - 104	17.99	12.67	15.33	10.00	8.67	9.33	14.00	10.67	12.33
32	AKms - 14 B x IS - 2284	10.01	4.67	7.34	22.67	9.33	16.00	16.34	7.00	11.67
33	AKms - 14 B x IS - 6335	10.67	5.34	8.01	18.00	8.67	13.33	14.34	7.00	10.67
34	AKms - 14 B x IS - 9471	12.01	4.67	8.34	23.33	8.67	16.00	17.67	6.67	12.17

Contd.. .. .. .

Table 34. Contd.....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	10.01	11.34	10.67	29.33	15.33	22.33	19.67	13.34	16.50
36	SRT - 26B x SPV - 946	19.34	10.67	15.01	40.67	25.33	33.00	30.00	18.00	24.00
37	SRT - 26B x SPV -104	19.33	14.67	17.00	12.00	22.00	17.00	15.67	18.34	17.00
38	SRT - 26B x IS – 2284	5.99	6.67	6.33	29.33	18.00	23.67	17.66	12.34	15.00
39	SRT - 26B x IS – 6335	6.67	7.99	7.33	25.33	15.33	20.33	16.00	11.66	13.83
40	SRT - 26B x IS – 9471	5.34	5.33	5.33	22.67	16.67	19.67	14.00	11.00	12.50
41	GJ-35-15-15 x SPV - 946	10.67	11.33	11.00	30.00	20.00	25.00	20.33	15.67	18.00
42	GJ-35-15-15 x SPV- 104	17.33	10.66	14.00	28.00	22.00	25.00	22.67	16.33	19.50
43	GJ-35-15-15 x IS - 2284	6.67	6.67	6.67	28.67	14.67	21.67	17.67	10.67	14.17
44	GJ-35-15-15 x IS - 6335	9.99	5.33	7.66	34.67	12.67	23.67	22.33	9.00	15.66
45	GJ-35-15-15 x IS - 9471	3.99	8.00	6.00	28.67	10.67	19.67	16.33	9.33	12.83
46	SPV - 946 x SPV- 104	7.33	8.67	8.00	16.67	14.67	15.67	12.00	11.67	11.83
47	SPV - 946 x IS - 2284	8.67	4.67	6.67	38.00	16.00	27.00	23.34	10.33	16.84
48	SPV - 946 x IS- 6335	7.33	2.00	4.66	37.33	15.33	26.33	22.33	8.67	15.50
49	SPV - 946 x IS 9471	8.66	4.66	6.66	31.33	14.67	23.00	20.00	9.66	14.83
50	SPV - 104 x IS 2284	11.33	12.67	12.00	26.67	14.00	20.33	19.00	13.33	16.17
51	SPV - 104 x IS 6335	4.66	9.33	6.99	28.00	14.00	21.00	16.33	11.66	14.00
52	SPV - 104 x IS 9471	4.66	1.99	3.33	31.33	15.33	23.33	18.00	8.66	13.33
53	IS 2284 x IS-6335	4.67	4.00	4.34	28.67	14.67	21.67	16.67	9.33	13.00
54	IS 2284 x IS -9471	8.01	6.01	7.01	22.00	11.33	16.67	15.00	8.67	11.84
55	IS 6335 x IS 9471	4.67	3.34	4.01	18.67	12.67	15.67	11.67	8.00	9.84
	Mean	10.78	9.19	9.99	23.89	13.32	18.61	17.34	11.26	14.30
	% increase (+)/decrease(-) over untreated			(-)14.75			(-)44.75			(-)35.06
	% increase over location						86.26 Akola			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.334	0.954	0.632	1.751	0.690	2.008
B	1.806	5.007	3.315	9.187	3.618	10.528
A x B	2.554	7.081	4.687	12.993	5.117	14.891

Table 35. Effect of pre-treatment on *F. pallidoroseum* (%) (GS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	0.67	0.33	6.00	5.33	5.67	3.00	3.00	300
2	ICSB-101B	0.00	4.67	2.33	3.33	3.33	3.33	1.67	4.00	283
3	Akms-14B	0.00	5.33	2.67	0.00	0.00	0.00	0.00	2.67	133
4	SRT-26B	0.00	4.00	2.00	1.33	4.00	2.67	1.67	4.00	283
5	GJ-35-15-15	0.00	6.67	3.33	4.00	0.00	2.00	2.00	3.33	267
6	SPV-946	0.67	6.00	3.33	6.00	3.33	4.67	3.33	4.67	400
7	SPV-104	0.00	6.67	3.33	0.00	0.00	0.00	0.00	3.33	167
8	IS-2284	1.33	2.67	2.00	12.00	6.00	9.00	6.67	4.33	550
9	IS-6335	2.67	2.67	2.67	7.33	5.33	6.33	5.00	4.00	450
10	IS-9471	0.67	0.67	0.67	6.00	6.00	6.00	3.33	3.33	333
11	SPV-1201 x ICSB-101B	1.33	0.00	0.67	4.00	4.67	4.33	2.67	2.33	250
12	SPV-1201 x Akms-14 B	0.00	2.67	1.33	8.67	2.67	5.67	4.33	2.67	350
13	SPV-1201 x SRT - 26B	0.00	2.00	1.00	8.00	6.67	7.33	4.00	4.33	417
14	SPV-1201 x GJ-35-15-15	0.00	2.67	1.33	6.67	4.67	5.67	3.33	3.67	350
15	SPV-1201 x SPV -946	0.00	0.67	0.33	5.33	6.00	5.67	2.67	3.33	300
16	SPV-1201 x SPV- 104	0.00	0.67	0.33	4.00	2.67	3.33	2.00	1.67	183
17	SPV-1201 x IS -2284	2.00	0.00	1.00	8.67	1.33	5.00	5.33	0.67	300
18	SPV-1201 x IS-6335	0.00	2.00	1.00	8.67	2.67	5.67	4.33	2.33	333
19	SPV-1201 x IS - 9471	2.00	0.67	1.33	6.67	2.00	4.33	4.33	1.33	283
20	ICSB - 101B x AKms 14 B	1.33	0.67	1.00	6.00	6.67	6.33	3.67	3.67	367
21	ICSB - 101B x SRT- 26 B	0.00	1.33	0.67	5.33	4.67	5.00	2.67	3.00	283
22	ICSB - 101B x GJ-35-15-15	0.00	0.00	0.00	14.67	6.00	10.33	7.33	3.00	517
23	ICSB - 101B x SPV – 946	2.67	1.33	2.00	8.00	4.00	6.00	5.33	2.67	400
24	ICSB - 101B x SPV – 104	0.00	2.67	1.33	6.67	4.67	5.67	3.33	3.67	350
25	ICSB - 101B x IS – 2284	0.00	2.67	1.33	5.33	4.67	5.00	2.67	3.67	317
26	ICSB - 101B x IS – 6335	0.67	0.67	0.67	6.67	3.33	5.00	3.67	2.00	283
27	ICSB -101B x IS – 9471	1.33	0.00	0.67	6.00	6.00	6.00	3.67	3.00	333
28	AKms - 14 B x SRT - 26B	1.33	0.67	1.00	3.33	4.00	3.67	2.33	2.33	233
29	AKms - 14 B x GJ-35-15-15	3.33	1.33	2.33	4.00	6.00	5.00	3.67	3.67	367
30	AKms -14 B x SPV – 946	0.00	0.67	0.33	3.33	2.00	2.67	1.67	1.33	150
31	AKms - 14 B x SPV – 104	4.00	2.00	3.00	4.00	3.33	3.67	4.00	2.67	333
32	AKms - 14 B x IS – 2284	4.00	1.33	2.67	10.67	3.33	7.00	7.33	2.33	483
33	AKms - 14 B x IS – 6335	3.33	2.00	2.67	8.00	4.00	6.00	5.67	3.00	433
34	AKms - 14 B x IS – 9471	1.33	0.67	1.00	7.33	5.33	6.33	4.33	3.00	367

Contd.. .. .. ..

VIII – 6

Table 35. Contd. .. ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.00	0.00	6.67	6.67	6.67	3.33	3.33	3.33
36	SRT - 26B x SPV - 946	0.00	6.00	3.00	10.67	4.67	7.67	5.33	5.33	5.33
37	SRT - 26B x SPV -104	0.67	2.00	1.33	3.33	6.67	5.00	2.00	4.33	3.17
38	SRT - 26B x IS – 2284	1.33	1.33	1.33	6.67	5.33	6.00	4.00	3.33	3.67
39	SRT - 26B x IS – 6335	3.33	3.33	3.33	7.33	7.33	7.33	5.33	5.33	5.33
40	SRT - 26B x IS – 9471	1.33	2.00	1.67	7.33	7.33	7.33	4.33	4.67	4.50
41	GJ-35-15-15 x SPV - 946	0.67	0.00	0.33	4.67	2.67	3.67	2.67	1.33	2.00
42	GJ-35-15-15 x SPV- 104	1.33	1.33	1.33	8.67	3.33	6.00	5.00	2.33	3.67
43	GJ-35-15-15 x IS - 2284	3.33	2.00	2.67	7.33	3.33	5.33	5.33	2.67	4.00
44	GJ-35-15-15 x IS - 6335	3.33	2.00	2.67	10.67	4.67	7.67	7.00	3.33	5.17
45	GJ-35-15-15 x IS - 9471	1.33	2.00	1.67	12.67	5.33	9.00	7.00	3.67	5.33
46	SPV - 946 x SPV- 104	0.67	0.67	0.67	3.33	6.00	4.67	2.00	3.33	2.67
47	SPV - 946 x IS - 2284	2.67	2.67	2.67	13.33	6.00	9.67	8.00	4.33	6.17
48	SPV - 946 x IS- 6335	1.33	0.00	0.67	17.33	6.00	11.67	9.33	3.00	6.17
49	SPV - 946 x IS 9471	3.33	2.67	3.00	12.00	6.00	9.00	7.67	4.33	6.00
50	SPV - 104 x IS 2284	6.00	2.00	4.00	8.67	4.00	6.33	7.33	3.00	5.17
51	SPV - 104 x IS 6335	1.33	5.33	3.33	9.33	4.67	7.00	5.33	5.00	5.17
52	SPV - 104 x IS 9471	2.00	0.67	1.33	7.33	6.00	6.67	4.67	3.33	4.00
53	IS 2284 x IS-6335	1.33	4.67	3.00	8.00	6.00	7.00	4.67	5.33	5.00
54	IS 2284 x IS -9471	4.67	6.00	5.33	8.00	4.00	6.00	6.33	5.00	5.67
55	IS 6335 x IS 9471	2.00	0.67	1.33	6.00	4.67	5.33	4.00	2.67	3.33
	Mean	2.20	2.12	2.16	7.00	4.46	5.73	4.21	3.29	3.75
	% increase (+)/decrease(-) over untreated			(-)3.64			(-)36.28			(-)21.75
	% increase over location						165.27 Akola			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.168	0.468	0.220	0.610	0.216	0.628
B	0.885	2.454	1.154	3.200	1.131	3.291
A x B	1.252	3.470	1.632	4.526	1.599	4.656

Table 36. Effect of pre-treatment on *C. lunata* (%) (GS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	45.33	45.36	45.35	15.33	18.67	17.00	30.33	32.01	31.17
2	ICSB-101B	45.33	39.32	42.33	11.33	14.00	12.67	28.33	26.66	27.50
3	Akms-14B	24.67	37.36	31.01	2.00	2.67	2.33	13.33	20.01	16.67
4	SRT-26B	48.67	34.00	41.33	6.00	6.00	6.00	27.33	20.00	23.67
5	GJ-35-15-15	49.33	30.68	40.01	4.00	4.67	4.33	26.67	17.67	22.17
6	SPV-946	51.33	28.68	40.01	10.67	8.67	9.67	31.00	18.67	24.84
7	SPV-104	28.67	16.68	22.67	0.00	2.67	1.33	14.33	9.67	12.00
8	IS-2284	43.33	30.68	37.01	18.00	18.00	18.00	30.67	24.34	27.50
9	IS-6335	22.00	14.00	18.00	12.67	17.33	15.00	17.33	15.67	16.50
10	IS-9471	20.00	16.68	18.34	14.67	23.33	19.00	17.33	20.01	18.67
11	SPV-1201 x ICSB-101B	48.67	46.68	47.67	18.67	13.33	16.00	33.67	30.01	31.84
12	SPV-1201 x Akms-14 B	50.67	40.00	45.33	14.00	12.00	13.00	32.33	26.00	29.17
13	SPV-1201 x SRT - 26B	48.00	44.68	46.34	24.67	24.67	24.67	36.33	34.67	35.50
14	SPV-1201 x GJ-35-15-15	34.00	45.36	39.68	20.67	25.33	23.00	27.33	35.35	31.34
15	SPV-1201 x SPV -946	37.33	39.36	38.35	20.00	32.00	26.00	28.67	35.68	32.17
16	SPV-1201 x SPV- 104	48.00	44.00	46.00	14.67	18.67	16.67	31.33	31.33	31.33
17	SPV-1201 x IS -2284	24.67	9.36	17.01	24.00	12.67	18.33	24.33	11.01	17.67
18	SPV-1201 x IS-6335	16.67	8.68	12.67	23.33	10.00	16.67	20.00	9.34	14.67
19	SPV-1201 x IS - 9471	16.00	9.36	12.68	19.33	11.33	15.33	17.67	10.35	14.01
20	ICSB - 101B x AKms 14 B	47.33	32.68	40.01	11.33	18.00	14.67	29.33	25.34	27.34
21	ICSB - 101B x SRT- 26 B	62.00	28.68	45.34	6.67	12.00	9.33	34.33	20.34	27.34
22	ICSB - 101B x GJ-35-15-15	60.67	46.00	53.33	20.00	19.33	19.67	40.33	32.67	36.50
23	ICSB - 101B x SPV - 946	45.33	26.68	36.01	15.33	18.00	16.67	30.33	22.34	26.34
24	ICSB - 101B x SPV - 104	38.67	39.32	38.99	3.33	15.33	9.33	21.00	27.33	24.16
25	ICSB - 101B x IS - 2284	34.00	19.36	26.68	16.67	14.00	15.33	25.33	16.68	21.01
26	ICSB - 101B x IS - 6335	23.33	16.00	19.67	12.67	12.67	12.67	18.00	14.33	16.17
27	ICSB -101B x IS - 9471	24.00	16.00	20.00	15.33	18.67	17.00	19.67	17.33	18.50
28	AKms - 14 B x SRT - 26B	41.33	48.68	45.01	6.67	16.00	11.33	24.00	32.34	28.17
29	AKms - 14 B x GJ-35-15-15	44.67	50.00	47.33	5.33	12.00	8.67	25.00	31.00	28.00
30	AKms -14 B x SPV - 946	47.33	52.00	49.67	13.33	13.33	13.33	30.33	32.67	31.50
31	AKms - 14 B x SPV - 104	24.00	39.36	31.68	6.00	11.33	8.67	15.00	25.35	20.17
32	AKms - 14 B x IS - 2284	38.00	22.00	30.00	17.33	16.00	16.67	27.67	19.00	23.33
33	AKms - 14 B x IS - 6335	27.33	16.00	21.67	16.00	12.67	14.33	21.67	14.33	18.00
34	AKms - 14 B x IS - 9471	34.00	22.68	28.34	20.67	12.67	16.67	27.33	17.67	22.50

Contd.. .. .. ..

Table 36. Contd.....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	50.67	42.00	46.33	4.67	15.33	10.00	27.67	28.67	28.17
36	SRT - 26B x SPV - 946	44.67	48.00	46.33	11.33	26.67	19.00	28.00	37.33	32.67
37	SRT - 26B x SPV -104	36.67	36.68	36.67	8.00	10.67	9.33	22.33	23.67	23.00
38	SRT - 26B x IS – 2284	38.00	17.36	27.68	15.33	22.00	18.67	26.67	19.68	23.17
39	SRT - 26B x IS – 6335	31.33	16.68	24.01	12.00	22.67	17.33	21.67	19.67	20.67
40	SRT - 26B x IS – 9471	27.33	20.00	23.67	12.00	21.33	16.67	19.67	20.67	20.17
41	GJ-35-15-15 x SPV - 946	51.33	36.68	44.01	17.33	37.33	27.33	34.33	37.01	35.67
42	GJ-35-15-15 x SPV- 104	41.33	48.00	44.67	10.67	13.33	12.00	26.00	30.67	28.33
43	GJ-35-15-15 x IS - 2284	34.67	21.36	28.01	14.00	30.67	22.33	24.33	26.01	25.17
44	GJ-35-15-15 x IS - 6335	29.33	22.00	25.67	15.33	38.67	27.00	22.33	30.33	26.33
45	GJ-35-15-15 x IS - 9471	28.67	34.00	31.33	18.00	26.00	22.00	23.33	30.00	26.67
46	SPV - 946 x SPV- 104	47.33	36.68	42.01	6.67	17.33	12.00	27.00	27.01	27.00
47	SPV - 946 x IS - 2284	26.00	14.00	20.00	17.33	22.67	20.00	21.67	18.33	20.00
48	SPV - 946 x IS- 6335	28.00	14.00	21.00	16.67	30.67	23.67	22.33	22.33	22.33
49	SPV - 946 x IS 9471	26.00	20.00	23.00	14.67	22.67	18.67	20.33	21.33	20.83
50	SPV - 104 x IS 2284	31.33	18.00	24.67	20.67	16.00	18.33	26.00	17.00	21.50
51	SPV - 104 x IS 6335	30.00	20.68	25.34	18.67	18.00	18.33	24.33	19.34	21.84
52	SPV - 104 x IS 9471	34.00	20.00	27.00	11.33	18.00	14.67	22.67	19.00	20.83
53	IS 2284 x IS-6335	25.33	16.68	21.01	16.00	22.00	19.00	20.67	19.34	20.00
54	IS 2284 x IS -9471	26.00	17.36	21.68	20.67	15.33	18.00	23.33	16.35	19.84
55	IS 6335 x IS 9471	21.33	13.36	17.35	12.67	18.67	15.67	17.00	16.01	16.51
	Mean	36.43	28.89	32.66	13.72	17.53	15.63	25.08	23.21	24.15
	% increase (+)/decrease(-) over untreated			(-)20.69			(+)21.73			(-)7.44
	% increase over location			108.95 Patancheru						

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.504	1.455	0.056	0.164	0.616	1.792
B	2.643	7.633	0.297	0.860	3.232	9.405
A x B	3.738	10.795	0.421	1.216	4.571	13.302

Table 37. Effect of pre-treatment on other fungi (%) (GS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	20.00	18.67	19.33	0.67	2.00	1.33	10.33	10.33	10.33
2	ICSB-101B	13.33	12.67	13.00	2.67	0.00	1.33	8.00	6.33	7.17
3	Akms-14B	4.67	8.00	6.33	0.00	0.00	0.00	2.33	4.00	3.17
4	SRT-26B	15.33	16.67	16.00	0.00	0.67	0.33	7.67	8.67	8.17
5	GJ-35-15-15	20.00	14.67	17.33	0.00	0.00	0.00	10.00	7.33	8.67
6	SPV-946	23.33	14.00	18.67	0.00	2.00	1.00	11.67	8.00	9.83
7	SPV-104	12.67	7.33	10.00	0.00	1.33	0.67	6.33	4.33	5.33
8	IS-2284	24.67	10.00	17.33	5.33	4.00	4.67	15.00	7.00	11.00
9	IS-6335	20.00	6.67	13.33	4.67	6.00	5.33	12.33	6.33	9.33
10	IS-9471	19.33	6.00	12.67	4.00	4.67	4.33	11.67	5.33	8.50
11	SPV-1201 x ICSB-101B	22.67	18.67	20.67	1.33	3.33	2.33	12.00	11.00	11.50
12	SPV-1201 x Akms-14 B	23.33	18.00	20.67	5.33	4.67	5.00	14.33	11.33	12.83
13	SPV-1201 x SRT - 26B	34.00	20.67	27.33	23.33	7.33	15.33	28.67	14.00	21.33
14	SPV-1201 x GJ-35-15-15	14.00	17.33	15.67	18.67	13.33	16.00	16.33	15.33	15.83
15	SPV-1201 x SPV -946	11.33	18.00	14.67	21.33	22.00	21.67	16.33	20.00	18.17
16	SPV-1201 x SPV- 104	26.67	27.33	27.00	4.00	2.67	3.33	15.33	15.00	15.17
17	SPV-1201 x IS -2284	18.67	9.33	14.00	8.67	2.00	5.33	13.67	5.67	9.67
18	SPV-1201 x IS-6335	18.00	5.33	11.67	9.33	1.33	5.33	13.67	3.33	8.50
19	SPV-1201 x IS - 9471	16.67	5.33	11.00	10.00	0.67	5.33	13.33	3.00	8.17
20	ICSB - 101B x AKms 14 B	16.67	10.67	13.67	4.00	6.00	5.00	10.33	8.33	9.33
21	ICSB - 101B x SRT- 26 B	18.00	10.00	14.00	1.33	3.33	2.33	9.67	6.67	8.17
22	ICSB - 101B x GJ-35-15-15	22.00	8.67	15.33	6.00	1.33	3.67	14.00	5.00	9.50
23	ICSB - 101B x SPV - 946	33.33	10.67	22.00	2.00	0.00	1.00	17.67	5.33	11.50
24	ICSB - 101B x SPV - 104	16.00	11.33	13.67	0.00	0.00	0.00	8.00	5.67	6.83
25	ICSB - 101B x IS - 2284	32.00	10.00	21.00	8.00	0.00	4.00	20.00	5.00	12.50
26	ICSB - 101B x IS - 6335	31.33	8.00	19.67	7.33	3.33	5.33	19.33	5.67	12.50
27	ICSB -101B x IS - 9471	26.00	9.33	17.67	8.00	0.00	4.00	17.00	4.67	10.83
28	AKms - 14 B x SRT - 26B	14.67	18.00	16.33	0.00	0.67	0.33	7.33	9.33	8.33
29	AKms - 14 B x GJ-35-15-15	18.00	18.67	18.33	0.67	4.00	2.33	9.33	11.33	10.33
30	AKms -14 B x SPV - 946	20.67	18.67	19.67	4.00	0.00	2.00	12.33	9.33	10.83
31	AKms - 14 B x SPV - 104	8.00	12.67	10.33	2.00	0.67	1.33	5.00	6.67	5.83
32	AKms - 14 B x IS - 2284	24.00	6.00	15.00	7.33	4.00	5.67	15.67	5.00	10.33
33	AKms - 14 B x IS - 6335	37.33	7.33	22.33	6.00	2.00	4.00	21.67	4.67	13.17
34	AKms - 14 B x IS - 9471	20.67	10.67	15.67	8.00	2.00	5.00	14.33	6.33	10.33

Contd.. .. .. ..

VIII – 10

Table 37. Contd. . . ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	34.00	19.33	26.67	0.00	3.33	1.67	17.00	11.33	14.17
36	SRT - 26B x SPV - 946	20.00	21.33	20.67	1.33	6.00	3.67	10.67	13.67	12.17
37	SRT - 26B x SPV -104	13.33	18.67	16.00	1.33	0.67	1.00	7.33	9.67	8.50
38	SRT - 26B x IS – 2284	32.00	11.33	21.67	5.33	6.67	6.00	18.67	9.00	13.83
39	SRT - 26B x IS – 6335	24.00	13.33	18.67	6.00	4.67	5.33	15.00	9.00	12.00
40	SRT - 26B x IS – 9471	16.67	14.00	15.33	4.67	4.00	4.33	10.67	9.00	9.83
41	GJ-35-15-15 x SPV - 946	24.00	16.00	20.00	4.67	6.67	5.67	14.33	11.33	12.83
42	GJ-35-15-15 x SPV- 104	17.33	24.00	20.67	4.00	4.00	4.00	10.67	14.00	12.33
43	GJ-35-15-15 x IS - 2284	17.33	14.00	15.67	4.67	7.33	6.00	11.00	10.67	10.83
44	GJ-35-15-15 x IS - 6335	22.00	13.33	17.67	7.33	6.67	7.00	14.67	10.00	12.33
45	GJ-35-15-15 x IS - 9471	22.67	15.33	19.00	7.33	7.33	7.33	15.00	11.33	13.17
46	SPV - 946 x SPV- 104	30.67	22.67	26.67	0.67	6.67	3.67	15.67	14.67	15.17
47	SPV - 946 x IS - 2284	23.33	7.33	15.33	6.00	4.67	5.33	14.67	6.00	10.33
48	SPV - 946 x IS- 6335	26.00	12.00	19.00	4.00	5.33	4.67	15.00	8.67	11.83
49	SPV - 946 x IS 9471	23.33	12.67	18.00	5.33	8.00	6.67	14.33	10.33	12.33
50	SPV - 104 x IS 2284	25.33	12.67	19.00	7.33	5.33	6.33	16.33	9.00	12.67
51	SPV - 104 x IS 6335	29.33	10.67	20.00	6.67	6.67	6.67	18.00	8.67	13.33
52	SPV - 104 x IS 9471	22.67	10.00	16.33	5.33	4.67	5.00	14.00	7.33	10.67
53	IS 2284 x IS-6335	24.67	10.67	17.67	4.67	4.00	4.33	14.67	7.33	11.00
54	IS 2284 x IS -9471	25.33	11.33	18.33	5.33	3.33	4.33	15.33	7.33	11.33
55	IS 6335 x IS 9471	16.67	6.67	11.67	5.33	5.33	5.33	11.00	6.00	8.50
	Mean	21.60	13.14	17.34	5.11	3.94	4.53	13.36	8.54	10.95
	% increase (+)/decrease(-) over untreated			(-)39.16			(-)22.89			(-)36.09
	% increase over location			283.44 Patancheru						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.675	1.871		0.400	1.108		0.666	1.938	
	B	3.539	9.810		2.097	5.813		3.494	10.167	
	A x B	5.005	13.873		2.966	8.220		4.942	14.381	

Table 38. Effect of pre-treatment on score (GS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	4.00	3.00	3.50	4.00	4.00	4.00	4.00	3.50	3.75
2	ICSB-101B	4.00	3.00	3.50	4.00	4.00	4.00	4.00	3.50	3.75
3	Akms-14B	5.00	3.50	4.25	3.00	4.33	3.67	4.00	3.92	3.96
4	SRT-26B	3.83	3.00	3.42	3.50	4.00	3.75	3.67	3.50	3.58
5	GJ-35-15-15	3.50	3.00	3.25	3.50	3.33	3.42	3.50	3.17	3.33
6	SPV-946	3.83	2.50	3.17	3.50	3.00	3.25	3.67	2.75	3.21
7	SPV-104	4.50	3.50	4.00	3.33	3.33	3.33	3.92	3.42	3.67
8	IS-2284	2.00	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50
9	IS-6335	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	IS-9471	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	SPV-1201 x ICSB-101B	3.00	2.50	2.75	3.00	3.00	3.00	3.00	2.75	2.88
12	SPV-1201 x Akms-14 B	3.00	2.50	2.75	3.67	3.00	3.33	3.33	2.75	3.04
13	SPV-1201 x SRT - 26B	2.83	3.00	2.92	3.33	3.00	3.17	3.08	3.00	3.04
14	SPV-1201 x GJ-35-15-15	2.50	3.00	2.75	3.50	3.00	3.25	3.00	3.00	3.00
15	SPV-1201 x SPV -946	2.83	3.00	2.92	3.50	3.00	3.25	3.17	3.00	3.08
16	SPV-1201 x SPV- 104	3.17	2.83	3.00	3.50	3.00	3.25	3.33	2.92	3.13
17	SPV-1201 x IS -2284	1.00	1.00	1.00	2.50	1.00	1.75	1.75	1.00	1.38
18	SPV-1201 x IS-6335	1.00	1.00	1.00	1.50	1.00	1.25	1.25	1.00	1.13
19	SPV-1201 x IS - 9471	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	ICSB - 101B x AKms 14 B	3.00	3.00	3.00	3.00	3.50	3.25	3.00	3.25	3.13
21	ICSB - 101B x SRT- 26 B	3.00	2.00	2.50	3.00	3.17	3.08	3.00	2.58	2.79
22	ICSB - 101B x GJ-35-15-15	2.67	2.00	2.33	3.00	3.00	3.00	2.83	2.50	2.67
23	ICSB - 101B x SPV - 946	2.67	3.00	2.83	3.00	3.00	3.00	2.83	3.00	2.92
24	ICSB - 101B x SPV - 104	3.33	2.00	2.67	3.50	2.00	2.75	3.42	2.00	2.71
25	ICSB - 101B x IS - 2284	1.33	1.00	1.17	1.50	1.00	1.25	1.42	1.00	1.21
26	ICSB - 101B x IS - 6335	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
27	ICSB -101B x IS - 9471	1.50	1.00	1.25	1.00	1.00	1.00	1.25	1.00	1.13
28	AKms - 14 B x SRT - 26B	3.00	2.83	2.92	3.50	3.33	3.42	3.25	3.08	3.17
29	AKms - 14 B x GJ-35-15-15	3.00	3.00	3.00	3.50	2.50	3.00	3.25	2.75	3.00
30	AKms -14 B x SPV - 946	3.00	3.00	3.00	3.50	4.00	3.75	3.25	3.50	3.38
31	AKms - 14 B x SPV - 104	3.50	4.00	3.75	3.67	4.00	3.83	3.58	4.00	3.79
32	AKms - 14 B x IS - 2284	2.00	1.00	1.50	1.50	1.00	1.25	1.75	1.00	1.38
33	AKms - 14 B x IS - 6335	1.50	1.00	1.25	1.00	1.00	1.00	1.25	1.00	1.13
34	AKms - 14 B x IS - 9471	2.17	1.00	1.58	1.00	1.00	1.00	1.58	1.00	1.29

Contd.......

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	2.83	2.50	2.67	3.50	2.83	3.17	3.17	2.67	2.92
36	SRT - 26B x SPV – 946	3.00	2.50	2.75	3.50	3.17	3.33	3.25	2.83	3.04
37	SRT - 26B x SPV –104	3.00	3.00	3.00	3.00	2.67	2.83	3.00	2.83	2.92
38	SRT - 26B x IS – 2284	1.00	1.00	1.00	1.50	2.00	1.75	1.25	1.50	1.38
39	SRT - 26B x IS – 6335	1.00	1.00	1.00	1.50	1.67	1.58	1.25	1.33	1.29
40	SRT - 26B x IS – 9471	1.00	1.00	1.00	1.50	1.00	1.25	1.25	1.00	1.13
41	GJ-35-15-15 x SPV - 946	3.00	2.33	2.67	3.50	3.83	3.67	3.25	3.08	3.17
42	GJ-35-15-15 x SPV- 104	2.33	2.50	2.42	3.50	4.00	3.75	2.92	3.25	3.08
43	GJ-35-15-15 x IS - 2284	1.00	1.00	1.00	1.50	2.00	1.75	1.25	1.50	1.38
44	GJ-35-15-15 x IS - 6335	1.00	1.00	1.00	1.50	2.17	1.83	1.25	1.58	1.42
45	GJ-35-15-15 x IS - 9471	1.00	2.00	1.50	1.67	2.00	1.83	1.33	2.00	1.67
46	SPV - 946 x SPV- 104	3.33	3.00	3.17	3.67	4.00	3.83	3.50	3.50	3.50
47	SPV - 946 x IS - 2284	1.17	1.00	1.08	1.50	4.00	2.75	1.33	2.50	1.92
48	SPV - 946 x IS- 6335	1.00	1.00	1.00	2.00	2.00	2.00	1.50	1.50	1.50
49	SPV - 946 x IS 9471	1.00	1.00	1.00	1.50	2.00	1.75	1.25	1.50	1.38
50	SPV - 104 x IS 2284	1.50	1.00	1.25	1.17	1.50	1.33	1.33	1.26	1.29
51	SPV - 104 x IS 6335	1.50	1.00	1.25	1.00	1.00	1.00	1.25	1.00	1.13
52	SPV - 104 x IS 9471	1.50	2.00	1.75	1.50	2.00	1.75	1.60	2.00	1.75
53	IS 2284 x IS-6335	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
54	IS 2284 x IS -9471	1.50	1.00	1.25	1.00	1.00	1.00	1.25	1.00	1.13
55	IS 6335 x IS 9471	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Mean	2.26	1.96	2.11	2.41	2.39	2.40	2.34	2.18	2.26
	% increase (+)/decrease(-) over untreated			(-)13.27			(-)0.83			(-)6.83
	% increase over location						12.74 (Akola)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.039	0.110	0.041	0.115	0.043	0.125
B	0.209	0.581	0.218	0.603	0.226	0.658
A x B	0.296	0.821	0.307	0.853	0.310	0.905

VIII - 13

Table 39. Effect of pre-treatment on Ungerminated seed of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	22.00	24.00	23.00	50.67	48.00	49.33	36.33	36.00	36.17
2	ICSB-101B	23.33	20.00	21.67	64.67	71.33	68.00	44.00	45.67	44.83
3	Akms-14B	46.00	31.33	38.67	96.00	94.67	95.33	71.00	63.00	67.00
4	SRT-26B	13.33	14.67	14.00	78.00	82.00	80.00	45.67	48.33	47.00
5	GJ-35-15-15	18.67	22.67	20.67	75.33	88.00	81.67	47.00	55.33	51.17
6	SPV-946	12.67	18.67	15.67	68.67	77.33	73.00	40.67	48.00	44.33
7	SPV-104	38.67	42.00	40.33	96.00	91.33	93.67	67.33	66.67	67.00
8	IS-2284	6.67	9.33	8.00	33.33	18.00	25.67	20.00	13.67	16.83
9	IS-6335	6.67	6.67	6.67	22.00	16.67	19.33	14.33	11.67	13.00
10	IS-9471	6.67	6.00	6.33	28.67	23.33	26.00	17.67	14.67	16.17
11	SPV-1201 x ICSB-101B	14.67	12.00	13.33	47.33	47.33	47.33	31.00	29.67	30.33
12	SPV-1201 x Akms-14 B	17.33	14.67	16.00	47.33	38.67	43.00	32.33	26.67	29.50
13	SPV-1201 x SRT - 26B	6.00	10.00	8.00	19.33	17.33	18.33	12.67	13.67	13.17
14	SPV-1201 x GJ-35-15-15	39.33	5.33	22.33	28.00	16.00	22.00	33.67	10.67	22.17
15	SPV-1201 x SPV -946	34.67	25.33	30.00	32.00	18.67	25.33	33.33	22.00	27.67
16	SPV-1201 x SPV- 104	15.33	12.67	14.00	56.67	38.00	47.33	36.00	25.33	30.67
17	SPV-1201 x IS -2284	8.67	4.00	6.33	25.33	20.67	23.00	17.00	12.33	14.67
18	SPV-1201 x IS-6335	4.00	6.67	5.33	30.00	31.33	30.67	17.00	19.00	18.00
19	SPV-1201 x IS - 9471	4.67	7.33	6.00	23.33	27.32	25.33	14.00	17.33	15.66
20	ICSB - 101B x AKms 14 B	21.33	24.00	22.67	54.67	57.33	56.00	38.00	40.67	39.33
21	ICSB - 101B x SRT- 26 B	12.00	8.67	10.33	60.67	58.67	59.67	36.33	33.67	35.00
22	ICSB - 101B x GJ-35-15-15	12.00	6.00	9.00	21.33	21.33	21.33	16.67	13.67	15.17
23	ICSB - 101B x SPV - 946	8.00	10.67	9.33	41.33	50.67	46.00	24.67	30.67	27.67
24	ICSB - 101B x SPV - 104	23.33	19.33	21.33	62.67	54.67	58.67	43.00	37.00	40.00
25	ICSB - 101B x IS - 2284	11.33	9.33	10.33	12.67	10.67	11.67	12.00	10.00	11.00
26	ICSB - 101B x IS - 6335	10.00	6.67	8.33	6.00	10.00	8.00	8.00	8.33	8.17
27	ICSB -101B x IS - 9471	8.00	6.00	7.00	14.00	6.67	10.33	11.00	6.33	8.67
28	AKms - 14 B x SRT - 26B	28.00	18.00	23.00	74.00	71.33	72.67	51.00	44.67	47.83
29	AKms - 14 B x GJ-35-15-15	18.00	18.67	18.33	73.33	67.33	70.33	45.67	43.00	44.33
30	AKms -14 B x SPV - 946	22.67	19.33	21.00	65.33	77.33	71.33	44.00	48.33	46.17
31	AKms - 14 B x SPV - 104	46.00	34.00	40.00	76.67	76.00	76.33	61.33	55.00	58.17
32	AKms - 14 B x IS - 2284	20.00	6.00	13.00	33.33	17.33	25.33	26.67	11.67	19.17
33	AKms - 14 B x IS - 6335	6.67	2.67	4.67	12.00	12.00	12.00	9.33	7.33	8.33
34	AKms - 14 B x IS - 9471	12.00	6.00	9.00	19.33	23.33	21.33	15.67	14.67	15.17

Contd.. .. .. ..

Table 39. Contd.....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	7.33	10.00	8.67	59.33	59.33	59.33	33.33	34.67	34.00
36	SRT - 26B x SPV - 946	16.00	14.00	15.00	36.00	37.33	36.67	26.00	25.67	25.83
37	SRT - 26B x SPV -104	30.67	28.00	29.33	75.33	60.00	67.67	53.00	44.00	48.50
38	SRT - 26B x IS – 2284	12.00	21.33	16.67	19.33	4.67	12.00	15.67	13.00	14.33
39	SRT - 26B x IS – 6335	10.00	10.67	10.33	11.33	6.67	9.00	10.67	8.67	9.67
40	SRT - 26B x IS – 9471	10.00	4.67	7.33	14.00	9.33	11.67	12.00	7.00	9.50
41	GJ-35-15-15 x SPV - 946	14.67	12.00	13.33	44.00	26.67	35.33	29.33	19.33	24.33
42	GJ-35-15-15 x SPV- 104	16.67	14.00	15.33	49.33	57.33	53.33	33.00	35.67	34.33
43	GJ-35-15-15 x IS - 2284	9.33	12.00	10.67	17.33	16.00	16.67	13.33	14.00	13.67
44	GJ-35-15-15 x IS - 6335	8.00	10.00	9.00	16.67	12.00	14.33	12.33	11.00	11.67
45	GJ-35-15-15 x IS - 9471	7.33	8.00	7.67	26.00	28.67	27.33	16.67	18.33	17.50
46	SPV - 946 x SPV- 104	15.33	20.00	17.67	72.67	54.67	63.67	44.00	37.33	40.67
47	SPV - 946 x IS - 2284	13.33	7.33	10.33	20.67	16.00	18.33	17.00	11.67	14.33
48	SPV - 946 x IS- 6335	6.67	4.67	5.67	22.67	16.67	19.67	14.67	10.67	12.67
49	SPV - 946 x IS 9471	8.00	10.67	9.33	22.00	18.00	20.00	15.00	14.33	14.67
50	SPV - 104 x IS 2284	11.33	10.67	11.00	19.33	12.67	16.00	15.33	11.67	13.50
51	SPV - 104 x IS 6335	7.33	6.67	7.00	15.33	6.67	11.00	11.33	6.67	9.00
52	SPV - 104 x IS 9471	8.00	6.00	7.00	22.00	8.00	15.00	15.00	7.00	11.00
53	IS 2284 x IS-6335	8.67	7.33	8.00	14.00	14.67	14.33	11.33	11.00	11.17
54	IS 2284 x IS -9471	12.00	16.00	14.00	22.67	7.33	15.00	17.33	11.67	14.50
55	IS 6335 x IS 9471	4.00	5.33	4.67	21.33	21.33	21.33	12.67	13.33	13.00
	Mean	15.18	13.24	14.21	39.48	35.90	37.69	27.33	24.57	25.95
	% increase (+)/decrease(-) over untreated			(-)12.77			(-)9.06			(-)10.09
	% increase over location						165.24 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.430	0.193		0.631	1.750		0.575	1.673	
	B	2.258	6.258		3.311	9.178		3.019	8.785	
	A x B	3.193	8.850		4.683	12.980		4.270	12.426	

Table 40. Effect of pre-treatment on *F. moniliforme* (%) (UGS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	8.00	8.00	8.00	27.33	22.00	24.67	17.67	15.00	16.33
2	ICSB-101B	8.67	8.67	8.67	34.67	32.67	33.67	21.67	20.67	21.17
3	Akms-14B	21.33	16.00	18.67	56.00	28.00	42.00	38.67	22.00	30.33
4	SRT-26B	5.33	8.00	6.67	37.33	38.67	38.00	21.33	23.33	22.33
5	GJ-35-15-15	6.67	8.67	7.67	36.00	34.67	35.33	21.33	21.67	21.50
6	SPV-946	6.00	8.00	7.00	44.67	37.33	41.00	25.33	22.67	24.00
7	SPV-104	18.67	14.67	16.67	67.33	40.67	54.00	43.00	27.67	35.33
8	IS-2284	4.00	3.33	3.67	20.00	9.33	14.67	12.00	6.33	9.17
9	IS-6335	2.67	4.00	3.33	15.33	8.00	11.67	9.00	6.00	7.50
10	IS-9471	2.00	2.67	2.33	13.33	10.67	12.00	7.67	6.67	7.17
11	SPV-1201 x ICSB-101B	5.33	4.00	4.67	24.67	16.00	20.33	15.00	10.00	12.50
12	SPV-1201 x Akms-14 B	4.67	5.33	5.00	29.33	16.00	22.67	17.00	10.67	13.83
13	SPV-1201 x SRT - 26B	3.33	4.67	4.00	11.33	11.33	11.33	7.33	8.00	7.67
14	SPV-1201 x GJ-35-15-15	16.67	2.67	9.67	14.67	10.00	12.33	15.67	6.33	11.00
15	SPV-1201 x SPV -946	19.33	14.67	17.00	20.67	13.33	17.00	20.00	14.00	17.00
16	SPV-1201 x SPV- 104	4.67	4.00	4.33	25.33	20.00	22.67	15.00	12.00	13.50
17	SPV-1201 x IS -2284	2.67	2.00	2.33	12.00	10.67	11.33	7.33	6.33	6.83
18	SPV-1201 x IS-6335	2.00	4.00	3.00	14.00	14.00	14.00	8.00	9.00	8.50
19	SPV-1201 x IS - 9471	2.00	2.67	2.33	8.67	12.00	10.33	5.33	7.33	6.33
20	ICSB - 101B x AKms 14 B	6.00	5.33	5.67	32.00	32.67	32.33	19.00	19.00	19.00
21	ICSB - 101B x SRT- 26 B	4.00	0.67	2.33	40.00	32.00	36.00	22.00	16.33	19.17
22	ICSB - 101B x GJ-35-15-15	4.00	2.67	3.33	17.33	12.67	15.00	10.67	7.67	9.17
23	ICSB - 101B x SPV - 946	3.33	2.67	3.00	24.67	29.33	27.00	14.00	16.00	15.00
24	ICSB - 101B x SPV - 104	11.33	8.00	9.67	43.33	32.00	37.67	27.33	20.00	23.67
25	ICSB - 101B x IS - 2284	6.00	1.33	3.67	8.00	6.67	7.33	7.00	4.00	5.50
26	ICSB - 101B x IS - 6335	3.33	2.67	3.00	4.67	6.00	5.33	4.00	4.33	4.17
27	ICSB -101B x IS - 9471	4.00	1.33	2.67	6.00	4.00	5.00	5.00	2.67	3.83
28	AKms - 14 B x SRT - 26B	14.00	5.33	9.67	38.67	33.33	36.00	26.33	19.33	22.83
29	AKms - 14 B x GJ-35-15-15	7.33	5.33	6.33	36.67	24.00	30.33	22.00	14.67	18.33
30	AKms -14 B x SPV - 946	8.00	6.00	7.00	35.33	26.67	31.00	21.67	16.33	19.00
31	AKms - 14 B x SPV - 104	17.33	10.67	14.00	44.67	28.67	36.67	31.00	19.67	25.33
32	AKms - 14 B x IS - 2284	5.33	3.33	4.33	14.00	9.33	11.67	9.67	6.33	8.00
33	AKms - 14 B x IS - 6335	3.33	0.00	1.67	7.33	7.33	7.33	5.33	3.67	4.50
34	AKms - 14 B x IS - 9471	4.67	2.00	3.33	14.00	13.33	13.67	9.33	7.67	8.50

Contd.. .. .. ..

Table 40. Contd.....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	2.67	6.00	4.33	38.00	26.00	32.00	20.33	16.00	18.17
36	SRT - 26B x SPV - 946	6.67	6.00	6.33	22.00	21.33	21.67	14.33	13.67	14.00
37	SRT - 26B x SPV -104	11.33	14.00	12.67	40.00	31.33	35.67	25.67	22.67	24.17
38	SRT - 26B x IS – 2284	5.33	8.00	6.67	11.33	4.00	7.67	8.33	6.00	7.17
39	SRT - 26B x IS – 6335	3.33	4.00	3.67	8.67	2.67	5.67	6.00	3.33	4.67
40	SRT - 26B x IS – 9471	4.00	1.33	2.67	8.67	4.67	6.67	6.33	3.00	4.67
41	GJ-35-15-15 x SPV - 946	9.33	5.33	7.33	30.00	12.00	21.00	19.67	8.67	14.17
42	GJ-35-15-15 x SPV- 104	5.33	5.33	5.33	31.33	28.00	29.67	18.33	16.67	17.50
43	GJ-35-15-15 x IS - 2284	2.67	5.33	4.00	11.33	7.33	9.33	7.00	6.33	6.67
44	GJ-35-15-15 x IS - 6335	4.00	4.67	4.33	10.00	6.00	8.00	7.00	5.33	6.17
45	GJ-35-15-15 x IS - 9471	4.00	4.00	4.00	18.00	8.67	13.33	11.00	6.33	8.67
46	SPV - 946 x SPV- 104	4.00	7.33	5.67	52.00	36.67	44.33	28.00	22.00	25.00
47	SPV - 946 x IS - 2284	6.67	4.67	5.67	12.00	8.00	10.00	9.33	6.33	7.83
48	SPV - 946 x IS- 6335	4.67	1.33	3.00	14.67	9.33	12.00	9.67	5.33	7.50
49	SPV - 946 x IS 9471	3.33	6.00	4.67	11.33	8.67	10.00	7.33	7.33	7.33
50	SPV - 104 x IS 2284	4.67	6.00	5.33	8.67	7.33	8.00	6.67	6.67	6.67
51	SPV - 104 x IS 6335	1.33	2.67	2.00	8.67	4.67	6.67	5.00	3.67	4.33
52	SPV - 104 x IS 9471	3.33	4.00	3.67	12.67	4.67	8.67	8.00	4.33	6.17
53	IS 2284 x IS-6335	1.33	4.00	2.67	8.00	8.00	8.00	4.67	6.00	5.33
54	IS 2284 x IS -9471	4.00	7.33	5.67	12.00	4.00	8.00	8.00	5.67	6.83
55	IS 6335 x IS 9471	1.33	2.00	1.67	11.33	10.00	10.67	6.33	6.00	6.17
	Mean	6.17	5.32	5.75	22.91	17.03	19.61	15.54	11.18	13.36
	% increase (+)/decrease(-) over untreated			(-)13.77			(-)25.66			(-)28.05
	% increase over location						241.04 (Akola)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.353	0.980	0.539	1.494	0.490	1.426
B	1.853	5.137	2.827	7.837	2.571	7.481
A x B	2.621	7.265	3.299	11.083	3.636	10.582

Table 41. Effect of pre-treatment on *F. pallidoroseum* (%) (UGS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	1.33	0.67	6.00	6.00	6.00	3.00	3.67	3.33
2	ICSB-101B	0.00	0.00	0.00	9.33	10.00	9.67	4.67	5.00	4.83
3	Akms-14B	0.00	0.67	0.33	7.33	8.00	7.67	3.67	4.33	4.00
4	SRT-26B	0.00	0.00	0.00	8.67	7.33	8.00	4.33	3.67	4.00
5	GJ-35-15-15	0.00	0.00	0.00	9.33	8.67	9.00	4.67	4.33	4.50
6	SPV-946	0.00	0.00	0.00	8.67	12.00	10.33	4.33	6.00	5.17
7	SPV-104	0.00	8.00	4.00	10.00	10.67	10.33	5.00	9.33	7.17
8	IS-2284	0.00	0.00	0.00	7.33	0.00	3.67	3.67	0.00	1.83
9	IS-6335	0.00	0.00	0.00	3.33	0.67	2.00	1.67	0.33	1.00
10	IS-9471	0.00	0.67	0.33	4.00	4.00	4.00	2.00	2.33	2.17
11	SPV-1201 x ICSB-101B	0.00	0.00	0.00	8.00	6.00	7.00	4.00	3.00	3.50
12	SPV-1201 x Akms-14 B	0.00	0.00	0.00	8.00	5.33	6.67	4.00	2.67	3.33
13	SPV-1201 x SRT - 26B	0.00	0.67	0.33	2.00	2.00	2.00	1.00	1.33	1.17
14	SPV-1201 x GJ-35-15-15	1.33	0.00	0.67	5.33	2.00	3.67	3.33	1.00	2.17
15	SPV-1201 x SPV -946	0.00	0.00	0.00	5.33	0.00	2.67	2.67	0.00	1.33
16	SPV-1201 x SPV- 104	0.00	0.00	0.00	3.33	4.00	3.67	1.67	2.00	1.83
17	SPV-1201 x IS -2284	0.00	0.67	0.33	6.00	2.00	4.00	3.00	1.33	2.17
18	SPV-1201 x IS-6335	0.00	0.00	0.00	7.33	3.33	5.33	3.67	1.67	2.67
19	SPV-1201 x IS - 9471	0.00	0.00	0.00	6.00	0.67	3.33	3.00	0.33	1.67
20	ICSB - 101B x AKms 14 B	0.00	0.00	0.00	8.67	6.00	7.33	4.33	3.00	3.67
21	ICSB - 101B x SRT- 26 B	0.00	0.00	0.00	13.33	6.67	10.00	6.67	3.33	5.00
22	ICSB - 101B x GJ-35-15-15	0.00	0.00	0.00	1.33	1.33	1.33	0.67	0.67	0.67
23	ICSB - 101B x SPV - 946	0.00	0.00	0.00	8.67	7.33	8.00	4.33	3.67	4.00
24	ICSB - 101B x SPV - 104	0.00	0.00	0.00	14.67	7.33	11.00	7.33	3.67	5.50
25	ICSB - 101B x IS - 2284	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
26	ICSB - 101B x IS - 6335	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
27	ICSB -101B x IS - 9471	0.00	0.00	0.00	2.00	0.00	1.00	1.00	0.00	0.50
28	AKms - 14 B x SRT - 26B	0.00	2.00	1.00	8.00	8.00	8.00	4.00	5.00	4.50
29	AKms - 14 B x GJ-35-15-15	0.67	0.67	0.67	11.33	8.00	9.67	6.00	4.33	5.17
30	AKms -14 B x SPV - 946	0.00	1.33	0.67	11.33	11.33	11.33	5.67	6.33	6.00
31	AKms - 14 B x SPV - 104	0.67	4.67	2.67	14.67	8.00	11.33	7.67	6.33	7.00
32	AKms - 14 B x IS - 2284	2.00	0.00	1.00	2.67	3.33	3.00	2.33	1.67	2.00
33	AKms - 14 B x IS - 6335	0.00	0.00	0.00	0.67	0.00	0.33	0.33	0.00	0.17
34	AKms - 14 B x IS - 9471	0.67	0.00	0.33	3.33	2.67	3.00	2.00	1.33	1.67

Contd.. .. .. ..

Table 41. Contd.....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.00	0.00	10.00	6.00	8.00	5.00	3.00	4.00
36	SRT - 26B x SPV - 946	0.00	0.67	0.33	6.00	4.00	5.00	3.00	2.33	2.67
37	SRT - 26B x SPV -104	0.67	1.33	1.00	12.00	7.33	9.67	6.33	4.33	5.33
38	SRT - 26B x IS – 2284	0.00	0.67	0.33	3.33	0.00	1.67	1.67	0.33	1.00
39	SRT - 26B x IS – 6335	0.00	0.67	0.33	0.00	0.00	0.00	0.00	0.33	0.17
40	SRT - 26B x IS – 9471	1.33	0.67	1.00	2.00	0.67	1.33	1.67	0.67	1.17
41	GJ-35-15-15 x SPV - 946	0.00	0.00	0.00	5.33	2.00	3.67	2.67	1.00	1.83
42	GJ-35-15-15 x SPV- 104	1.33	0.00	0.67	6.67	4.67	5.67	4.00	2.33	3.17
43	GJ-35-15-15 x IS - 2284	1.33	0.00	0.67	3.33	1.33	2.33	2.33	0.67	1.50
44	GJ-35-15-15 x IS - 6335	1.33	0.67	1.00	2.00	0.00	1.00	1.67	0.33	1.00
45	GJ-35-15-15 x IS - 9471	0.00	0.00	0.00	4.67	2.67	3.67	2.33	1.33	1.83
46	SPV - 946 x SPV- 104	0.00	1.33	0.67	4.00	5.33	4.67	2.00	3.33	2.67
47	SPV - 946 x IS - 2284	2.00	0.67	1.33	4.00	0.67	2.33	3.00	0.67	1.83
48	SPV - 946 x IS- 6335	0.67	0.00	0.33	4.00	1.33	2.67	2.33	0.67	1.50
49	SPV - 946 x IS 9471	0.00	0.00	0.00	4.67	2.67	3.67	2.33	1.33	1.83
50	SPV - 104 x IS 2284	1.33	0.67	1.00	4.67	1.33	3.00	3.00	1.00	2.00
51	SPV - 104 x IS 6335	0.00	1.33	0.67	2.00	0.67	1.33	1.00	1.00	1.00
52	SPV - 104 x IS 9471	0.00	0.00	0.00	3.33	0.00	1.67	1.67	0.00	0.83
53	IS 2284 x IS-6335	1.33	1.33	1.33	1.33	2.00	1.67	1.33	1.67	1.50
54	IS 2284 x IS -9471	3.33	0.67	2.00	4.00	0.00	2.00	3.67	0.33	2.00
55	IS 6335 x IS 9471	0.00	0.00	0.00	0.67	3.33	2.00	0.33	1.67	1.00
	Mean	0.36	0.57	0.47	5.71	3.82	4.77	3.04	2.20	2.62
	% increase (+)/decrease(-) over untreated			(+) 58.33			(-)33.09			(-)27.68
	% increase over location						918.89 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.104	0.288		0.306	0.849		0.161	0.869	
	B	0.545	1.511		1.607	4.454		0.842	2.450	
	A x B	0.771	2.136		2.272	6.299		1.191	3.466	

Table 42. Effect of pre-treatment on *C. lunata* (%) (UGS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	10.67	13.33	12.00	19.33	19.33	19.33	15.00	16.33	15.67
2	ICSB-101B	12.67	8.00	10.33	16.67	27.33	22.00	14.67	17.67	16.17
3	Akms-14B	19.33	12.67	16.00	32.00	54.00	43.00	25.67	33.33	29.50
4	SRT-26B	7.33	6.00	6.67	31.33	32.67	32.00	19.33	19.33	19.33
5	GJ-35-15-15	10.67	11.33	11.00	26.00	36.00	31.00	18.33	23.67	21.00
6	SPV-946	6.00	10.67	8.33	15.33	24.67	20.00	10.67	17.67	14.17
7	SPV-104	16.00	16.00	16.00	18.67	36.00	27.33	17.33	26.00	21.67
8	IS-2284	3.33	6.00	4.67	6.00	7.33	6.67	4.67	6.67	5.67
9	IS-6335	4.00	2.67	3.33	2.67	7.33	5.00	3.33	5.00	4.17
10	IS-9471	4.00	2.67	3.33	8.00	9.33	8.67	6.00	6.00	6.00
11	SPV-1201 x ICSB-101B	8.00	8.00	8.00	10.67	21.33	16.00	9.33	14.67	12.00
12	SPV-1201 x Akms-14 B	10.67	7.33	9.00	7.33	17.33	12.33	9.00	12.33	10.67
13	SPV-1201 x SRT - 26B	2.67	4.67	3.67	5.33	4.00	4.67	4.00	4.33	4.17
14	SPV-1201 x GJ-35-15-15	16.67	2.67	9.67	6.00	4.00	5.00	11.33	3.33	7.33
15	SPV-1201 x SPV -946	12.67	10.00	11.33	6.00	4.67	5.33	9.33	7.33	8.33
16	SPV-1201 x SPV- 104	7.33	8.00	7.67	22.67	12.67	17.67	15.00	10.33	12.67
17	SPV-1201 x IS -2284	3.33	2.00	2.67	8.00	7.33	7.67	5.67	4.67	5.17
18	SPV-1201 x IS-6335	1.33	2.00	1.67	8.00	13.33	10.67	4.67	7.67	6.17
19	SPV-1201 x IS - 9471	2.00	4.00	3.00	8.67	12.67	10.67	5.33	8.33	6.83
20	ICSB - 101B x AKms 14 B	12.00	16.67	14.33	5.33	16.67	11.00	8.67	16.67	12.67
21	ICSB - 101B x SRT- 26 B	6.00	6.67	6.33	7.33	18.00	12.67	6.67	12.33	9.50
22	ICSB - 101B x GJ-35-15-15	6.67	3.33	5.00	2.67	7.33	5.00	4.67	5.33	5.00
23	ICSB - 101B x SPV - 946	4.00	7.33	5.67	6.67	13.33	10.00	5.33	10.33	7.83
24	ICSB - 101B x SPV - 104	10.67	10.00	10.33	4.67	14.00	9.33	7.67	12.00	9.83
25	ICSB - 101B x IS - 2284	4.00	7.33	5.67	4.00	3.33	3.67	4.00	5.33	4.67
26	ICSB - 101B x IS - 6335	3.33	2.67	3.00	1.33	3.33	2.33	2.33	3.00	2.67
27	ICSB -101B x IS - 9471	3.33	4.00	3.67	6.00	2.00	4.00	4.67	3.00	3.83
28	AKms - 14 B x SRT - 26B	9.33	9.33	9.33	18.00	26.67	22.33	13.67	18.00	15.83
29	AKms - 14 B x GJ-35-15-15	8.00	12.67	10.33	21.33	31.33	26.33	14.67	22.00	18.33
30	AKms -14 B x SPV - 946	12.00	10.00	11.00	17.33	34.00	25.67	14.67	22.00	18.33
31	AKms - 14 B x SPV - 104	24.00	18.00	21.00	14.00	33.33	23.67	19.00	25.67	22.33
32	AKms - 14 B x IS - 2284	9.33	2.67	6.00	14.00	4.67	9.33	11.67	3.67	7.67
33	AKms - 14 B x IS - 6335	3.33	2.67	3.00	4.00	4.67	4.33	3.67	3.67	3.67
34	AKms - 14 B x IS - 9471	5.33	4.00	4.67	2.00	7.33	4.67	3.67	5.67	4.67

Contd.. .. .. ..

able 42 Contd.

1	2	3	4	5	6	7	8	9	10	11
5	SRT- 26B x GJ-35-15-15	4.67	3.33	4.00	7.33	23.33	15.33	6.00	13.33	9.67
6	SRT - 26B x SPV - 946	9.33	6.67	8.00	7.33	11.33	9.33	8.33	9.00	8.67
7	SRT - 26B x SPV -104	16.67	11.33	14.00	18.67	20.00	19.33	17.67	15.67	16.67
8	SRT - 26B x IS – 2284	8.00	10.67	9.33	7.33	0.67	4.00	7.67	5.67	6.67
9	SRT - 26B x IS – 6335	5.33	6.00	5.67	3.33	4.00	3.67	4.33	5.00	4.67
0	SRT - 26B x IS – 9471	4.00	2.00	3.00	2.67	4.67	3.67	3.33	3.33	3.33
1	GJ-35-15-15 x SPV - 946	4.67	6.67	5.67	8.00	12.00	10.00	6.33	9.33	7.83
2	GJ-35-15-15 x SPV- 104	8.67	8.00	8.33	9.33	20.67	15.00	9.00	14.33	11.67
3	GJ-35-15-15 x IS - 2284	4.00	6.67	5.33	2.67	6.67	4.67	3.33	6.67	5.00
4	GJ-35-15-15 x IS - 6335	2.67	4.67	3.67	4.00	5.33	4.67	3.33	5.00	4.17
5	GJ-35-15-15 x IS - 9471	3.33	4.00	3.67	3.33	16.67	10.00	3.33	10.33	6.83
6	SPV - 946 x SPV- 104	10.67	10.00	10.33	15.33	14.00	14.67	13.00	12.00	12.50
7	SPV - 946 x IS - 2284	4.67	2.00	3.33	4.67	7.33	6.00	4.67	4.67	4.67
8	SPV - 946 x IS- 6335	1.33	3.33	2.33	4.00	5.33	4.67	2.67	4.33	3.50
9	SPV - 946 x IS 9471	4.67	4.67	4.67	4.00	6.00	5.00	4.33	5.33	4.83
0	SPV - 104 x IS 2284	3.33	3.33	3.33	6.00	4.00	5.00	4.67	3.67	4.17
1	SPV - 104 x IS 6335	6.00	3.33	4.67	4.00	1.33	2.67	5.00	2.33	3.67
2	SPV - 104 x IS 9471	4.67	2.00	3.33	5.33	2.00	3.67	5.00	2.00	3.50
3	IS 2284 x IS-6335	6.00	2.00	4.00	4.67	4.00	4.33	5.33	3.00	4.17
4	IS 2284 x IS -9471	4.00	6.67	5.33	6.00	2.67	4.33	5.00	4.67	4.83
5	IS 6335 x IS 9471	2.00	3.33	2.67	9.33	8.67	9.00	5.67	6.00	5.83
	Mean	7.25	6.65	6.95	9.53	13.67	11.60	8.39	10.16	9.28
	% increase (+)/decrease(-) over untreated			(-)8.27			(+)43.44			(+)21.09
	% increase over location						66.91 (Akola)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.282	0.781	0.429	1.189	0.396	1.152
B	1.478	4.096	2.250	6.236	2.080	6.053
A x B	2.090	5.793	3.181	8.818	2.941	8.561

Table 43. Effect of pre-treatment on other fungi (%) (UGS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	3.33	1.33	2.33	0.00	1.33	0.67	1.67	1.33	1.50
2	ICSB-101B	2.00	2.00	2.00	3.33	1.33	2.33	2.67	1.67	2.17
3	Akms-14B	4.67	2.00	3.33	0.67	4.67	2.67	2.67	3.33	3.00
4	SRT-26B	0.67	0.67	0.67	1.33	3.33	2.33	1.00	2.00	1.50
5	GJ-35-15-15	1.33	2.67	2.00	4.00	8.67	6.33	2.67	5.67	4.17
6	SPV-946	2.67	0.00	1.33	0.67	3.33	2.00	1.67	1.67	1.67
7	SPV-104	3.33	4.00	3.67	0.00	4.00	2.00	1.67	4.00	2.83
8	IS-2284	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
9	IS-6335	0.00	0.00	0.00	0.67	0.67	0.67	0.33	0.33	0.33
10	IS-9471	0.67	0.00	0.33	3.33	0.00	1.67	2.00	0.00	1.00
11	SPV-1201 x ICSB-101B	1.33	0.00	0.67	4.00	4.00	4.00	2.67	2.00	2.33
12	SPV-1201 x Akms-14 B	2.00	1.33	1.67	2.67	0.00	1.33	2.33	0.67	1.50
13	SPV-1201 x SRT - 26B	0.00	0.67	0.33	0.67	0.00	0.33	0.33	0.33	0.33
14	SPV-1201 x GJ-35-15-15	5.33	0.00	2.67	2.00	0.00	1.00	3.67	0.00	1.83
15	SPV-1201 x SPV -946	4.67	0.67	2.67	0.00	0.67	0.33	2.33	0.67	1.50
16	SPV-1201 x SPV- 104	6.00	0.00	3.00	5.33	1.33	3.33	5.67	0.67	3.17
17	SPV-1201 x IS -2284	2.67	0.00	1.33	0.00	0.67	0.33	1.33	0.33	0.83
18	SPV-1201 x IS-6335	0.67	0.00	0.33	0.67	0.67	0.67	0.67	0.33	0.50
19	SPV-1201 x IS - 9471	0.67	0.00	0.33	0.00	2.00	1.00	0.33	1.00	0.67
20	ICSB - 101B x AKms 14 B	2.67	2.67	2.67	2.00	2.00	2.00	2.33	2.33	2.33
21	ICSB - 101B x SRT- 26 B	3.33	2.00	2.67	0.00	2.00	1.00	1.67	2.00	1.83
22	ICSB - 101B x GJ-35-15-15	1.33	0.00	0.67	0.00	0.00	0.00	0.67	0.00	0.33
23	ICSB - 101B x SPV - 946	0.67	0.67	0.67	0.00	0.67	0.33	0.33	0.67	0.50
24	ICSB - 101B x SPV - 104	1.33	1.33	1.33	0.00	1.33	0.67	0.67	1.33	1.00
25	ICSB - 101B x IS - 2284	1.33	0.67	1.00	0.67	0.00	0.33	1.00	0.33	0.67
26	ICSB - 101B x IS - 6335	2.67	0.00	1.33	0.00	0.00	0.00	1.33	0.00	0.67
27	ICSB -101B x IS - 9471	0.67	0.67	0.67	0.00	0.67	0.33	0.33	0.67	0.50
28	AKms - 14 B x SRT - 26B	4.67	1.33	3.00	5.33	3.33	4.33	5.00	2.33	3.67
29	AKms - 14 B x GJ-35-15-15	1.33	0.00	0.67	4.67	4.00	4.33	3.00	2.00	2.50
30	AKms -14 B x SPV - 946	2.67	2.00	2.33	1.33	5.33	3.33	2.00	3.67	2.83
31	AKms - 14 B x SPV - 104	4.00	0.67	2.33	4.00	6.67	5.33	4.00	3.67	3.83
32	AKms - 14 B x IS - 2284	3.33	0.00	1.67	2.67	0.00	1.33	3.00	0.00	1.50
33	AKms - 14 B x IS - 6335	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	AKms - 14 B x IS - 9471	1.33	0.00	0.67	0.00	0.00	0.00	0.67	0.00	0.33

Contd...

Table 43 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.67	0.33	3.33	4.00	3.67	1.67	2.33	2.00
36	SRT - 26B x SPV - 946	0.67	0.67	0.67	0.00	0.67	0.33	0.33	0.67	0.50
37	SRT - 26B x SPV -104	2.00	1.33	1.67	2.67	2.67	2.67	2.33	2.00	2.17
38	SRT - 26B x IS – 2284	2.00	2.00	2.00	0.00	0.00	0.00	1.00	1.00	1.00
39	SRT - 26B x IS – 6335	1.33	0.00	0.67	0.00	0.00	0.00	0.67	0.00	0.33
40	SRT - 26B x IS – 9471	0.67	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.17
41	GJ-35-15-15 x SPV - 946	0.67	0.00	0.33	0.67	0.67	0.67	0.67	0.33	0.50
42	GJ-35-15-15 x SPV- 104	1.33	0.67	1.00	2.67	4.00	3.33	2.00	2.33	2.17
43	GJ-35-15-15 x IS - 2284	1.33	0.00	0.67	0.00	0.67	0.33	0.67	0.33	0.50
44	GJ-35-15-15 x IS - 6335	0.00	0.67	0.33	0.67	0.67	0.67	0.33	0.67	0.50
45	GJ-35-15-15 x IS - 9471	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
46	SPV - 946 x SPV- 104	1.33	0.67	1.00	1.33	1.33	1.33	1.33	1.00	1.17
47	SPV - 946 x IS - 2284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	SPV - 946 x IS- 6335	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
49	SPV - 946 x IS 9471	0.00	0.00	0.00	2.00	0.67	1.33	1.00	0.33	0.67
50	SPV - 104 x IS 2284	2.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.50
51	SPV - 104 x IS 6335	0.00	0.00	0.00	0.67	0.00	0.33	0.33	0.00	0.17
52	SPV - 104 x IS 9471	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
53	IS 2284 x IS-6335	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
54	IS 2284 x IS -9471	0.67	1.33	1.00	1.33	0.67	1.00	1.00	1.00	1.00
55	IS 6335 x IS 9471	0.67	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.17
	Mean	1.60	0.64	1.12	1.19	1.51	1.35	1.39	1.08	1.24
	% increase (+)/decrease(-) over untreated			(-)60.00			(+)26.89			(-)22.30
	% increase over location						20.53 (Akola)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.120	0.333	0.146	0.405	0.126	0.367
B	0.631	1.749	0.766	2.125	0.659	1.917
A x B	0.892	2.473	1.084	3.006	0.932	2.712

Table 44. Effect of pre-treatment on score (UGS) of parents and F_1 crosses at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	4.50	4.00	4.25	5.00	5.00	5.00	4.75	4.50	4.63
2	ICSB-101B	4.67	4.00	4.33	4.83	5.00	4.92	4.75	4.50	4.63
3	Akms-14B	5.00	4.50	4.75	5.00	5.00	5.00	5.00	4.75	4.88
4	SRT-26B	4.00	4.00	4.00	4.50	5.00	4.75	4.25	4.50	4.38
5	GJ-35-15-15	4.00	4.00	4.00	4.50	5.00	4.75	4.25	4.50	4.38
6	SPV-946	4.00	3.50	3.75	4.83	5.00	4.92	4.42	4.25	4.33
7	SPV-104	4.50	4.00	4.25	5.00	5.00	5.00	4.75	4.50	4.63
8	IS-2284	2.00	2.17	2.08	3.50	2.17	2.83	2.75	2.17	2.46
9	IS-6335	1.83	1.50	1.67	2.33	2.83	2.58	2.08	2.17	2.13
10	IS-9471	1.33	1.00	1.17	2.00	3.00	2.50	1.67	2.00	1.83
11	SPV-1201 x ICSB-101B	3.50	3.50	3.50	4.50	4.00	4.25	4.00	3.75	3.88
12	SPV-1201 x Akms-14 B	4.33	4.00	4.17	4.67	4.00	4.33	4.50	4.00	4.25
13	SPV-1201 x SRT - 26B	3.17	4.00	3.58	4.50	4.00	4.25	3.83	4.00	3.92
14	SPV-1201 x GJ-35-15-15	4.50	4.00	4.25	4.50	4.00	4.25	4.50	4.00	4.25
15	SPV-1201 x SPV -946	4.50	4.00	4.25	4.50	4.00	4.25	4.50	4.00	4.25
16	SPV-1201 x SPV- 104	4.00	3.50	3.75	5.00	4.00	4.50	4.50	3.75	4.13
17	SPV-1201 x IS -2284	0.67	1.17	0.92	3.00	2.00	2.50	1.83	1.58	1.71
18	SPV-1201 x IS-6335	1.17	1.33	1.25	2.83	2.00	2.42	2.00	1.67	1.83
19	SPV-1201 x IS - 9471	1.50	1.00	1.25	2.50	2.00	2.25	2.00	1.50	1.75
20	ICSB - 101B x AKms 14 B	4.00	4.00	4.00	4.17	5.00	4.58	4.08	4.50	4.29
21	ICSB - 101B x SRT- 26 B	4.00	3.50	3.75	4.50	5.00	4.75	4.25	4.25	4.25
22	ICSB - 101B x GJ-35-15-15	3.67	3.00	3.33	4.00	4.00	4.00	3.83	3.50	3.67
23	ICSB - 101B x SPV - 946	3.00	4.00	3.50	4.00	4.00	4.00	3.50	4.00	3.75
24	ICSB - 101B x SPV - 104	4.00	3.00	3.50	4.50	4.00	4.25	4.25	3.50	3.88
25	ICSB - 101B x IS - 2284	1.83	1.83	1.83	1.50	2.00	1.75	1.67	1.92	1.79
26	ICSB - 101B x IS - 6335	1.50	1.00	1.25	1.00	2.00	1.50	1.25	1.50	1.38
27	ICSB -101B x IS - 9471	2.00	1.50	1.75	1.83	1.00	1.42	1.92	1.25	1.58
28	AKms - 14 B x SRT - 26B	3.50	3.50	3.50	4.50	4.50	4.50	4.00	4.00	4.00
29	AKms - 14 B x GJ-35-15-15	3.50	4.00	3.75	4.50	4.00	4.25	4.00	4.00	4.00
30	AKms -14 B x SPV - 946	4.17	4.00	4.08	4.83	5.00	4.92	4.50	4.50	4.50
31	AKms - 14 B x SPV - 104	4.83	4.33	4.58	4.67	5.00	4.83	4.75	4.67	4.71
32	AKms - 14 B x IS - 2284	2.00	1.67	1.83	2.00	2.00	2.00	2.00	1.83	1.92
33	AKms - 14 B x IS - 6335	2.00	0.83	1.42	2.00	2.00	2.00	2.00	1.42	1.71
34	AKms - 14 B x IS - 9471	3.17	1.50	2.33	2.50	2.00	2.25	2.83	1.75	2.29

Contd.......

Table 44 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	3.83	3.50	3.67	4.50	4.00	4.25	4.17	3.75	3.96
36	SRT - 26B x SPV - 946	4.00	3.50	3.75	4.50	4.00	4.25	4.25	3.75	4.00
37	SRT - 26B x SPV -104	4.00	4.00	4.00	4.50	4.00	4.25	4.25	4.00	4.13
38	SRT - 26B x IS – 2284	2.00	2.00	2.00	2.00	2.33	2.17	2.00	2.17	2.08
39	SRT - 26B x IS – 6335	2.00	2.00	2.00	2.00	2.50	2.25	2.00	2.25	2.13
40	SRT - 26B x IS – 9471	1.83	1.67	1.75	2.17	2.33	2.25	2.00	2.00	2.00
41	GJ-35-15-15 x SPV - 946	3.33	2.83	3.08	4.50	5.00	4.75	3.92	3.92	3.92
42	GJ-35-15-15 x SPV- 104	3.17	3.00	3.08	4.50	5.00	4.75	3.83	4.00	3.92
43	GJ-35-15-15 x IS - 2284	1.00	2.00	1.50	2.33	3.00	2.67	1.67	2.50	2.08
44	GJ-35-15-15 x IS - 6335	1.17	2.00	1.58	2.00	3.00	2.50	1.58	2.50	2.04
45	GJ-35-15-15 x IS - 9471	1.00	3.00	2.00	2.50	3.00	2.75	1.75	3.00	2.38
46	SPV - 946 x SPV- 104	4.00	3.83	3.92	5.00	5.00	5.00	4.50	4.42	4.46
47	SPV - 946 x IS - 2284	2.00	2.00	2.00	2.00	5.00	3.50	2.00	3.50	2.75
48	SPV - 946 x IS- 6335	1.67	1.67	1.67	2.17	4.00	3.08	1.92	2.83	2.38
49	SPV - 946 x IS 9471	2.00	1.83	1.92	2.00	3.00	2.50	2.00	2.42	2.21
50	SPV - 104 x IS 2284	2.00	2.00	2.00	2.50	3.00	2.75	2.25	2.50	2.38
51	SPV - 104 x IS 6335	2.00	2.00	2.00	2.50	3.00	2.75	2.25	2.50	2.38
52	SPV - 104 x IS 9471	2.50	3.00	2.75	2.50	3.00	2.75	2.50	3.00	2.75
53	IS 2284 x IS-6335	1.67	2.00	1.83	2.00	2.50	2.25	1.83	2.25	2.04
54	IS 2284 x IS -9471	2.00	2.00	2.00	2.50	2.00	2.25	2.25	2.00	2.13
55	IS 6335 x IS 9471	1.17	2.00	1.58	2.00	2.50	2.25	1.58	2.25	1.92
	Mean	2.88	2.77	2.83	3.43	3.55	3.49	3.18	3.16	3.17
	% increase (+)/decrease(-) over untreated			(-)3.97			(+)3.38			(-)0.63
	% increase over location						23.32 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.052	0.145		0.035	0.099		0.048	0.140	
	B	0.274	0.760		0.188	0.523		0.251	0.730	
	A x B	0.387	1.075		0.266	0.739		0.355	1.033	

Table 45 : Effect of pre-treatment on germination (%) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	78.00	76.00	77.00	52.00	49.33	50.67	65.00	62.67	63.83
2	ICSB-101B	76.67	80.00	78.33	28.67	35.33	32.00	52.67	57.67	55.17
3	Akms-14B	54.00	68.67	61.33	5.33	4.67	5.00	29.67	36.67	33.17
4	SRT-26B	86.67	85.33	86.00	18.00	22.00	20.00	52.33	53.67	53.00
5	GJ-35-15-15	81.33	77.33	79.33	12.00	24.67	18.33	46.67	51.00	48.83
6	SPV-946	87.33	81.33	84.33	22.67	32.67	27.67	55.00	57.00	56.00
7	SPV-104	61.33	58.00	59.67	8.67	4.00	6.33	35.00	31.00	33.00
8	IS-2284	93.33	90.67	92.00	82.00	66.67	74.33	87.67	78.67	83.17
9	IS-6335	93.33	93.33	93.33	83.33	78.00	80.67	88.33	85.67	87.00
10	IS-9471	93.33	94.00	93.67	76.67	71.33	74.00	85.00	82.67	83.83
11	SPV-1201 x ICSB-101B	87.00	91.40	89.20	76.20	79.40	77.80	81.60	85.40	83.50
12	SPV-1201 x Akms-14 B	74.40	79.40	76.90	45.66	51.34	48.50	60.03	65.37	62.70
13	SPV-1201 x SRT - 26B	86.80	87.40	87.10	68.66	72.50	70.58	77.73	79.95	78.84
14	SPV-1201 x GJ-35-15-15	84.40	84.80	84.60	74.26	71.50	72.88	79.33	78.15	78.74
15	SPV-1201 x SPV -946	83.00	86.00	84.50	63.90	69.50	66.70	73.45	77.75	75.60
16	SPV-1201 x SPV- 104	79.20	81.40	80.30	53.34	58.60	55.97	66.27	70.00	68.14
17	SPV-1201 x IS -2284	85.40	90.40	87.90	78.50	84.50	81.50	81.95	87.45	84.70
18	SPV-1201 x IS-6335	89.60	92.20	90.90	75.26	84.50	79.88	82.43	88.35	85.39
19	SPV-1201 x IS - 9471	87.80	89.00	88.40	59.50	67.50	63.50	73.65	78.25	75.95
20	ICSB - 101B x AKms 14 B	74.34	80.00	77.17	58.34	60.84	59.59	66.34	70.42	68.38
21	ICSB - 101B x SRT- 26 B	85.00	89.60	87.30	59.16	64.66	61.91	72.08	77.13	74.61
22	ICSB - 101B x GJ-35-15-15	83.80	89.40	86.60	75.74	77.74	76.74	79.77	83.57	81.67
23	ICSB - 101B x SPV - 946	75.00	78.80	76.90	65.74	72.76	69.25	70.37	75.78	73.08
24	ICSB - 101B x SPV - 104	80.80	84.80	82.80	30.00	32.00	31.00	55.40	58.40	56.90
25	ICSB - 101B x IS - 2284	86.20	91.60	88.90	69.84	77.42	73.63	78.02	84.51	81.27
26	ICSB - 101B x IS - 6335	87.80	92.20	90.00	79.26	82.50	80.88	83.53	87.35	85.44
27	ICSB -101B x IS - 9471	90.00	93.80	91.90	69.00	74.50	71.75	79.50	84.15	81.83
28	AKms - 14 B x SRT - 26B	75.00	81.60	78.30	18.50	22.50	20.50	46.75	52.05	49.40
29	AKms - 14 B x GJ-35-15-15	72.00	80.80	76.40	54.50	58.66	56.58	63.25	69.73	66.49
30	AKms -14 B x SPV - 946	69.60	77.80	73.70	39.50	38.00	38.75	54.55	57.90	56.23
31	AKms - 14 B x SPV - 104	52.00	60.56	56.28	30.50	34.00	32.25	41.25	47.28	44.27
32	AKms - 14 B x IS - 2284	83.60	90.20	86.90	69.50	74.00	71.75	76.55	82.10	79.33
33	AKms - 14 B x IS - 6335	87.60	92.40	90.00	73.00	76.00	74.50	80.30	84.20	82.25
34	AKms - 14 B x IS - 9471	85.40	88.80	87.10	60.50	69.00	64.75	72.95	78.90	75.93

Contd.. .. .. ..

Table 45 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	80.20	85.00	82.60	62.00	67.50	64.75	71.10	76.25	73.68
36	SRT - 26B x SPV - 946	81.60	88.60	85.10	70.16	78.60	74.38	75.88	83.60	79.74
37	SRT - 26B x SPV -104	68.00	73.00	70.50	50.50	55.00	52.75	59.25	64.00	61.63
38	SRT - 26B x IS – 2284	83.80	89.40	86.60	79.50	84.00	81.75	81.65	86.70	84.18
39	SRT - 26B x IS – 6335	78.60	86.60	82.60	78.00	84.26	81.13	78.30	85.43	81.87
40	SRT - 26B x IS – 9471	82.00	87.60	84.80	71.00	79.00	75.00	76.50	83.30	79.90
41	GJ-35-15-15 x SPV - 946	74.20	77.00	75.60	66.00	69.84	67.92	70.10	73.42	71.76
42	GJ-35-15-15 x SPV- 104	71.40	72.20	71.80	32.50	38.00	35.25	51.95	55.10	53.53
43	GJ-35-15-15 x IS - 2284	84.80	89.60	87.20	91.00	92.00	91.50	87.90	90.80	89.35
44	GJ-35-15-15 x IS - 6335	85.40	89.60	87.50	73.84	78.30	76.07	79.62	83.95	81.79
45	GJ-35-15-15 x IS - 9471	72.00	76.74	74.37	71.50	76.60	74.05	71.75	76.67	74.21
46	SPV - 946 x SPV- 104	73.40	75.00	74.20	57.50	63.00	60.25	65.45	69.00	67.23
47	SPV - 946 x IS - 2284	81.00	84.80	82.90	73.16	79.90	76.53	77.08	82.35	79.72
48	SPV - 946 x IS- 6335	90.00	92.80	91.40	88.66	90.34	89.50	89.33	91.57	90.45
49	SPV - 946 x IS 9471	83.00	88.16	85.58	67.20	72.20	69.70	75.10	80.18	77.64
50	SPV - 104 x IS 2284	73.80	77.60	75.70	64.66	76.00	70.33	69.23	76.80	73.02
51	SPV - 104 x IS 6335	70.60	74.10	72.35	58.00	63.50	60.75	64.30	68.80	66.55
52	SPV - 104 x IS 9471	65.40	72.00	68.70	65.00	71.50	68.25	65.20	71.75	68.48
53	IS 2284 x IS-6335	90.00	94.26	92.13	69.00	71.00	70.00	79.50	82.63	81.07
54	IS 2284 x IS -9471	90.50	90.14	90.32	89.50	92.00	90.75	90.00	91.07	90.54
55	IS 6335 x IS 9471	89.64	93.94	91.79	78.00	85.34	81.67	83.82	89.64	86.73
	Mean	80.37	83.95	82.16	59.390	63.82	61.87	70.14	73.89	72.02
	% increase (+)/decrease(-) over untreated			(+)4 45			(+)6.56			(+)5.35
	% increase over location			24.69 Patancheru						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.833	2.310		1.113	3.086		0.462	1.349	
	B	4.370	12.115		5.838	16.184		2.425	7.078	
	A x B	6.181	17.133		8.257	12.888		3.429	9.978	

Table 46 : Effect of pre-treatment on *F. moniliforme* (%) (GS) of parents and F_2 progenies Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	12.67	10.01	11.34	27.33	16.00	21.67	20.00	13.00	16.50
2	ICSB-101B	18.01	16.67	17.34	18.00	11.33	14.67	18.00	14.00	16.00
3	Akms-14B	24.67	17.99	21.33	2.67	2.67	2.67	13.67	10.33	12.00
4	SRT-26B	20.67	19.33	20.00	14.00	7.33	10.67	17.34	13.33	15.34
5	GJ-35-15-15	11.99	18.67	15.33	16.67	7.33	12.00	14.33	13.00	13.67
6	SPV-946	12.00	22.67	17.34	18.00	8.67	13.33	15.00	15.67	15.34
7	SPV-104	20.01	27.33	23.67	4.00	4.67	4.33	12.00	16.00	14.00
8	IS-2284	15.99	8.67	12.33	28.00	16.00	22.00	22.00	12.34	17.17
9	IS-6335	5.33	3.33	4.33	32.00	12.67	22.33	18.66	8.00	13.33
10	IS-9471	3.33	3.33	3.33	20.67	15.33	18.00	12.00	9.33	10.67
11	SPV-1201 x ICSB-101B	25.86	16.54	21.20	25.66	20.40	23.03	25.76	18.47	22.12
12	SPV-1201 x Akms-14 B	22.66	17.50	20.08	15.66	16.34	16.00	19.16	16.92	18.04
13	SPV-1201 x SRT - 26B	26.50	20.50	23.50	22.66	14.16	18.41	24.58	17.33	20.96
14	SPV-1201 x GJ-35-15-15	15.70	11.40	13.55	32.50	17.50	25.00	24.10	14.45	19.28
15	SPV-1201 x SPV -946	14.96	10.26	12.61	27.20	19.40	23.30	21.08	14.83	17.96
16	SPV-1201 x SPV- 104	19.90	13.46	16.68	28.34	16.60	22.47	24.12	15.03	19.58
17	SPV-1201 x IS -2284	21.36	13.10	17.23	20.50	13.50	17.00	20.93	13.30	17.12
18	SPV-1201 x IS-6335	25.00	18.16	21.58	25.50	17.26	21.38	25.25	17.71	21.48
19	SPV-1201 x IS - 9471	15.40	9.86	12.63	27.00	17.00	22.00	21.20	13.43	17.32
20	ICSB - 101B x AKms 14 B	14.16	10.42	12.29	24.00	22.84	23.42	19.08	16.63	17.86
21	ICSB - 101B x SRT- 26 B	15.20	12.00	13.60	33.50	25.66	29.58	24.35	18.83	21.59
22	ICSB - 101B x GJ-35-15-15	22.20	11.60	16.90	26.50	20.76	23.63	24.35	16.18	20.27
23	ICSB - 101B x SPV - 946	19.40	14.00	16.70	30.26	22.50	26.38	24.83	18.25	21.54
24	ICSB - 101B x SPV - 104	21.70	15.30	18.50	18.00	13.00	15.50	19.85	14.15	17.00
25	ICSB - 101B x IS - 2284	29.40	12.76	21.08	30.10	23.10	26.60	29.75	17.93	23.84
26	ICSB - 101B x IS - 6335	15.20	7.66	11.43	34.00	35.76	34.88	24.60	21.71	23.16
27	ICSB -101B x IS - 9471	23.40	16.80	20.10	24.50	30.00	27.25	23.95	23.40	23.68
28	AKms - 14 B x SRT - 26B	19.20	14.60	16.90	13.50	17.50	15.50	16.35	16.05	16.20
29	AKms - 14 B x GJ-35-15-15	17.00	13.60	15.30	29.34	20.34	24.84	23.17	16.97	20.07
30	AKms -14 B x SPV - 946	15.60	11.40	13.50	18.00	18.00	18.00	16.80	14.70	15.75
31	AKms - 14 B x SPV - 104	18.60	14.20	16.40	18.50	17.50	18.00	18.55	15.85	17.20
32	AKms - 14 B x IS - 2284	21.26	14.56	17.91	32.50	21.00	26.75	26.88	17.78	22.33
33	AKms - 14 B x IS - 6335	22.16	14.00	18.08	23.50	17.00	20.25	22.83	15.50	19.17
34	AKms - 14 B x IS - 9471	19.80	13.80	16.80	19.00	19.00	19.00	19.40	16.40	17.90

Contd.......

Table 46 . Contd.. ... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	24.00	18.60	21.30	30.00	28.50	29.25	27.00	23.55	25.28
36	SRT - 26B x SPV - 946	12.20	9.66	10.93	28.20	19.20	23.70	20.20	14.43	17.32
37	SRT - 26B x SPV -104	12.00	12.80	12.40	26.00	16.00	21.00	19.00	14.40	16.70
38	SRT - 26B x IS – 2284	17.96	13.06	15.51	28.00	23.50	25.75	22.98	18.28	20.63
39	SRT - 26B x IS – 6335	15.80	11.74	13.77	36.76	25.00	30.88	26.28	18.37	22.33
40	SRT - 26B x IS – 9471	24.60	19.20	21.90	30.66	19.00	24.83	27.63	19.10	23.37
41	GJ-35-15-15 x SPV - 946	15.50	11.48	13.49	26.42	17.16	21.79	20.96	14.32	17.64
42	GJ-35-15-15 x SPV- 104	18.76	14.66	16.71	21.00	21.00	21.00	19.88	17.83	18.86
43	GJ-35-15-15 x IS - 2284	27.00	16.80	21.90	38.00	15.00	26.50	32.50	15.90	24.20
44	GJ-35-15-15 x IS - 6335	23.86	13.54	18.70	32.50	26.60	29.55	28.18	20.07	24.13
45	GJ-35-15-15 x IS - 9471	22.40	15.06	18.73	24.00	16.00	20.00	23.20	15.53	19.37
46	SPV - 946 x SPV- 104	16.40	11.60	14.00	28.00	26.00	27.00	22.20	18.80	20.50
47	SPV - 946 x IS - 2284	27.00	13.80	20.40	35.16	20.70	27.93	31.08	17.25	24.17
48	SPV - 946 x IS- 6335	15.84	10.16	13.00	26.34	18.00	22.17	21.09	14.08	17.59
49	SPV - 946 x IS 9471	25.60	18.86	22.23	26.00	16.80	21.40	25.80	17.83	21.82
50	SPV - 104 x IS 2284	21.36	14.80	18.08	31.34	23.50	27.42	26.35	19.15	22.75
51	SPV - 104 x IS 6335	29.46	20.16	24.81	27.50	17.00	22.25	28.48	18.58	23.53
52	SPV - 104 x IS 9471	30.26	17.86	24.06	33.50	18.50	26.00	31.88	18.18	25.03
53	IS 2284 x IS-6335	26.30	18.76	22.53	39.00	28.00	33.50	32.65	23.38	28.02
54	IS 2284 x IS -9471	27.92	18.34	23.13	39.50	26.50	33.00	33.71	22.42	28.07
55	IS 6335 x IS 9471	21.50	19.60	20.55	17.00	12.00	14.50	24.25	15.80	20.03
	Mean	19.85	14.47	17.16	24.19	19.84	22.02	22.02	16.96	19.49
	% increase (+)/decrease(-) over untreated			(-)27.10			(-)17.98			(-)22.98
	% increase over location						28.32 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.824	2.284		0.734	2.034		1.348	3.923	
	B	4.320	11.975		3.849	10.669		7.076	20.591	
	A x B	6.110	16.936		5.443	15.088		10.008	29.124	

Table 47 : Effect of pre-treatment on *F. pallidoroseum* (%) (GS) of parents and F_2 progenies Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	0.67	0.33	5.33	6.00	5.67	2.67	3.33	3.00
2	ICSB-101B	0.00	4.67	2.33	3.33	3.33	3.33	1.67	4.00	2.83
3	Akms-14B	0.00	5.33	2.67	0.00	0.00	0.00	0.00	2.67	1.33
4	SRT-26B	2.00	4.00	3.00	4.00	1.33	2.67	3.00	2.67	2.83
5	GJ-35-15-15	0.00	6.67	3.33	0.00	4.00	2.00	0.00	5.33	2.67
6	SPV-946	0.67	6.00	3.33	3.33	6.00	4.67	2.00	6.00	4.00
7	SPV-104	0.00	6.67	3.33	0.00	0.00	0.00	0.00	3.33	1.67
8	IS-2284	1.33	2.67	2.00	6.00	12.00	9.00	3.67	7.33	5.50
9	IS-6335	2.67	2.67	2.67	5.33	7.33	6.33	4.00	5.00	4.50
10	IS-9471	0.67	0.67	0.67	6.00	6.00	6.00	3.33	3.33	3.33
11	SPV-1201 x ICSB-101B	1.50	2.56	2.03	2.14	1.46	1.80	1.82	2.01	1.92
12	SPV-1201 x Akms-14 B	1.50	0.60	1.05	1.34	0.50	0.92	1.42	0.55	0.99
13	SPV-1201 x SRT - 26B	1.80	1.40	1.60	5.50	0.84	3.17	3.65	1.12	2.39
14	SPV-1201 x GJ-35-15-15	1.20	0.40	0.80	6.50	3.26	4.88	3.85	1.83	2.84
15	SPV-1201 x SPV -946	1.00	0.20	0.60	5.20	2.40	3.80	3.10	1.30	2.20
16	SPV-1201 x SPV- 104	2.50	0.40	1.45	3.00	2.66	2.83	2.75	1.53	2.14
17	SPV-1201 x IS -2284	1.20	0.50	0.85	2.96	2.00	2.48	2.08	1.25	1.67
18	SPV-1201 x IS-6335	3.36	1.96	2.66	6.00	2.00	4.00	4.68	1.98	3.33
19	SPV-1201 x IS - 9471	1.56	0.50	1.03	4.00	3.50	3.75	2.78	2.00	2.39
20	ICSB - 101B x AKms 14 B	1.26	2.00	1.63	1.66	1.66	1.66	1.46	1.83	1.65
21	ICSB - 101B x SRT- 26 B	3.40	2.40	2.90	2.34	0.34	1.34	2.87	1.37	2.12
22	ICSB - 101B x GJ-35-15-15	1.60	1.60	1.60	3.00	2.00	2.50	2.30	1.80	2.05
23	ICSB - 101B x SPV - 946	2.20	1.80	2.00	3.50	1.00	2.25	2.85	1.40	2.13
24	ICSB - 101B x SPV - 104	3.80	3.70	3.75	1.50	0.00	0.75	2.65	1.85	2.25
25	ICSB - 101B x IS - 2284	3.20	2.16	2.68	3.10	2.26	2.68	3.15	2.21	2.68
26	ICSB - 101B x IS - 6335	1.66	0.70	1.18	1.76	4.26	3.01	1.71	2.48	2.10
27	ICSB -101B x IS - 9471	3.86	1.10	2.48	4.16	4.00	4.08	4.01	2.55	3.28
28	AKms - 14 B x SRT - 26B	2.20	1.20	1.70	1.00	0.00	0.50	1.60	0.60	1.10
29	AKms - 14 B x GJ-35-15-15	0.80	1.60	1.20	1.50	0.34	0.92	1.15	0.97	1.06
30	AKms -14 B x SPV - 946	0.80	0.40	0.60	6.50	1.50	4.00	3.65	0.95	2.30
31	AKms - 14 B x SPV - 104	1.00	1.60	1.30	2.50	2.50	2.50	1.75	2.05	1.90
32	AKms - 14 B x IS - 2284	1.56	1.86	1.71	5.00	3.00	4.00	3.28	2.43	2.86
33	AKms - 14 B x IS - 6335	1.00	2.34	1.67	6.00	5.50	5.75	3.50	3.92	3.71
34	AKms - 14 B x IS - 9471	1.00	1.50	1.25	3.00	4.50	3.75	2.00	3.00	2.50

Contd.......

Table 47 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	3.60	2.60	3.10	3.00	2.00	2.50	3.30	2.30	2.80
36	SRT - 26B x SPV - 946	1.10	1.50	1.30	6.10	1.40	3.75	3.60	1.45	2.53
37	SRT - 26B x SPV -104	1.20	1.20	1.20	3.00	1.50	2.25	2.10	1.35	1.73
38	SRT - 26B x IS – 2284	0.60	1.00	0.80	5.00	0.50	2.75	2.80	0.75	1.78
39	SRT - 26B x IS – 6335	1.80	2.20	2.00	4.00	1.00	2.50	2.90	1.60	2.25
40	SRT - 26B x IS – 9471	2.40	2.20	2.30	3.50	1.00	2.25	2.95	1.60	2.28
41	GJ-35-15-15 x SPV - 946	0.34	0.34	0.34	1.50	1.00	1.25	0.92	0.67	0.80
42	GJ-35-15-15 x SPV- 104	2.86	1.96	2.41	1.00	1.50	1.25	1.93	1.73	1.83
43	GJ-35-15-15 x IS - 2284	4.46	2.14	3.30	8.00	3.00	5.50	6.23	2.57	4.40
44	GJ-35-15-15 x IS - 6335	2.20	0.20	1.20	5.00	3.00	4.00	3.60	1.60	2.60
45	GJ-35-15-15 x IS - 9471	2.92	2.80	2.86	4.76	1.00	2.88	3.84	1.90	2.87
46	SPV - 946 x SPV- 104	2.20	1.40	1.80	5.00	3.00	4.00	3.60	2.20	2.90
47	SPV - 946 x IS - 2284	4.40	2.20	3.30	4.00	2.50	3.25	4.20	2.35	3.28
48	SPV - 946 x IS- 6335	3.42	2.16	2.79	2.66	1.34	2.00	3.04	1.75	2.40
49	SPV - 946 x IS 9471	3.76	3.00	3.38	4.80	1.60	3.20	4.28	2.30	3.29
50	SPV - 104 x IS 2284	2.30	2.40	2.35	3.66	1.00	2.33	2.98	1.70	2.34
51	SPV - 104 x IS 6335	3.70	5.10	4.40	5.00	1.50	3.25	4.35	3.30	3.83
52	SPV - 104 x IS 9471	4.60	2.86	3.73	4.50	1.00	2.75	4.55	1.93	3.24
53	IS 2284 x IS-6335	6.04	3.52	4.78	4.00	3.00	3.50	5.02	3.26	4.14
54	IS 2284 x IS -9471	3.74	0.92	2.33	4.50	0.50	2.50	4.12	0.71	2.42
55	IS 6335 x IS 9471	5.34	4.10	4.72	5.34	2.34	3.84	5.34	3.22	4.28
	Mean	2.29	2 18	2.24	3.72	2.40	306	2.91	2.29	2.60
	% increase (+)/decrease(-) over untreated			(-)4.80			(-)35.48			(-)21.30
	% increase over location						36.60 (Akola)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.148	0.409	0.205	0.569	0.216	0.598
B	0.775	2.147	1.076	2.983	1.133	3.139
A x B	1.095	3.036	1.522	4.220	1.602	4.441

Table 48. Effect of pre-treatment on *C. lunata* (%) (GS) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	45.33	45.36	45.35	18.67	15.33	17.00	32.00	30.35	31.17
2	ICSB-101B	45.33	39.32	42.33	14.00	11.33	12.67	29.67	25.33	27.50
3	Akms-14B	24.67	37.36	31.01	2.67	2.00	2.33	13.67	19.68	16.67
4	SRT-26B	48.67	34.00	41.33	6.00	6.00	6.00	27.33	20.00	23.67
5	GJ-35-15-15	49.33	30.68	40.01	4.67	4.00	4.33	27.00	17.34	22.17
6	SPV-946	51.33	28.68	40.01	8.67	10.67	9.67	30.00	19.67	24.84
7	SPV-104	28.67	16.68	22.67	2.67	0.00	1.33	15.67	8.34	12.00
8	IS-2284	43.33	30.68	37.01	18.00	18.00	18.00	30.67	24.34	27.50
9	IS-6335	22.00	14.00	18.00	17.33	12.67	15.00	19.67	13.33	16.50
10	IS-9471	20.00	16.68	18.34	23.33	14.67	19.00	21.67	15.67	18.67
11	SPV-1201 x ICSB-101B	40.76	29.10	34.93	25.80	29.94	27.87	33.28	29.52	31.40
12	SPV-1201 x Akms-14 B	31.16	34.30	32.73	14.00	24.16	19.08	22.58	29.23	25.91
13	SPV-1201 x SRT - 26B	34.90	30.00	32.45	22.16	23.84	23.00	28.53	26.92	27.73
14	SPV-1201 x GJ-35-15-15	51.76	35.60	43.68	26.00	24.50	25.25	38.88	30.05	34.47
15	SPV-1201 x SPV -946	39.10	35.06	37.08	21.40	23.00	22.20	30.25	29.03	29.64
16	SPV-1201 x SPV- 104	37.26	33.66	35.46	16.34	25.00	20.67	26.80	29.33	28.07
17	SPV-1201 x IS -2284	39.90	34.46	37.18	29.26	21.50	25.38	34.58	27.98	31.28
18	SPV-1201 x IS-6335	32.16	27.06	29.61	30.50	25.26	27.88	31.33	26.16	28.75
19	SPV-1201 x IS - 9471	36.50	35.60	36.05	20.50	16.00	18.25	28.50	25.80	27.15
20	ICSB - 101B x AKms 14 B	46.16	40.84	43.50	25.34	18.84	22.09	35.75	29.84	32.80
21	ICSB - 101B x SRT- 26 B	51.00	37.20	44.10	16.84	14.24	15.54	33.92	25.72	29.82
22	ICSB - 101B x GJ-35-15-15	43.40	29.20	36.30	32.26	27.26	29.76	37.83	28.23	33.03
23	ICSB - 101B x SPV - 946	40.40	33.60	37.00	20.50	18.50	19.50	30.45	26.05	28.25
24	ICSB - 101B x SPV - 104	36.60	36.40	36.50	8.50	10.50	9.50	22.55	23.45	23.00
25	ICSB - 101B x IS - 2284	34.26	31.20	32.73	21.76	20.66	21.21	28.01	25.93	26.97
26	ICSB - 101B x IS - 6335	51.30	37.36	44.33	16.26	18.76	17.51	33.78	28.06	30.92
27	ICSB -101B x IS - 9471	40.16	32.36	36.26	16.34	15.34	15.84	28.25	23.85	26.05
28	AKms - 14 B x SRT - 26B	43.60	35.60	39.60	3.50	4.50	4.00	23.55	20.05	21.80
29	AKms - 14 B x GJ-35-15-15	44.80	37.60	41.20	20.00	25.00	22.50	32.40	31.30	31.85
30	AKms -14 B x SPV - 946	42.60	36.20	39.40	18.00	15.00	16.50	30.30	25.60	27.95
31	AKms - 14 B x SPV - 104	25.30	25.16	25.23	8.50	8.50	8.50	16.90	16.83	16.87
32	AKms - 14 B x IS - 2284	32.36	27.66	30.01	18.00	16.00	17.00	25.18	21.83	23.51
33	AKms - 14 B x IS - 6335	36.50	21.16	28.83	18.00	18.50	18.25	27.25	19.83	23.54
34	AKms - 14 B x IS - 9471	32.70	20.40	26.55	20.00	21.00	20.50	26.35	20.70	23.53

Contd.......

Table 48 . Contd.......

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	33.80	29.60	31.70	18.00	18.00	18.00	25.90	23.80	24.85
36	SRT - 26B x SPV - 946	52.20	41.86	47.03	25.10	20.10	22.60	38.65	30.98	34.82
37	SRT - 26B x SPV -104	41.00	34.60	37.80	17.50	16.50	17.00	29.25	25.55	27.40
38	SRT - 26B x IS – 2284	39.46	32.16	35.81	24.00	19.50	21.75	31.73	25.83	28.78
39	SRT - 26B x IS – 6335	44.80	36.54	40.67	20.26	17.00	18.63	32.53	26.77	29.65
40	SRT - 26B x IS – 9471	36.00	27.00	31.50	25.66	24.00	24.83	30.83	25.50	28.17
41	GJ-35-15-15 x SPV - 946	35.30	25.74	30.52	22.34	23.52	22.93	28.82	24.63	26.73
42	GJ-35-15-15 x SPV- 104	51.16	24.70	37.93	9.00	12.00	10.50	30.08	18.35	24.22
43	GJ-35-15-15 x IS - 2284	39.20	27.60	33.40	26.00	32.00	29.00	32.60	29.80	31.20
44	GJ-35-15-15 x IS - 6335	31.86	25.80	28.83	23.00	19.50	21.25	27.43	22.65	25.04
45	GJ-35-15-15 x IS - 9471	29.40	25.80	27.60	18.76	21.00	19.88	24.08	23.40	23.74
46	SPV - 946 x SPV- 104	38.20	34.20	36.20	11.50	18.00	14.75	24.85	26.10	25.48
47	SPV - 946 x IS - 2284	31.80	29.80	30.80	24.84	28.00	26.42	28.32	28.90	28.61
48	SPV - 946 x IS- 6335	37.26	28.26	32.76	18.66	21.00	19.83	27.96	24.63	26.30
49	SPV - 946 x IS 9471	23.80	22.36	23.08	19.20	18.60	18.90	21.50	20.48	20.99
50	SPV - 104 x IS 2284	33.56	27.26	30.41	19.00	17.50	18.25	26.28	22.38	24.33
51	SPV - 104 x IS 6335	23.70	21.40	22.56	17.00	18.00	17.50	20.35	19.70	20.03
52	SPV - 104 x IS 9471	18.52	17.46	17.99	15.00	15.50	15.25	16.76	16.48	16.62
53	IS 2284 x IS-6335	19.60	16.26	17.93	14.00	13.00	13.50	16.80	14.63	15.72
54	IS 2284 x IS -9471	18.50	16.92	17.71	17.00	18.50	17.75	17.75	17.71	17.73
55	IS 6335 x IS 9471	17.00	13.34	15.17	17.66	14.00	15.83	17.33	13.67	15.50
	Mean	36.72	29.61	33.17	17.99	17.55	17.77	27.36	23.58	25.47
	% increase (+)/decrease(-) over untreated			(-)19.36			(-)2.44			(-)13.81
	% increase over location			46.43 Patancheru						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	1.092	3.028		0.601	1.666		0.500	1.457	
	B	5.729	15.880		3.152	8.736		2.627	7.668	
	A x B	8.102	22.458		4.457	12.354		3.710	2.627	

VIII - 33

Table 49. Effect of pre-treatment on other fungi (%) (GS) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	20.00	18.67	19.33	2.00	0.67	1.33	11.00	9.67	10.33
2	ICSB-101B	13.33	12.67	13.00	0.00	2.67	1.33	6.67	7.67	7.17
3	Akms-14B	4.67	8.00	6.33	0.00	0.00	0.00	2.33	4.00	3.17
4	SRT-26B	15.33	16.67	16.00	0.67	0.00	0.33	8.00	8.33	8.17
5	GJ-35-15-15	20.00	14.67	17.33	0.00	0.00	0.00	10.00	7.33	8.67
6	SPV-946	23.33	14.00	18.67	2.00	0.00	1.00	12.67	7.00	9.83
7	SPV-104	12.67	7.33	10.00	1.33	0.00	0.67	7.00	3.67	5.33
8	IS-2284	24.67	10.00	17.33	4.00	5.33	4.67	14.33	7.67	11.00
9	IS-6335	20.00	6.67	13.33	6.00	4.67	5.33	13.00	5.67	9.33
10	IS-9471	19.33	6.00	12.67	4.67	4.00	4.33	12.00	5.00	8.50
11	SPV-1201 x ICSB-101B	16.70	16.00	16.35	12.46	19.60	16.03	14.58	17.80	16.19
12	SPV-1201 x Akms-14 B	15.60	21.30	18.45	5.34	7.84	6.59	10.47	14.57	12.52
13	SPV-1201 x SRT - 26B	20.10	14.60	17.35	9.32	10.00	9.66	14.71	12.30	13.51
14	SPV-1201 x GJ-35-15-15	15.90	13.76	14.83	6.26	11.50	8.88	11.08	12.63	11.86
15	SPV-1201 x SPV -946	17.86	14.10	15.98	10.10	11.20	10.65	13.98	12.65	13.32
16	SPV-1201 x SPV- 104	17.00	17.96	17.48	6.00	6.64	6.32	11.50	12.30	11.90
17	SPV-1201 x IS -2284	16.56	16.30	16.43	17.76	11.50	14.63	17.16	13.90	15.53
18	SPV-1201 x IS-6335	16.36	16.30	16.33	10.26	12.76	11.51	13.31	14.53	13.92
19	SPV-1201 x IS - 9471	16.20	18.10	17.15	10.00	8.50	9.25	13.10	13.30	13.20
20	ICSB - 101B x AKms 14 B	12.26	18.50	15.38	7.34	9.34	8.34	9.80	13.92	11.86
21	ICSB - 101B x SRT- 26 B	26.60	16.40	21.50	6.00	12.66	9.33	16.30	14.53	15.42
22	ICSB - 101B x GJ-35-15-15	16.80	19.40	18.10	14.00	12.50	13.25	15.40	15.95	15.68
23	ICSB - 101B x SPV - 946	11.60	19.40	15.50	13.00	13.76	13.38	12.30	16.58	14.44
24	ICSB - 101B x SPV - 104	18.50	16.40	17.45	2.00	7.00	4.50	10.25	11.70	10.98
25	ICSB - 101B x IS - 2284	18.90	20.50	19.70	10.76	8.34	9.55	14.83	14.42	14.63
26	ICSB - 101B x IS - 6335	14.96	15.60	15.28	14.26	8.00	11.13	14.61	11.80	13.21
27	ICSB -101B x IS - 9471	14.40	12.26	13.33	11.66	10.00	10.83	13.03	11.13	12.08
28	AKms - 14 B x SRT - 26B	9.80	16.60	13.20	0.50	0.50	0.50	5.15	8.55	6.85
29	AKms - 14 B x GJ-35-15-15	9.80	16.20	13.00	3.00	7.66	5.33	6.40	11.93	9.17
30	AKms -14 B x SPV - 946	10.80	15.80	13.30	5.00	6.00	5.50	7.90	10.90	9.40
31	AKms - 14 B x SPV - 104	7.86	15.16	11.51	1.00	5.00	3.00	4.43	10.08	7.26
32	AKms - 14 B x IS - 2284	20.10	14.46	17.28	9.00	11.00	10.00	14.55	12.73	13.64
33	AKms - 14 B x IS - 6335	25.16	14.00	19.58	7.50	7.00	7.25	16.33	10.50	13.42
34	AKms - 14 B x IS - 9471	17.90	13.50	15.70	13.50	8.00	10.75	15.70	10.75	13.23

Contd.. .. .. ..

Table 49 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	14.40	15.40	14.90	12.00	9.50	10.75	13.20	12.45	12.83
36	SRT - 26B x SPV - 946	15.50	21.40	18.45	13.50	11.46	12.48	14.50	16.43	15.47
37	SRT - 26B x SPV -104	13.40	13.20	13.30	5.00	6.00	5.50	9.20	9.60	9.40
38	SRT - 26B x IS – 2284	19.16	14.50	16.83	9.00	7.50	8.25	14.08	11.00	12.54
39	SRT - 26B x IS – 6335	15.54	16.74	16.14	12.76	9.00	10.88	14.15	12.87	13.51
40	SRT - 26B x IS – 9471	16.40	18.00	17.20	6.84	9.66	8.25	11.62	13.83	12.73
41	GJ-35-15-15 x SPV - 946	17.02	13.80	15.41	12.66	10.52	11.59	14.84	12.16	13.50
42	GJ-35-15-15 x SPV- 104	13.86	15.30	14.58	1.50	4.00	2.75	7.68	9.65	8.67
43	GJ-35-15-15 x IS - 2284	9.00	12.54	10.77	16.00	8.00	12.00	12.50	10.27	11.39
44	GJ-35-15-15 x IS - 6335	14.06	16.80	15.43	9.84	12.60	11.22	11.95	14.70	13.33
45	GJ-35-15-15 x IS - 9471	12.54	13.06	12.80	8.76	7.76	8.26	10.65	10.41	10.53
46	SPV - 946 x SPV- 104	10.80	15.60	13.20	5.50	8.50	7.00	8.15	12.05	10.10
47	SPV - 946 x IS - 2284	22.40	12.60	17.50	10.00	13.60	11.80	16.20	13.10	14.65
48	SPV - 946 x IS- 6335	17.76	10.50	14.13	21.34	10.00	15.67	19.55	10.25	14.90
49	SPV - 946 x IS 9471	9.90	12.76	11.33	11.60	9.20	10.40	10.75	10.98	10.87
50	SPV - 104 x IS 2284	9.20	13.96	11.58	9.16	5.50	7.33	9.18	9.73	9.46
51	SPV - 104 x IS 6335	10.46	11.66	11.06	9.00	8.00	8.50	9.73	9.83	9.78
52	SPV - 104 x IS 9471	9.66	9.80	9.73	11.50	7.50	9.50	10.58	8.65	9.62
53	IS 2284 x IS-6335	11.86	8.02	9.94	12.00	7.00	9.50	11.93	7.51	9.72
54	IS 2284 x IS -9471	11.40	10.60	11.00	14.50	8.00	11.25	12.95	9.30	11.13
55	IS 6335 x IS 9471	10.34	8.00	9.17	10.00	8.66	9.33	10.17	8.33	9.25
	Mean	15.37	14.39	14.88	8.17	7.74	7.96	11.77	10.07	10.92
	% increase (+)/decrease(-) over untreated			(-)6.37			(-)4.91			(-)14.44
	% increase over location			46.50 Patancheru						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.616	1.708		0.425	1.179		0.326	0.950	
	B	3.231	8.955		2.230	6.182		1.714	5.003	
	A x B	4.569	12.665		3.154	8.743		2.424	7.053	

Table 50. Effect of pre-treatment on score (GS) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	4.00	3.00	3.50	4.00	4.00	4.00	4.00	3.50	3.75
2	ICSB-101B	4.00	3.00	3.50	4.00	4.00	4.00	4.00	3.50	3.75
3	Akms-14B	5.00	3.50	4.25	4.33	3.00	3.67	4.67	3.25	3.96
4	SRT-26B	3.83	3.00	3.42	4.00	3.50	3.75	3.92	3.25	3.58
5	GJ-35-15-15	3.50	3.00	3.25	3.33	3.50	3.42	3.42	3.25	3.33
6	SPV-946	3.83	2.50	3.17	3.00	3.50	3.25	3.42	3.00	3.21
7	SPV-104	4.50	3.50	4.00	3.33	3.33	3.33	3.92	3.42	3.67
8	IS-2284	2.00	1.00	1.50	1.00	2.00	1.50	1.50	1.50	1.50
9	IS-6335	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	IS-9471	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	SPV-1201 x ICSB-101B	3.20	3.00	3.10	3.45	3.15	3.30	3.33	3.08	3.20
12	SPV-1201 x Akms-14 B	3.70	3.40	3.55	3.50	3.92	3.71	3.60	3.66	3.63
13	SPV-1201 x SRT - 26B	3.60	3.10	3.35	3.40	2.79	3.10	3.50	2.95	3.22
14	SPV-1201 x GJ-35-15-15	3.73	3.13	3.43	3.50	3.13	3.31	3.61	3.13	3.37
15	SPV-1201 x SPV -946	3.05	2.70	2.88	3.70	3.20	3.45	3.38	2.95	3.16
16	SPV-1201 x SPV- 104	3.75	3.10	3.43	4.00	2.67	3.33	3.88	2.88	3.38
17	SPV-1201 x IS -2284	3.10	2.58	2.84	3.13	3.00	3.06	3.11	2.79	2.95
18	SPV-1201 x IS-6335	3.10	2.88	2.99	3.19	2.50	2.85	3.16	2.69	2.92
19	SPV-1201 x IS - 9471	2.98	2.73	2.85	3.75	2.50	3.13	3.36	2.61	2.99
20	ICSB - 101B x AKms 14 B	3.75	3.00	3.38	3.75	3.42	3.58	3.75	3.21	3.48
21	ICSB - 101B x SRT- 26 B	3.65	2.90	3.28	3.84	3.00	3.42	3.74	2.95	3.35
22	ICSB - 101B x GJ-35-15-15	3.65	3.00	3.33	3.50	3.07	3.28	3.58	3.03	3.30
23	ICSB - 101B x SPV - 946	3.65	3.20	3.43	3.50	3.25	3.38	3.58	3.23	3.40
24	ICSB - 101B x SPV - 104	3.40	3.10	3.25	3.75	3.00	3.38	3.58	3.05	3.31
25	ICSB - 101B x IS - 2284	3.05	2.85	2.95	2.96	2.63	2.79	3.01	2.74	2.87
26	ICSB - 101B x IS - 6335	3.05	2.98	3.01	3.07	2.69	2.88	3.06	2.83	2.95
27	ICSB -101B x IS - 9471	3.00	2.08	2.54	3.25	3.25	3.25	3.13	2.66	2.89
28	AKms - 14 B x SRT - 26B	3.65	3.00	3.33	3.13	3.50	3.31	3.39	3.25	3.32
29	AKms - 14 B x GJ-35-15-15	3.75	3.00	3.38	3.84	3.34	3.59	3.79	3.17	3.48
30	AKms -14 B x SPV - 946	4.00	3.30	3.65	3.75	3.50	3.63	3.88	3.40	3.64
31	AKms - 14 B x SPV - 104	4.00	3.40	3.70	3.88	3.75	3.81	3.94	3.58	3.76
32	AKms - 14 B x IS - 2284	2.78	2.30	2.54	3.00	3.00	3.00	2.89	2.65	2.77
33	AKms - 14 B x IS - 6335	2.34	2.17	2.25	3.13	2.75	2.94	2.73	2.46	2.59
34	AKms - 14 B x IS - 9471	2.70	2.40	2.55	3.75	3.25	3.50	3.23	2.83	3.03

Contd.. .. .. ..

Table 50 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	3.30	2.80	3.05	3.50	3.10	3.30	3.40	2.95	3.18
36	SRT - 26B x SPV - 946	3.70	2.90	3.30	3.50	2.85	3.18	3.60	2.88	3.24
37	SRT - 26B x SPV -104	4.00	3.40	3.70	3.88	3.25	3.56	3.94	3.33	3.63
38	SRT - 26B x IS – 2284	3.23	2.58	2.90	3.50	2.38	2.94	3.36	2.48	2.92
39	SRT - 26B x IS – 6335	3.60	2.80	3.20	2.94	2.50	2.72	3.27	2.65	2.96
40	SRT - 26B x IS – 9471	3.00	2.60	2.80	3.25	2.92	3.08	3.13	2.76	2.94
41	GJ-35-15-15 x SPV - 946	3.55	2.92	3.23	4.00	3.23	3.62	3.78	3.07	3.42
42	GJ-35-15-15 x SPV- 104	3.80	3.35	3.58	4.00	3.00	3.50	3.90	3.18	3.54
43	GJ-35-15-15 x IS - 2284	3.38	2.74	3.06	3.50	2.50	3.00	3.44	2.62	3.03
44	GJ-35-15-15 x IS - 6335	2.67	2.40	2.53	3.38	3.05	3.21	3.02	2.73	2.87
45	GJ-35-15-15 x IS - 9471	3.19	2.54	2.86	3.00	2.55	2.78	3.09	2.54	2.82
46	SPV - 946 x SPV- 104	3.80	3.60	3.70	3.63	2.75	3.19	3.71	3.18	3.44
47	SPV - 946 x IS - 2284	3.50	2.70	3.10	3.88	3.15	3.51	3.69	2.93	3.31
48	SPV - 946 x IS- 6335	2.92	2.34	2.63	2.75	3.00	2.88	2.83	2.67	2.75
49	SPV - 946 x IS 9471	2.94	2.30	2.62	3.20	3.00	3.10	3.07	2.65	2.86
50	SPV - 104 x IS 2284	3.87	3.07	3.47	3.84	2.75	3.29	3.85	2.91	3.38
51	SPV - 104 x IS 6335	3.90	3.03	3.46	3.50	3.00	3.25	3.70	3.01	3.36
52	SPV - 104 x IS 9471	3.79	2.97	3.38	2.75	2.75	2.75	3.27	2.86	3.06
53	IS 2284 x IS-6335	2.70	1.88	2.29	3.25	3.25	3.25	2.98	2.56	2.77
54	IS 2284 x IS -9471	2.44	1.75	2.10	2.75	2.50	2.63	2.60	2.13	2.36
55	IS 6335 x IS 9471	2.69	2.13	2.41	1.84	1.67	1.75	2.26	1.90	2.08
	Mean	3.33	2.74	3.03	3.32	2.95	3.14	3.33	2.85	3.09
	% increase (+)/decrease(-) over untreated			(-)17.71			(-)11.14			(-)14.41
	% increase over location						3.63 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.041	0.113		0.047	0.131		0.052	0.151	
	B	0.214	0.595		0.248	0.688		0.275	0.800	
	A x B	0.304	0.841		0.351	0.972		0.388	1.128	

VIII - 37

Table 51. Effect of pre-treatment on ungerminated (%) seed of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	22.00	24.00	23.00	48.00	50.67	49.33	35.00	37.33	36.17
2	ICSB-101B	23.33	20.00	21.67	71.33	64.67	68.00	47.33	42.33	44.83
3	Akms-14B	46.00	31.33	38.67	94.67	96.00	95.33	70.33	63.67	67.00
4	SRT-26B	13.33	14.67	14.00	82.00	78.00	80.00	47.67	46.33	47.00
5	GJ-35-15-15	18.67	22.67	20.67	88.00	75.33	81.67	53.33	49.00	51.17
6	SPV-946	12.67	18.67	15.67	77.33	68.67	73.00	45.00	43.67	44.33
7	SPV-104	38.67	42.00	40.33	91.33	96.00	93.67	65.00	69.00	67.00
8	IS-2284	6.67	9.33	8.00	18.00	33.33	25.67	12.33	21.33	16.83
9	IS-6335	6.67	6.67	6.67	16.67	22.00	19.33	11.67	14.33	13.00
10	IS-9471	6.67	6.00	6.33	23.33	28.67	26.00	15.00	17.33	16.17
11	SPV-1201 x ICSB-101B	13.00	8.60	10.80	19.80	20.60	20.20	16.40	14.60	15.50
12	SPV-1201 x Akms-14 B	25.60	20.60	23.10	54.34	48.74	51.54	39.97	34.67	37.32
13	SPV-1201 x SRT - 26B	13.20	12.60	12.90	31.34	27.50	29.42	22.27	20.06	21.16
14	SPV-1201 x GJ-35-15-15	15.60	15.20	15.40	25.74	28.50	27.12	20.67	21.85	21.26
15	SPV-1201 x SPV -946	16.80	14.00	15.40	36.10	30.50	33.30	26.45	22.25	24.35
16	SPV-1201 x SPV- 104	20.80	18.60	19.70	46.66	41.40	44.03	33.73	30.00	31.87
17	SPV-1201 x IS -2284	14.60	9.60	12.10	21.50	15.50	18.50	18.05	12.56	15.30
18	SPV-1201 x IS-6335	10.40	7.80	9.10	24.74	15.50	20.12	17.57	11.65	14.61
19	SPV-1201 x IS - 9471	12.20	11.00	11.60	40.50	32.50	36.50	26.35	21.75	24.05
20	ICSB - 101B x AKms 14 B	25.66	20.00	22.83	41.66	39.16	40.41	33.66	29.58	31.62
21	ICSB - 101B x SRT- 26 B	15.00	10.40	12.70	40.84	35.34	38.09	27.92	22.87	25.40
22	ICSB - 101B x GJ-35-15-15	16.20	10.60	13.40	24.26	22.26	23.26	20.23	16.43	18.33
23	ICSB - 101B x SPV - 946	25.00	21.20	23.10	34.26	27.24	30.75	29.63	24.22	26.93
24	ICSB - 101B x SPV - 104	19.20	15.20	17.20	70.00	68.00	69.00	44.60	41.60	43.10
25	ICSB - 101B x IS - 2284	13.80	8.40	11.10	30.16	22.58	26.37	21.98	15.49	18.74
26	ICSB - 101B x IS - 6335	12.20	7.80	10.00	20.74	17.50	19.12	16.47	12.65	14.56
27	ICSB -101B x IS - 9471	10.00	6.20	8.10	31.00	25.50	28.25	20.50	15.85	18.18
28	AKms - 14 B x SRT - 26B	25.00	18.40	21.70	81.50	77.50	79.50	53.25	47.96	50.60
29	AKms - 14 B x GJ-35-15-15	28.00	19.20	23.60	45.50	41.34	43.42	36.75	30.27	33.51
30	AKms -14 B x SPV - 946	30.40	22.20	26.30	60.50	62.00	61.25	45.45	42.10	43.78
31	AKms - 14 B x SPV - 104	48.00	39.44	43.72	69.50	66.00	67.75	58.75	52.72	55.74
32	AKms - 14 B x IS - 2284	16.40	11.80	14.10	30.50	26.00	28.25	23.45	18.90	21.18
33	AKms - 14 B x IS - 6335	12.40	7.60	10.00	27.00	24.00	25.50	19.70	15.80	17.75
34	AKms - 14 B x IS - 9471	14.60	11.20	12.90	39.50	31.00	35.25	27.05	21.10	24.08

Contd.. .. .. ..

Table 51 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	19.80	15.00	17.40	38.00	33.50	35.75	28.90	24.25	2658
36	SRT - 26B x SPV - 946	18.40	11.40	14.90	29.84	21.40	25.62	24.12	16.40	2026
37	SRT - 26B x SPV -104	33.60	27.00	30.30	49.50	45.00	47.25	41.55	36.00	3878
38	SRT - 26B x IS – 2284	16.20	10.60	13.40	20.50	16.00	18.25	18.35	13.30	1583
39	SRT - 26B x IS – 6335	21.40	13.40	17.40	22.00	15.74	18.87	21.70	14.57	1814
40	SRT - 26B x IS – 9471	18.00	12.40	15.20	29.00	21.00	25.00	23.50	16.70	2010
41	GJ-35-15-15 x SPV - 946	25.80	23.00	24.40	34.00	30.84	32.42	29.90	26.92	2841
42	GJ-35-15-15 x SPV- 104	28.60	27.80	28.20	67.50	62.00	64.75	48.05	44.90	4648
43	GJ-35-15-15 x IS - 2284	15.20	10.40	12.80	9.00	8.00	8.50	12.10	9.20	1065
44	GJ-35-15-15 x IS - 6335	14.60	10.40	12.50	26.16	21.70	23.93	20.38	16.05	1822
45	GJ-35-15-15 x IS - 9471	28.00	23.26	25.63	28.50	23.40	25.95	28.25	23.33	2579
46	SPV - 946 x SPV- 104	28.60	25.00	26.80	43.50	37.00	40.25	36.05	31.00	3353
47	SPV - 946 x IS - 2284	19.00	15.20	17.10	26.84	20.10	23.47	22.92	17.65	2029
48	SPV - 946 x IS- 6335	10.00	7.20	8.60	11.34	9.66	10.50	10.67	8.43	955
49	SPV - 946 x IS 9471	17.00	11.84	14.42	32.80	27.80	30.30	24.90	19.82	2236
50	SPV - 104 x IS 2284	26.20	22.40	24.30	35.34	24.00	29.67	30.77	23.20	2699
51	SPV - 104 x IS 6335	29.40	25.90	27.65	42.00	36.50	39.25	35.70	31.20	3345
52	SPV - 104 x IS 9471	34.60	28.00	31.30	35.00	28.50	31.75	34.80	28.25	3153
53	IS 2284 x IS-6335	10.00	5.74	7.87	31.00	29.00	30.00	20.50	17.37	1894
54	IS 2284 x IS -9471	9.40	5.86	7.63	10.50	8.00	9.25	9.95	6.93	844
55	IS 6335 x IS 9471	10.40	6.06	8.23	22.00	14.66	18.33	16.20	10.36	1328
	Mean	19.69	16.02	17.86	40.05	36.24	38.15	29.87	26.13	2802
	% increase (+)/decrease(-) over untreated			(-)18.63			(-)9.51			(-)1250
	% increase over location						113.60 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.830	2.301		1.112	3.081		0.460	1.338	
	B	4.354	12.067		5.829	16.157		2.418	7.059	
	A x B	3.156	17.065		8.243	22.850		3.413	9.931	

Table 52. Effect of pre-treatment on *F. moniliforme* (%) (UGS) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	8.00	8.00	8.00	22.00	27.33	24.67	15.00	17.67	16.33
2	ICSB-101B	8.67	8.67	8.67	32.67	34.67	33.67	20.67	21.67	21.17
3	Akms-14B	21.33	16.00	18.67	28.00	56.00	42.00	24.67	36.00	30.33
4	SRT-26B	5.33	8.00	6.67	38.67	37.33	38.00	22.00	22.67	22.33
5	GJ-35-15-15	6.67	8.67	7.67	34.67	36.00	35.33	20.67	22.33	21.50
6	SPV-946	6.00	8.00	7.00	37.33	44.67	41.00	21.67	26.33	24.00
7	SPV-104	18.67	14.67	16.67	40.67	67.33	54.00	29.67	41.00	35.33
8	IS-2284	4.00	3.33	3.67	9.33	20.00	14.67	6.67	11.67	9.17
9	IS-6335	2.67	4.00	3.33	8.00	15.33	11.67	5.33	9.67	7.50
10	IS-9471	2.00	2.67	2.33	10.67	13.33	12.00	6.33	8.00	7.17
11	SPV-1201 x ICSB-101B	6.36	4.40	5.38	12.20	10.34	11.27	9.28	7.37	8.33
12	SPV-1201 x Akms-14 B	9.16	7.60	8.38	29.16	19.50	24.33	19.16	13.55	16.36
13	SPV-1201 x SRT - 26B	6.10	6.30	6.20	23.50	14.16	18.83	14.80	10.23	12.52
14	SPV-1201 x GJ-35-15-15	5.70	4.90	5.30	16.00	13.00	14.50	10.85	8.95	9.90
15	SPV-1201 x SPV -946	7.76	6.26	7.01	23.00	17.70	20.35	15.38	11.98	13.68
16	SPV-1201 x SPV- 104	8.30	7.86	8.08	30.00	29.26	29.63	19.15	18.56	18.86
17	SPV-1201 x IS -2284	6.96	5.50	6.23	10.50	7.26	8.88	8.73	6.38	7.56
18	SPV-1201 x IS-6335	6.56	4.16	4.86	14.00	7.76	10.88	9.78	5.96	7.87
19	SPV-1201 x IS - 9471	6.30	4.60	5.45	14.50	12.50	13.50	10.40	8.55	9.48
20	ICSB - 101B x AKms 14 B	7.42	5.50	6.46	22.50	22.34	22.42	14.96	13.92	14.44
21	ICSB - 101B x SRT- 26 B	3.80	2.80	3.30	25.34	24.34	24.84	14.57	13.57	14.07
22	ICSB - 101B x GJ-35-15-15	7.20	4.40	5.80	11.76	10.76	11.26.	9.48	7.58	8.53
23	ICSB - 101B x SPV - 946	10.40	7.40	8.90	20.00	13.26	16.63	15.20	10.33	12.77
24	ICSB - 101B x SPV - 104	9.60	7.00	8.30	39.50	39.00	39.25	24.55	23.00	23.78
25	ICSB - 101B x IS - 2284	5.70	4.20	4.95	20.76	15.00	17.88	13.23	9.60	11.42
26	ICSB - 101B x IS - 6335	3.30	2.16	2.73	11.76	12.00	11.88	7.53	7.08	7.31
27	ICSB -101B x IS - 9471	3.96	3.66	3.81	17.50	16.00	16.75	10.73	9.83	10.28
28	AKms - 14 B x SRT - 26B	10.20	8.00	9.10	37.50	33.50	35.50	23.85	20.75	22.30
29	AKms - 14 B x GJ-35-15-15	9.00	7.20	8.10	27.00	24.66	25.83	18.00	15.93	16.97
30	AKms -14 B x SPV - 946	7.80	6.20	7.00	32.00	40.50	36.25	19.90	23.35	21.63
31	AKms - 14 B x SPV - 104	22.46	16.30	19.38	49.00	38.50	43.75	35.73	27.40	31.57
32	AKms - 14 B x IS - 2284	7.80	6.00	6.90	21.00	17.50	19.25	14.40	11.75	13.08
33	AKms - 14 B x IS - 6335	5.66	3.66	4.66	17.50	14.50	16.00	11.58	9.08	10.33
34	AKms - 14 B x IS - 9471	6.50	5.80	6.15	19.00	15.00	17.00	12.75	10.40	11.58

Contd.. .. .. ..

Table 52 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	9.40	7.80	8.60	20.50	15.90	18.20	14.95	11.85	13.40
36	SRT - 26B x SPV - 946	6.50	4.10	5.30	12.56	8.96	10.76	9.53	6.53	8.03
37	SRT - 26B x SPV -104	12.00	12.60	12.30	26.50	28.00	27.25	19.25	20.30	19.78
38	SRT - 26B x IS – 2284	7.66	5.86	6.76	9.50	9.00	9.25	8.58	7.43	8.01
39	SRT - 26B x IS – 6335	6.26	4.34	5.30	13.26	12.00	12.63	9.76	8.17	8.97
40	SRT - 26B x IS – 9471	9.40	7.60	8.50	17.16	11.34	14.25	13.28	9.47	11.38
41	GJ-35-15-15 x SPV - 946	10.20	8.52	9.36	19.18	14.60	16.89	14.69	11.56	13.13
42	GJ-35-15-15 x SPV- 104	12.10	9.76	10.93	46.00	44.00	45.00	29.05	26.88	27.97
43	GJ-35-15-15 x IS - 2284	6.06	4.54	5.30	7.00	4.00	5.50	6.53	4.27	5.40
44	GJ-35-15-15 x IS - 6335	6.40	5.00	5.70	15.66	10.50	13.08	11.03	7.75	9.39
45	GJ-35-15-15 x IS - 9471	16.52	12.26	14.39	14.26	10.40	12.33	15.39	11.33	13.36
46	SPV - 946 x SPV- 104	10.60	10.20	10.40	32.50	22.50	27.50	21.55	16.35	18.95
47	SPV - 946 x IS - 2284	11.00	8.60	9.80	12.10	8.00	10.05	11.55	8.30	9.93
48	SPV - 946 x IS- 6335	4.58	3.00	3.79	7.00	6.66	6.83	5.79	4.83	5.31
49	SPV - 946 x IS 9471	10.66	7.00	8.83	16.00	14.00	15.00	13.33	10.50	11.92
50	SPV - 104 x IS 2284	12.46	10.20	11.33	22.16	16.50	19.33	17.31	13.35	15.33
51	SPV - 104 x IS 6335	14.60	13.46	14.03	20.00	15.50	17.75	17.30	14.48	15.89
52	SPV - 104 x IS 9471	22.26	16.80	19.53	19.50	15.00	17.25	20.88	15.90	18.39
53	IS 2284 x IS-6335	7.36	4.26	5.81	20.00	21.00	20.50	13.68	12.63	13.16
54	IS 2284 x IS -9471	6.50	4.84	5.67	9.00	6.00	7.50	7.75	5.42	6.59
55	IS 6335 x IS 9471	7.42	4.76	6.09	8.34	8.66	8.50	7.88	6.71	7.30
	Mean	8.66	7.08	7.87	21.37	20.42	20.90	14.99	13.75	14.37
	% increase (+)/decrease(-) over untreated			(-)18.36			(-)4.45			(-)6.67
	% increase over location						165.56 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.473	1.310		0.857	2.377		0.358	1.041	
	B	2.479	6.872		4.496	12.464		1.881	5.493	
	A x B	3.506	9.719		6.359	12.627		2.556	7.729	

Table53. Effect of pre-treatment on *F. pallidoroseum* (%)(UGS) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	1.33	0.67	6.00	6.00	6.00	3.00	3.67	3.33
2	ICSB-101B	0.00	0.00	0.00	10.00	9.33	9.67	5.00	4.67	4.83
3	Akms-14B	0.00	0.67	0.33	8.00	7.33	7.67	4.00	4.00	4.00
4	SRT-26B	0.00	0.00	0.00	7.33	8.67	8.00	3.67	4.33	4.00
5	GJ-35-15-15	0.00	0.00	0.00	8.67	9.33	9.00	4.33	4.67	4.50
6	SPV-946	0.00	0.00	0.00	12.00	8.67	10.33	6.00	4.33	5.17
7	SPV-104	0.00	8.00	4.00	10.67	10.00	10.33	5.33	9.00	7.17
8	IS-2284	0.00	0.00	0.00	0.00	7.33	3.67	0.00	3.67	1.83
9	IS-6335	0.00	0.00	0.00	0.67	3.33	2.00	0.33	1.67	1.00
10	IS-9471	0.00	0.67	0.33	4.00	4.00	4.00	2.00	2.33	2.17
11	SPV-1201 x ICSB-101B	0.00	0.00	0.00	1.20	0.00	0.60	0.60	0.00	0.30
12	SPV-1201 x Akms-14 B	0.26	0.00	0.13	3.00	1.84	2.42	1.63	0.92	1.28
13	SPV-1201 x SRT - 26B	0.00	0.00	0.00	0.66	0.16	0.41	0.33	0.08	0.21
14	SPV-1201 x GJ-35-15-15	0.00	0.00	0.00	1.00	0.26	0.63	0.50	0.13	0.32
15	SPV-1201 x SPV -946	0.00	0.00	0.00	1.90	0.50	1.20	0.95	0.25	0.60
16	SPV-1201 x SPV- 104	0.00	0.00	0.00	1.34	3.00	2.17	0.67	1.50	1.09
17	SPV-1201 x IS -2284	0.00	0.00	0.00	0.26	0.00	0.13	0.13	0.00	0.07
18	SPV-1201 x IS-6335	0.00	0.00	0.00	1.00	0.00	0.50	0.50	0.00	0.25
19	SPV-1201 x IS - 9471	0.00	0.00	0.00	2.50	1.00	1.75	1.25	0.50	0.88
20	ICSB - 101B x AKms 14 B	0.34	0.00	0.17	2.66	2.00	2.33	1.50	1.00	1.25
21	ICSB - 101B x SRT- 26 B	0.00	0.00	0.00	2.50	1.00	1.75	1.25	0.50	0.88
22	ICSB - 101B x GJ-35-15-15	0.00	0.40	0.20	0.26	0.00	0.13	0.13	0.20	0.17
23	ICSB - 101B x SPV - 946	0.20	0.00	0.10	2.00	0.00	1.00	1.10	0.00	0.55
24	ICSB - 101B x SPV - 104	0.40	0.20	0.30	9.50	3.50	6.50	4.95	1.85	3.40
25	ICSB - 101B x IS - 2284	0.00	0.00	0.00	0.60	0.00	0.30	0.30	0.00	0.15
26	ICSB - 101B x IS - 6335	0.00	0.00	0.00	0.26	0.00	0.13	0.13	0.00	0.07
27	ICSB -101B x IS - 9471	0.40	0.00	0.20	1.66	0.00	0.83	1.03	0.00	0.52
28	AKms - 14 B x SRT - 26B	0.20	0.00	0.10	5.00	4.00	4.50	2.60	2.00	2.30
29	AKms - 14 B x GJ-35-15-15	0.40	0.00	0.20	0.00	2.00	1.00	0.20	1.00	0.60
30	AKms -14 B x SPV - 946	0.40	0.00	0.20	1.00	2.50	1.75	0.70	1.25	0.98
31	AKms - 14 B x SPV - 104	0.80	0.80	0.80	3.00	4.50	3.75	1.90	2.65	2.28
32	AKms - 14 B x IS - 2284	0.00	0.20	0.10	1.50	0.50	1.00	0.75	0.35	0.55
33	AKms - 14 B x IS - 6335	0.00	0.34	0.17	1.50	1.00	1.25	0.75	0.67	0.71
34	AKms - 14 B x IS - 9471	0.00	0.00	0.00	0.00	2.00	1.00	0.00	1.00	0.50

Contd.......

Table 39. Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.00	0.00	1.00	1.00	1.00	0.50	0.50	050
36	SRT - 26B x SPV - 946	0.00	0.00	0.00	0.20	0.00	0.10	0.10	0.00	005
37	SRT - 26B x SPV -104	0.20	0.00	0.10	0.50	0.50	0.50	0.35	0.25	030
38	SRT - 26B x IS – 2284	0.00	0.00	0.00	1.50	0.00	0.75	0.75	0.00	038
39	SRT - 26B x IS – 6335	0.40	0.00	0.20	0.26	0.00	0.13	0.33	0.00	0.17
40	SRT - 26B x IS – 9471	0.40	0.00	0.20	0.84	0.00	0.42	0.62	0.00	031
41	GJ-35-15-15 x SPV - 946	0.28	0.42	0.35	0.66	0.50	0.58	0.47	0.46	047
42	GJ-35-15-15 x SPV- 104	0.00	0.00	0.00	4.00	2.00	3.00	2.00	1.00	150
43	GJ-35-15-15 x IS - 2284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	000
44	GJ-35-15-15 x IS - 6335	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	000
45	GJ-35-15-15 x IS - 9471	0.66	1.86	1.26	0.50	0.00	0.25	0.58	0.93	076
46	SPV - 946 x SPV- 104	0.00	0.00	0.00	1.50	0.50	1.00	0.75	0.25	050
47	SPV - 946 x IS - 2284	0.20	0.00	0.10	0.50	0.00	0.25	0.35	0.00	0.18
48	SPV - 946 x IS- 6335	0.00	0.00	0.00	0.34	0.00	0.17	0.17	0.00	009
49	SPV - 946 x IS 9471	0.00	0.00	0.00	0.80	0.00	0.40	0.40	0.00	020
50	SPV - 104 x IS 2284	0.26	0.00	0.13	2.50	0.00	1.25	1.38	0.00	069
51	SPV - 104 x IS 6335	1.26	0.50	0.88	3.00	1.50	2.25	2.13	1.00	157
52	SPV - 104 x IS 9471	1.32	1.34	1.33	3.00	0.00	1.50	2.16	0.67	142
53	IS 2284 x IS-6335	0.00	0.00	0.00	4.00	2.00	3.00	2.00	1.00	150
54	IS 2284 x IS -9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	000
55	IS 6335 x IS 9471	0.50	0.00	0.25	0.00	0.00	0.00	0.25	0.00	0.13
	Mean	0.16	0.30	0.23	2.48	2.032	2.26	1.32	1.67	150
	% increase (+)/decrease(-) over untreated			(+)87.50			(+)88.15			(+)2652
	% increase over location						882.60 (Akola)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.059	0.164	0.228	0.631	.100	0.291
B	0.311	0.861	1.193	3.308	0.526	1.535
A x B	0.439	1.218	1.688	4.678	0.742	2.156

Table 54. Effect of pre-treatment on *C. lunata* (%) (UGS) of parents and F_2 progenies Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	10.67	13.33	12.00	19.33	19.33	19.33	15.00	16.33	15.67
2	ICSB-101B	12.67	8.00	10.33	27.33	16.67	22.00	20.00	12.33	16.17
3	Akms-14B	19.33	12.67	16.00	54.00	32.00	43.00	36.67	22.33	29.50
4	SRT-26B	7.33	6.00	6.67	32.67	31.33	32.00	20.00	18.67	19.33
5	GJ-35-15-15	10.67	11.33	11.00	36.00	26.00	31.00	23.33	18.67	21.00
6	SPV-946	6.00	10.67	8.33	24.67	15.33	20.00	15.33	13.00	14.17
7	SPV-104	16.00	16.00	16.00	36.00	18.67	27.33	26.00	17.33	21.67
8	IS-2284	3.33	6.00	4.67	7.33	6.00	6.67	5.33	6.00	5.67
9	IS-6335	4.00	2.67	3.33	7.33	2.67	5.00	5.67	2.67	4.17
10	IS-9471	4.00	2.67	3.33	9.33	8.00	8.67	6.67	5.33	6.00
11	SPV-1201 x ICSB-101B	5.76	3.86	4.81	8.26	9.94	9.10	7.01	6.90	6.96
12	SPV-1201 x Akms-14 B	14.20	11.26	12.73	13.66	22.66	18.16	13.93	16.96	15.45
13	SPV-1201 x SRT - 26B	6.20	5.40	5.80	16.50	10.66	13.58	11.35	8.03	9.69
14	SPV-1201 x GJ-35-15-15	9.26	9.70	9.48	6.26	12.76	9.51	7.76	11.23	9.50
15	SPV-1201 x SPV -946	8.10	6.66	7.38	10.20	11.50	10.85	9.15	9.08	9.12
16	SPV-1201 x SPV- 104	11.00	9.50	10.25	11.66	7.00	9.33	11.33	8.25	9.79
17	SPV-1201 x IS -2284	6.76	3.40	5.08	7.26	6.26	6.76	7.01	4.83	5.92
18	SPV-1201 x IS-6335	4.40	3.36	3.88	8.00	6.76	7.38	6.20	5.06	5.63
19	SPV-1201 x IS - 9471	5.50	5.76	5.63	20.50	16.00	18.25	13.00	10.88	11.94
20	ICSB - 101B x AKms 14 B	18.10	13.50	15.80	13.66	14.00	13.83	15.88	13.75	14.82
21	ICSB - 101B x SRT- 26 B	10.80	14.80	12.80	10.84	8.66	9.75	10.82	11.73	11.28
22	ICSB - 101B x GJ-35-15-15	7.80	5.20	6.50	12.50	11.76	12.13	10.15	8.48	9.32
23	ICSB - 101B x SPV - 946	13.80	13.20	13.50	10.50	11.00	10.75	12.15	12.10	12.13
24	ICSB - 101B x SPV - 104	9.00	7.80	8.40	20.50	22.00	21.25	14.75	14.90	14.83
25	ICSB - 101B x IS - 2284	7.56	4.20	5.88	10.00	7.10	8.55	8.78	5.65	7.22
26	ICSB - 101B x IS - 6335	8.00	5.66	6.83	7.00	5.50	6.25	7.50	5.58	6.54
27	ICSB -101B x IS - 9471	5.36	2.66	4.01	9.16	8.34	8.75	7.26	5.50	6.38
28	AKms - 14 B x SRT - 26B	13.00	10.00	11.50	34.50	30.50	32.50	23.75	20.25	22.00
29	AKms - 14 B x GJ-35-15-15	16.40	11.80	14.10	15.50	13.16	14.33	15.35	12.48	14.22
30	AKms -14 B x SPV - 946	19.20	14.80	17.00	25.50	17.00	21.25	22.35	15.90	19.13
31	AKms - 14 B x SPV - 104	19.70	17.56	18.63	11.50	9.00	10.25	15.60	13.28	14.44
32	AKms - 14 B x IS - 2284	7.36	3.40	5.38	6.50	7.00	6.75	6.93	5.20	6.07
33	AKms - 14 B x IS - 6335	5.84	3.34	4.59	8.00	7.50	7.75	6.92	5.42	6.17
34	AKms - 14 B x IS - 9471	6.60	5.40	6.00	14.50	13.00	13.75	10.55	9.20	9.88

Contd.. .. .. ..

Table 54 . Contd.. ....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	8.80	6.60	7.70	13.00	11.40	12.20	10.90	9.00	9.95
36	SRT - 26B x SPV - 946	11.10	7.36	9.23	13.56	10.60	12.08	12.33	8.98	10.66
37	SRT - 26B x SPV -104	17.60	14.00	15.80	20.00	12.50	16.25	18.80	13.25	16.03
38	SRT - 26B x IS – 2284	7.90	4.66	6.28	11.00	7.00	9.00	9.45	5.83	7.64
39	SRT - 26B x IS – 6335	14.54	8.06	11.30	7.50	3.76	5.63	11.02	5.91	8.47
40	SRT - 26B x IS – 9471	7.20	4.20	5.70	10.16	8.66	9.41	8.68	6.43	7.56
41	GJ-35-15-15 x SPV - 946	13.20	13.14	13.17	12.16	13.92	13.04	12.68	13.53	13.11
42	GJ-35-15-15 x SPV- 104	15.20	16.06	15.63	15.50	13.00	14.25	15.35	14.53	14.94
43	GJ-35-15-15 x IS - 2284	8.72	2.40	5.66	2.00	4.00	3.00	5.36	3.20	4.28
44	GJ-35-15-15 x IS - 6335	5.20	4.86	5.03	8.50	10.10	9.30	6.85	7.48	7.17
45	GJ-35-15-15 x IS - 9471	8.50	8.14	8.32	11.50	11.50	11.50	10.00	9.82	9.91
46	SPV - 946 x SPV- 104	16.40	13.40	14.90	7.50	8.50	8.00	11.95	10.95	11.45
47	SPV - 946 x IS - 2284	7.00	5.80	6.40	11.82	11.60	11.71	9.41	8.70	9.06
48	SPV - 946 x IS- 6335	5.16	4.26	4.71	3.50	3.00	3.25	4.33	3.63	3.98
49	SPV - 946 x IS 9471	6.46	4.36	5.41	14.20	12.60	13.40	10.33	8.48	9.41
50	SPV - 104 x IS 2284	13.46	11.46	12.46	10.16	4.50	7.33	11.81	7.98	9.90
51	SPV - 104 x IS 6335	11.16	10.96	11.06	16.50	19.00	17.75	13.83	14.98	14.41
52	SPV - 104 x IS 9471	9.52	8.00	8.76	11.50	11.00	11.25	10.51	9.50	10.01
53	IS 2284 x IS-6335	2.60	1.26	1.93	6.00	6.00	6.00	4.30	3.63	3.97
54	IS 2284 x IS -9471	2.42	1.10	1.76	1.50	2.00	1.75	1.96	1.55	1.76
55	IS 6335 x IS 9471	2.26	1.10	1.68	7.66	5.66	6.66	4.96	3.38	4.17
	Mean	8.8	7.25	7.77	6.22	4.98	5.60	7.25	6.12	6.69
	% increase (+)/decrease(-) over untreated			(-)2.44			(-)19.93			(-)15.58
	% increase over location			27.92 Patancheru						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.534	1.480		0.989	2.740		0.330	0.960	
	B	2.799	7.79		5.184	14.370		1.731	5.051	
	A x B	3.958	10.972		7.331	20.323		2.449	7.126	

S.N.	Parents/Crosses	Akola			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	3.33	1.33	2.33	1.33	0.00	0.67	2.33	0.67	1.50
2	ICSB-101B	2.00	2.00	2.00	1.33	3.33	2.33	1.67	2.67	2.17
3	Akms-14B	4.67	2.00	3.33	4.67	0.67	2.67	4.67	1.33	3.00
4	SRT-26B	0.67	0.67	0.67	3.33	1.33	2.33	2.00	1.00	1.50
5	GJ-35-15-15	1.33	2.67	2.00	8.67	4.00	6.33	5.00	3.33	4.17
6	SPV-946	2.67	0.00	1.33	3.33	0.67	2.00	3.00	0.33	1.67
7	SPV-104	3.33	4.00	3.67	4.00	0.00	2.00	3.67	2.00	2.83
8	IS-2284	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
9	IS-6335	0.00	0.00	0.00	0.67	0.67	0.67	0.33	0.33	0.33
10	IS-9471	0.67	0.00	0.33	0.00	3.33	1.67	0.33	1.67	1.00
11	SPV-1201 x ICSB-101B	0.70	0.46	0.58	2.34	1.34	1.84	1.52	0.90	1.21
12	SPV-1201 x Akms-14 B	1.90	2.00	1.95	5.00	4.66	4.83	3.45	3.33	3.39
13	SPV-1201 x SRT - 26B	0.70	0.90	0.80	4.16	2.16	3.16	2.43	1.53	1.98
14	SPV-1201 x GJ-35-15-15	0.70	0.70	0.70	2.00	2.50	2.25	1.35	1.60	1.48
15	SPV-1201 x SPV -946	0.70	0.76	0.73	1.00	0.80	0.90	0.85	0.78	0.82
16	SPV-1201 x SPV- 104	1.46	4.00	2.73	3.66	2.00	2.83	2.56	3.00	2.78
17	SPV-1201 x IS -2284	0.90	0.20	0.55	2.76	1.76	2.26	1.83	0.98	1.41
18	SPV-1201 x IS-6335	0.66	0.46	0.56	1.26	1.00	1.13	0.96	0.73	0.85
19	SPV-1201 x IS - 9471	0.50	0.70	0.60	2.50	3.00	2.75	1.50	1.85	1.68
20	ICSB - 101B x AKms 14 B	0.34	0.50	0.42	3.84	1.16	2.50	2.09	0.83	1.46
21	ICSB - 101B x SRT- 26 B	0.40	0.00	0.20	2.16	1.34	1.75	1.28	0.67	0.98
22	ICSB - 101B x GJ-35-15-15	4.60	0.40	2.50	0.26	0.76	0.51	2.43	0.58	1.51
23	ICSB - 101B x SPV - 946	1.60	0.60	1.10	1.76	1.50	1.63	1.68	1.05	1.37
24	ICSB - 101B x SPV - 104	0.20	0.00	0.10	4.50	3.50	4.00	2.35	1.75	2.05
25	ICSB - 101B x IS - 2284	0.60	1.20	0.90	2.34	1.00	1.67	1.47	1.10	1.29
26	ICSB - 101B x IS - 6335	0.80	0.00	0.40	1.76	1.00	1.38	1.28	0.50	0.89
27	ICSB -101B x IS - 9471	0.00	0.00	0.00	2.66	0.34	1.50	1.33	0.17	0.75
28	AKms - 14 B x SRT - 26B	1.60	0.40	1.00	5.00	9.50	7.25	3.30	4.95	4.13
29	AKms - 14 B x GJ-35-15-15	2.20	0.20	1.20	3.00	0.66	1.83	2.60	0.43	1.52
30	AKms -14 B x SPV - 946	3.00	1.00	2.00	2.00	2.00	2.00	2.50	1.50	2.00
31	AKms - 14 B x SPV - 104	4.96	3.60	4.28	6.00	1.00	3.50	5.48	2.30	3.89
32	AKms - 14 B x IS - 2284	1.20	0.00	0.60	1.50	1.00	1.25	1.35	0.50	0.93
33	AKms - 14 B x IS - 6335	1.00	0.34	0.67	0.00	1.00	0.50	0.50	0.67	0.59
34	AKms - 14 B x IS - 9471	0.50	0.00	0.25	6.00	1.00	3.50	3.25	0.50	1.88

Contd.. .. .. ..

Table 55. Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	1.60	0.60	1.10	3.50	4.00	3.75	2.55	2.30	243
36	SRT - 26B x SPV - 946	2.60	0.00	1.30	2.56	1.76	2.16	2.58	0.88	173
37	SRT - 26B x SPV -104	3.20	2.40	2.80	3.00	4.00	3.50	3.10	3.20	315
38	SRT - 26B x IS – 2284	0.60	0.20	0.40	0.00	0.00	0.00	0.30	0.10	020
39	SRT - 26B x IS – 6335	0.20	0.34	0.27	1.50	0.00	0.75	0.85	0.17	051
40	SRT - 26B x IS – 9471	1.40	0.20	0.80	0.84	1.00	0.92	1.12	0.60	086
41	GJ-35-15-15 x SPV - 946	2.06	1.78	1.92	1.50	1.80	1.65	1.78	1.79	179
42	GJ-35-15-15 x SPV- 104	1.20	2.10	1.65	1.50	4.00	2.75	1.35	3.05	220
43	GJ-35-15-15 x IS - 2284	0.34	3.40	1.87	0.00	0.00	0.00	0.17	1.70	094
44	GJ-35-15-15 x IS - 6335	0.00	0.54	0.27	2.00	1.70	1.85	1.00	1.12	106
45	GJ-35-15-15 x IS - 9471	1.72	1.00	1.36	2.50	1.50	2.00	2.11	1.25	168
46	SPV - 946 x SPV- 104	2.40	1.20	1.80	2.00	5.50	3.75	2.20	3.35	278
47	SPV - 946 x IS - 2284	0.80	0.60	0.70	2.34	0.50	1.42	1.57	0.55	106
48	SPV - 946 x IS- 6335	0.26	0.00	0.13	0.34	0.00	0.17	0.30	0.00	015
49	SPV - 946 x IS 9471	1.16	0.50	0.83	1.80	1.20	1.50	1.48	0.85	117
50	SPV - 104 x IS 2284	0.86	0.76	0.81	2.34	1.00	1.67	1.60	0.88	124
51	SPV - 104 x IS 6335	2.30	1.00	1.65	2.50	1.00	1.75	2.40	1.00	170
52	SPV - 104 x IS 9471	1.06	1.86	1.46	1.00	2.50	1.75	1.03	2.18	151
53	IS 2284 x IS-6335	0.26	0.26	0.26	1.00	0.00	0.50	0.63	0.13	038
54	IS 2284 x IS -9471	0.60	0.00	0.30	0.00	0.00	0.00	0.30	0.00	015
55	IS 6335 x IS 9471	0.26	0.34	0.30	2.66	0.34	1.50	1.46	0.34	090
	Mean	6.22	4.98	5.60	7.43	6.26	7.10	7.08	5.62	635
	% increase (+)/decrease(-) over untreated			(-)9.93			(-)21.05			(-)2062
	% increase over location						26.78 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.776	2.150		0.962	2.667		0.119	0.331	
	B	4.068	11.276		5.046	13.988		0.626	1.827	
	A x B	5.753	15.947		7.136	19.782		0.883	2.447	

Table 56. Effect of pre-treatment on score (UGS) of parents and F_2 progenies at Akola and Patancheru, 1996

S.N.	Parents/Crosses	Akola-96			Patancheru			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	4.50	4.00	4.25	5.00	5.00	5.00	4.75	4.50	4.63
2	ICSB-101B	4.67	4.00	4.33	5.00	4.83	4.92	4.83	4.42	4.63
3	Akms-14B	5.00	4.50	4.75	5.00	5.00	5.00	5.00	4.75	4.88
4	SRT-26B	4.00	4.00	4.00	5.00	4.50	4.75	4.50	4.25	4.38
5	GJ-35-15-15	4.00	4.00	4.00	5.00	4.50	4.75	4.50	4.25	4.38
6	SPV-946	4.00	3.50	3.75	5.00	4.83	4.92	4.50	4.17	4.33
7	SPV-104	4.50	4.00	4.25	5.00	5.00	5.00	4.75	4.50	4.63
8	IS-2284	2.00	2.17	2.08	2.17	3.50	2.83	2.08	2.83	2.46
9	IS-6335	1.83	1.50	1.67	2.83	2.33	2.58	2.33	1.92	2.13
10	IS-9471	1.33	1.00	1.17	3.00	2.00	2.50	2.17	1.50	1.83
11	SPV-1201 x ICSB-101B	4.05	3.80	3.93	4.54	4.49	4.51	4.29	4.14	4.22
12	SPV-1201 x Akms-14 B	4.75	4.40	4.58	5.00	5.00	5.00	4.88	4.70	4.79
13	SPV-1201 x SRT - 26B	4.50	4.00	4.25	4.63	4.25	4.44	4.56	4.13	4.34
14	SPV-1201 x GJ-35-15-15	4.83	4.18	4.50	4.75	4.38	4.56	4.79	4.28	4.53
15	SPV-1201 x SPV -946	4.00	3.60	3.80	4.65	4.60	4.63	4.33	4.10	4.21
16	SPV-1201 x SPV- 104	4.70	4.25	4.48	5.00	4.34	4.67	4.85	4.29	4.57
17	SPV-1201 x IS -2284	3.98	3.08	3.53	3.75	4.13	3.94	3.86	3.60	3.73
18	SPV-1201 x IS-6335	4.00	3.68	3.84	4.00	3.44	3.72	4.00	3.56	3.78
19	SPV-1201 x IS - 9471	3.90	3.58	3.74	4.75	4.00	4.38	4.33	3.79	4.06
20	ICSB - 101B x AKms 14 B	4.75	3.84	4.29	5.00	4.34	4.67	4.88	4.09	4.48
21	ICSB - 101B x SRT- 26 B	4.65	3.90	4.28	5.00	4.25	4.63	4.83	4.08	4.45
22	ICSB - 101B x GJ-35-15-15	4.60	4.00	4.30	5.00	4.13	4.56	4.80	4.06	4.43
23	ICSB - 101B x SPV - 946	4.65	4.20	4.43	5.00	4.25	4.63	4.83	4.23	4.53
24	ICSB - 101B x SPV - 104	4.40	4.10	4.25	4.88	3.75	4.31	4.64	3.93	4.28
25	ICSB - 101B x IS - 2284	4.10	3.85	3.98	4.15	3.88	4.01	4.13	3.86	3.99
26	ICSB - 101B x IS - 6335	4.10	3.98	4.04	4.25	3.75	4.00	4.18	3.86	4.02
27	ICSB -101B x IS - 9471	3.95	2.99	3.47	4.25	4.34	4.29	4.10	3.66	3.88
28	AKms - 14 B x SRT - 26B	5.00	4.00	4.50	5.00	5.00	5.00	5.00	4.50	4.75
29	AKms - 14 B x GJ-35-15-15	4.70	4.00	4.35	4.84	4.50	4.67	4.77	4.25	4.51
30	AKms -14 B x SPV - 946	5.00	4.40	4.70	5.00	5.00	5.00	5.00	4.70	4.85
31	AKms - 14 B x SPV - 104	5.00	4.40	4.70	5.00	4.75	4.88	5.00	4.58	4.79
32	AKms - 14 B x IS - 2284	3.78	3.20	3.49	4.50	4.00	4.25	4.14	3.60	3.87
33	AKms - 14 B x IS - 6335	3.17	2.84	3.00	4.50	4.00	4.25	3.83	3.42	3.63
34	AKms - 14 B x IS - 9471	3.70	3.65	3.68	4.75	4.25	4.50	4.23	3.95	4.09

Table 56 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	4.30	3.80	4.05	4.50	4.60	4.55	4.40	4.20	4.30
36	SRT - 26B x SPV - 946	4.70	3.90	4.30	4.75	4.20	4.48	4.73	4.05	4.39
37	SRT - 26B x SPV -104	5.00	4.40	4.70	5.00	4.25	4.63	5.00	4.33	4.66
38	SRT - 26B x IS – 2284	4.23	3.58	3.90	4.25	3.75	4.00	4.24	3.66	3.95
39	SRT - 26B x IS – 6335	4.40	3.80	4.10	4.07	3.50	3.78	4.23	3.65	3.94
40	SRT - 26B x IS – 9471	4.05	3.60	3.83	4.34	4.59	4.46	4.19	4.09	4.14
41	GJ-35-15-15 x SPV - 946	4.60	3.80	4.20	5.00	4.53	4.76	4.80	4.16	4.48
42	GJ-35-15-15 x SPV- 104	4.70	3.90	4.30	5.00	4.50	4.75	4.85	4.20	4.53
43	GJ-35-15-15 x IS - 2284	4.23	3.39	3.81	4.50	3.50	4.00	4.37	3.44	3.90
44	GJ-35-15-15 x IS - 6335	3.12	3.10	3.11	4.46	4.50	4.48	3.79	3.80	3.79
45	GJ-35-15-15 x IS - 9471	4.18	3.39	3.78	4.07	4.25	4.16	4.12	3.82	3.97
46	SPV - 946 x SPV- 104	4.85	4.55	4.70	4.50	4.00	4.25	4.68	4.28	4.48
47	SPV - 946 x IS - 2284	4.50	3.55	4.03	4.58	4.80	4.69	4.54	4.18	4.36
48	SPV - 946 x IS- 6335	3.67	2.65	3.16	3.84	4.00	3.92	3.75	3.33	3.54
49	SPV - 946 x IS 9471	3.99	2.95	3.47	4.05	4.10	4.08	4.02	3.53	3.77
50	SPV - 104 x IS 2284	4.59	4.25	4.42	4.84	3.88	4.36	4.71	4.06	4.39
51	SPV - 104 x IS 6335	4.33	4.13	4.23	4.50	4.00	4.25	4.41	4.06	4.24
52	SPV - 104 x IS 9471	4.78	3.97	4.37	4.13	4.00	4.06	4.45	3.98	4.22
53	IS 2284 x IS-6335	3.50	2.88	3.19	4.25	4.50	4.38	3.88	3.69	3.78
54	IS 2284 x IS -9471	3.44	2.38	2.91	3.75	3.50	3.63	3.59	2.94	3.27
55	IS 6335 x IS 9471	3.69	2.57	3.13	3.17	2.67	2.92	3.43	2.62	3.02
	Mean	4.16	3.61	3.89	4.48	4.18	4.33	4.32	3.90	4.11
	% increase (+)/decrease(-) over untreated			(-)13.22			(-)6.96			(-)9.72
	% increase over location						11.31 (Akola)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.050	0.139		0.039	0.110		0.047	0.248	
	B	0.263	0.729		0.209	0.579		0.248	0.723	
	A x B	0.372	1.216		0.296	0.750		0.350	1.020	

Table 57. Effect of pre-treatment on germination (%) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	97.78	95.56	96.67	78.00	76.00	77.00	87.89	85.78	86.84
2	ICSB-101B	74.45	90.00	82.23	76.67	80.00	78.33	75.56	85.00	80.28
3	Akms-14B	51.11	55.56	53.34	54.00	68.67	61.33	52.56	62.11	57.33
4	SRT-26B	73.34	68.89	71.11	86.67	85.33	86.00	80.00	77.11	78.56
5	GJ-35-15-15	97.78	92.23	95.00	81.33	77.33	79.33	89.56	84.78	87.17
6	SPV-946	77.78	67.78	72.78	87.33	81.33	84.33	82.56	74.56	78.56
7	SPV-104	71.11	82.23	76.67	61.33	58.00	59.67	66.22	70.11	68.17
8	IS-2284	87.78	91.12	89.45	93.33	90.67	92.00	90.56	90.89	90.72
9	IS-6335	97.78	96.67	97.23	93.33	93.33	93.33	95.56	95.00	95.28
10	IS-9471	97.78	96.67	97.23	93.33	94.00	93.67	95.56	95.34	95.45
11	SPV-1201 x ICSB-101B	67.78	91.12	79.45	85.33	88.00	86.67	76.56	89.56	83.06
12	SPV-1201 x Akms-14 B	67.78	78.89	73.34	82.67	85.33	84.00	75.22	82.11	78.67
13	SPV-1201 x SRT - 26B	64.45	83.34	73.89	94.00	90.00	92.00	79.22	86.67	82.95
14	SPV-1201 x GJ-35-15-15	96.67	97.78	97.23	60.67	94.67	77.67	78.67	96.22	87.45
15	SPV-1201 x SPV -946	92.23	94.45	93.34	65.33	74.67	70.00	78.78	84.56	81.67
16	SPV-1201 x SPV- 104	67.78	75.56	71.67	84.67	87.33	86.00	76.22	81.45	78.84
17	SPV-1201 x IS -2284	95.56	96.67	96.12	91.33	96.00	93.67	93.45	96.34	94.89
18	SPV-1201 x IS-6335	82.23	92.23	87.23	96.00	93.33	94.67	89.11	92.78	90.95
19	SPV-1201 x IS - 9471	80.00	88.89	84.45	95.33	92.67	94.00	87.67	90.78	89.22
20	ICSB - 101B x AKms 14 B	65.56	78.89	72.23	78.67	76.00	77.33	72.11	77.45	74.78
21	ICSB - 101B x SRT- 26 B	35.56	62.23	48.89	88.00	91.33	89.67	61.78	76.78	69.28
22	ICSB - 101B x GJ-35-15-15	58.89	78.89	68.89	88.00	94.00	91.00	73.45	86.45	79.95
23	ICSB - 101B x SPV - 946	62.23	80.00	71.11	92.00	89.33	90.67	77.11	84.67	80.89
24	ICSB - 101B x SPV - 104	71.11	72.23	71.67	76.67	80.67	78.67	73.89	76.45	75.17
25	ICSB - 101B x IS - 2284	94.45	95.56	95.00	88.67	90.67	89.67	91.56	93.11	92.34
26	ICSB - 101B x IS - 6335	92.23	94.45	93.34	90.00	93.33	91.67	91.11	93.89	92.50
27	ICSB -101B x IS - 9471	92.23	94.45	93.34	92.00	94.00	93.00	92.11	94.22	93.17
28	AKms - 14 B x SRT - 26B	76.67	81.12	78.89	72.00	82.00	77.00	74.34	81.56	77.95
29	AKms - 14 B x GJ-35-15-15	61.11	74.45	67.78	82.00	81.33	81.67	71.56	77.89	74.72
30	AKms -14 B x SPV - 946	78.89	86.67	82.78	77.33	81.33	79.33	78.11	84.00	81.06
31	AKms - 14 B x SPV - 104	76.67	83.34	80.00	53.33	66.00	59.67	65.00	74.67	69.84
32	AKms - 14 B x IS - 2284	78.89	86.67	82.78	80.00	94.00	87.00	79.45	90.34	84.89
33	AKms - 14 B x IS - 6335	90.00	93.34	91.67	93.33	97.33	95.33	91.67	95.34	93.50
34	AKms - 14 B x IS - 9471	84.45	90.00	87.23	88.00	94.00	91.00	86.22	92.00	89.11

Contd.. .. ..

Table 57 . Contd.. ... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	93.34	95.56	94.45	92.67	90.00	91.33	93.00	92.78	92.89
36	SRT - 26B x SPV - 946	84.45	87.78	86.12	84.00	86.00	85.00	84.22	86.89	85.56
37	SRT - 26B x SPV -104	92.23	96.67	94.45	69.33	72.00	70.67	80.78	84.34	82.56
38	SRT - 26B x IS – 2284	84.45	82.23	83.34	88.00	78.67	83.33	86.22	80.45	83.34
39	SRT - 26B x IS – 6335	78.89	84.45	81.67	90.00	89.33	89.67	84.45	86.89	85.67
40	SRT - 26B x IS – 9471	82.23	84.45	83.34	90.00	95.33	92.67	86.11	89.89	88.00
41	GJ-35-15-15 x SPV - 946	86.67	94.45	90.56	85.33	88.00	86.67	86.00	91.22	88.61
42	GJ-35-15-15 x SPV- 104	45.56	54.45	50.00	83.33	86.00	84.67	64.45	70.22	67.33
43	GJ-35-15-15 x IS - 2284	85.56	85.56	85.56	90.67	88.00	89.33	88.11	86.78	87.45
44	GJ-35-15-15 x IS - 6335	96.67	98.89	97.78	92.00	90.00	91.00	94.34	94.45	94.39
45	GJ-35-15-15 x IS - 9471	78.89	82.23	80.56	92.67	92.00	92.33	85.78	87.11	86.45
46	SPV - 946 x SPV- 104	51.11	55.56	53.34	84.67	80.00	82.33	67.89	67.78	67.83
47	SPV - 946 x IS - 2284	96.67	98.89	97.78	86.67	92.67	89.67	91.67	95.78	93.72
48	SPV - 946 x IS- 6335	97.78	97.78	97.78	93.33	95.33	94.33	95.56	96.56	96.06
49	SPV - 946 x IS 9471	90.00	90.00	90.00	92.00	89.33	90.67	91.00	89.67	90.34
50	SPV - 104 x IS 2284	81.12	86.67	83.89	88.67	89.33	89.00	84.89	88.00	86.45
51	SPV - 104 x IS 6335	61.11	70.00	65.56	92.67	93.33	93.00	76.89	81.67	79.28
52	SPV - 104 x IS 9471	83.34	85.56	84.45	92.00	94.00	93.00	87.67	89.78	88.72
53	IS 2284 x IS-6335	90.00	98.89	94.45	91.33	92.67	92.00	90.67	95.78	93.22
54	IS 2284 x IS -9471	91.12	97.78	94.45	88.00	84.00	86.00	89.56	90.89	90.22
55	IS 6335 x IS 9471	93.34	97.78	95.56	96.00	94.67	95.33	94.67	96.22	95.45
	Mean	80.04	85 70	82.87	84.80	86.78	85.79	82.42	86.24	84.33
	% increase (+)/decrease(-) over untreated			(+)7.07			(+)2.33			(+)4.63
	% increase over location						3.52 (Akola 95)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.450	1.249		0.430	1.91		0.585	1.702	
	B	2.364	6.553		2.255	6.250		3.073	8.972	
	A x B	3.344	9 268		3 189	8.839		4.341	12.629	

Table 58. Effect of pre-treatment on *F. moniliforme* (%) (GS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	6.67	12.81	9.74	12.67	10.01	11.34	9.67	11.41	10.54
2	ICSB-101B	24.45	22.22	23.33	18.01	16.67	17.34	21.23	19.45	20.34
3	Akms-14B	4.44	4.44	4.44	24.67	17.99	21.33	14.56	11.22	12.89
4	SRT-26B	21.11	13.33	17.22	20.67	19.33	20.00	20.89	16.33	18.61
5	GJ-35-15-15	0.00	2.22	1.11	11.99	18.67	15.33	6.00	10.45	8.22
6	SPV-946	12.22	11.11	11.67	12.00	22.67	17.34	12.11	16.89	14.50
7	SPV-104	2.22	5.56	3.89	20.01	27.33	23.67	11.11	16.44	13.78
8	IS-2284	0.00	3.33	1.67	15.99	8.67	12.33	8.00	6.00	7.00
9	IS-6335	1.11	1.11	1.11	5.33	3.33	4.33	3.22	2.22	2.72
10	IS-9471	2.22	1.11	1.67	3.33	3.33	3.33	2.78	2.22	2.50
11	SPV-1201 x ICSB-101B	12.22	6.67	9.44	12.67	9.34	11.01	12.45	8.00	10.23
12	SPV-1201 x Akms-14 B	12.22	8.89	10.56	8.67	10.01	9.34	10.45	9.45	9.95
13	SPV-1201 x SRT - 26B	7.78	7.78	7.78	12.01	12.67	12.34	9.89	10.22	10.06
14	SPV-1201 x GJ-35-15-15	10.00	11.11	10.56	12.67	11.34	12.00	11.33	11.23	11.28
15	SPV-1201 x SPV -946	20.00	7.78	13.89	16.66	13.99	15.33	18.33	10.89	14.61
16	SPV-1201 x SPV- 104	12.22	10.00	11.11	10.00	9.99	10.00	11.11	10.00	10.55
17	SPV-1201 x IS -2284	3.33	4.44	3.89	5.34	3.33	4.34	4.34	3.89	4.11
18	SPV-1201 x IS-6335	4.44	4.44	4.44	5.34	3.99	4.67	4.89	4.22	4.56
19	SPV-1201 x IS - 9471	6.67	5.56	6.11	6.66	4.67	5.67	6.66	5.11	5.89
20	ICSB - 101B x AKms 14 B	10.00	7.78	8.89	13.33	9.99	11.66	11.67	8.89	10.28
21	ICSB - 101B x SRT- 26 B	6.67	8.89	7.78	7.99	5.34	6.67	7.33	7.11	7.22
22	ICSB - 101B x GJ-35-15-15	10.00	6.67	8.33	5.33	14.01	9.67	7.67	10.34	9.00
23	ICSB - 101B x SPV - 946	5.56	11.11	8.33	11.33	12.01	11.67	8.44	11.56	10.00
24	ICSB - 101B x SPV - 104	23.33	15.56	19.45	22.67	10.67	16.67	23.00	13.11	18.06
25	ICSB - 101B x IS - 2284	5.56	4.44	5.00	8.66	3.99	6.33	7.11	4.22	5.66
26	ICSB - 101B x IS - 6335	10.00	5.56	7.78	6.66	5.34	6.00	8.33	5.45	6.89
27	ICSB -101B x IS - 9471	3.33	0.00	1.67	6.67	3.33	5.00	5.00	1.67	3.34
28	AKms - 14 B x SRT - 26B	52.22	26.67	39.45	14.67	14.67	14.67	33.45	20.67	27.06
29	AKms - 14 B x GJ-35-15-15	15.56	8.89	12.22	15.99	11.33	13.66	15.77	10.11	12.94
30	AKms -14 B x SPV - 946	10.00	5.56	7.78	9.33	9.99	9.66	9.67	7.77	8.72
31	AKms - 14 B x SPV - 104	15.56	13.33	14.45	17.99	12.67	15.33	16.77	13.00	14.89
32	AKms - 14 B x IS - 2284	10.00	5.56	7.78	10.01	4.67	7.34	10.00	5.11	7.56
33	AKms - 14 B x IS - 6335	7.78	5.56	6.67	10.67	5.34	8.01	9.23	5.45	7.34
34	AKms - 14 B x IS - 9471	5.56	2.22	3.89	12.01	4.67	8.34	8.78	3.45	6.11

Contd.....

Table 58 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	35.56	23.33	29.45	10.01	11.34	10.67	22.78	17.34	20.06
36	SRT - 26B x SPV – 946	26.67	15.56	21.11	19.34	10.67	15.01	23.00	13.11	18.06
37	SRT - 26B x SPV –104	3.33	4.44	3.89	19.33	14.67	17.00	11.33	9.56	10.45
38	SRT - 26B x IS – 2284	1.11	3.33	2.22	5.99	6.67	6.33	3.55	5.00	4.28
39	SRT - 26B x IS – 6335	1.11	4.44	2.78	6.67	7.99	7.33	3.89	6.22	5.06
40	SRT - 26B x IS – 9471	2.22	2.22	2.22	5.34	5.33	5.33	3.78	3.77	3.78
41	GJ-35-15-15 x SPV - 946	10.00	5.56	7.78	10.67	11.33	11.00	10.33	8.44	9.39
42	GJ-35-15-15 x SPV- 104	11.11	12.22	11.67	17.33	10.66	14.00	14.22	11.44	12.83
43	GJ-35-15-15 x IS - 2284	3.33	1.11	2.22	6.67	6.67	6.67	5.00	3.89	4.45
44	GJ-35-15-15 x IS - 6335	1.11	1.11	1.11	9.99	5.33	7.66	5.55	3.22	4.39
45	GJ-35-15-15 x IS - 9471	2.22	3.33	2.78	3.99	8.00	6.00	3.11	5.67	4.39
46	SPV - 946 x SPV- 104	8.89	8.89	8.89	7.33	8.67	8.00	8.11	8.78	8.44
47	SPV - 946 x IS - 2284	4.44	1.11	2.78	8.67	4.67	6.67	6.56	2.89	4.72
48	SPV - 946 x IS- 6335	5.56	0.00	2.78	7.33	2.00	4.66	6.44	1.00	3.72
49	SPV - 946 x IS 9471	7.78	3.33	5.56	8.66	4.66	6.66	8.22	4.00	6.11
50	SPV - 104 x IS 2284	6.67	3.33	5.00	11.33	12.67	12.00	9.00	8.00	8.50
51	SPV - 104 x IS 6335	17.78	11.11	14.45	4.66	9.33	6.99	11.22	10.22	10.72
52	SPV - 104 x IS 9471	5.56	2.22	3.89	4.66	1.99	3.33	5.11	2.11	3.61
53	IS 2284 x IS-6335	4.44	6.67	5.56	4.67	4.00	4.34	4.56	5.33	4.95
54	IS 2284 x IS -9471	3.33	3.33	3.33	8.01	6.01	7.01	5.67	4.67	5.17
55	IS 6335 x IS 9471	2.22	4.44	3.33	4.67	3.34	4.01	3.45	3.89	3.67
	Mean	9.443	6.93	8.18	10.79	2.32	6.56	10.26	4.63	7.45
	% increase (+)/decrease(-) over untreated			(-)26.51			(-)78.49			(-)54.87
	% increase over location			19.80 (Akola 96)						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.492	1.363		0.344	0.954		0.377	1.097	
	B	2.577	7.145		1.806	5.006		1.979	5.777	
	A x B	3.645	10.105		2.554	7.080		2.799	8.145	

Table 59. Effect of pre-treatment on *F. pallidoroseum* (%) (GS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
2	ICSB-101B	0.00	0.00	0.00	0.00	4.67	2.33	0.00	2.33	1.17
3	Akms-14B	0.00	0.00	0.00	0.00	5.33	2.67	0.00	2.67	1.33
4	SRT-26B	0.00	0.00	0.00	2.00	4.00	3.00	1.00	2.00	1.50
5	GJ-35-15-15	0.00	0.00	0.00	0.00	6.67	3.33	0.00	3.33	1.67
6	SPV-946	0.00	0.00	0.00	0.67	6.00	3.33	0.33	3.00	1.67
7	SPV-104	0.00	0.00	0.00	0.00	6.67	3.33	0.00	3.33	1.67
8	IS-2284	0.00	0.00	0.00	1.33	2.67	2.00	0.67	1.33	1.00
9	IS-6335	0.00	0.00	0.00	2.67	2.67	2.67	1.33	1.33	1.33
10	IS-9471	0.00	0.00	0.00	0.67	0.67	0.67	0.33	0.33	0.33
11	SPV-1201 x ICSB-101B	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
12	SPV-1201 x Akms-14 B	0.00	0.00	0.00	0.00	2.67	1.33	0.00	1.33	0.67
13	SPV-1201 x SRT - 26B	0.00	0.00	0.00	0.00	2.00	1.00	0.00	1.00	0.50
14	SPV-1201 x GJ-35-15-15	0.00	0.00	0.00	0.00	2.67	1.33	0.00	1.33	0.67
15	SPV-1201 x SPV -946	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
16	SPV-1201 x SPV- 104	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
17	SPV-1201 x IS -2284	1.11	0.00	0.56	2.00	0.00	1.00	1.56	0.00	0.78
18	SPV-1201 x IS-6335	0.00	0.00	0.00	0.00	2.00	1.00	0.00	1.00	0.50
19	SPV-1201 x IS - 9471	0.00	0.00	0.00	2.00	0.67	1.33	1.00	0.33	0.67
20	ICSB - 101B x AKms 14 B	0.00	0.00	0.00	1.33	0.67	1.00	0.67	0.33	0.50
21	ICSB - 101B x SRT- 26 B	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
22	ICSB - 101B x GJ-35-15-15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	ICSB - 101B x SPV - 946	0.00	0.00	0.00	2.67	1.33	2.00	1.33	0.67	1.00
24	ICSB - 101B x SPV - 104	0.00	0.00	0.00	0.00	2.67	1.33	0.00	1.33	0.67
25	ICSB - 101B x IS - 2284	0.00	0.00	0.00	0.00	2.67	1.33	0.00	1.33	0.67
26	ICSB - 101B x IS - 6335	0.00	0.00	0.00	0.67	0.67	0.67	0.33	0.33	0.33
27	ICSB -101B x IS - 9471	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
28	AKms - 14 B x SRT - 26B	0.00	0.00	0.00	1.33	0.67	1.00	0.67	0.33	0.50
29	AKms - 14 B x GJ-35-15-15	0.00	0.00	0.00	3.33	1.33	2.33	1.67	0.67	1.17
30	AKms -14 B x SPV - 946	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
31	AKms - 14 B x SPV - 104	0.00	0.00	0.00	4.00	2.00	3.00	2.00	1.00	1.50
32	AKms - 14 B x IS - 2284	0.00	0.00	0.00	4.00	1.33	2.67	2.00	0.67	1.33
33	AKms - 14 B x IS - 6335	0.00	0.00	0.00	3.33	2.00	2.67	1.67	1.00	1.33
34	AKms - 14 B x IS - 9471	0.00	0.00	0.00	1.33	0.67	1.00	0.67	0.33	0.50

Contd.. .. .. ..

Table 59 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	SRT - 26B x SPV - 946	0.00	0.00	0.00	0.00	6.00	3.00	0.00	3.00	1.50
37	SRT - 26B x SPV -104	0.00	0.00	0.00	0.67	2.00	1.33	0.33	1.00	0.67
38	SRT - 26B x IS – 2284	0.00	0.00	0.00	1.33	1.33	1.33	0.67	0.67	0.67
39	SRT - 26B x IS – 6335	0.00	0.00	0.00	3.33	3.33	3.33	1.67	1.67	1.67
40	SRT - 26B x IS – 9471	0.00	0.00	0.00	1.33	2.00	1.67	0.67	1.00	0.83
41	GJ-35-15-15 x SPV - 946	0.00	0.00	0.00	0.67	0.00	0.33	0.33	0.00	0.17
42	GJ-35-15-15 x SPV- 104	0.00	0.00	0.00	1.33	1.33	1.33	0.67	0.67	0.67
43	GJ-35-15-15 x IS - 2284	0.00	0.00	0.00	3.33	2.00	2.67	1.67	1.00	1.33
44	GJ-35-15-15 x IS - 6335	0.00	0.00	0.00	3.33	2.00	2.67	1.67	1.00	1.33
45	GJ-35-15-15 x IS - 9471	0.00	0.00	0.00	1.33	2.00	1.67	0.67	1.00	0.83
46	SPV - 946 x SPV- 104	0.00	0.00	0.00	0.67	0.67	0.67	0.33	0.33	0.33
47	SPV - 946 x IS - 2284	0.00	0.00	0.00	2.67	2.67	2.67	1.33	1.33	1.33
48	SPV - 946 x IS- 6335	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
49	SPV - 946 x IS 9471	0.00	0.00	0.00	3.33	2.67	3.00	1.67	1.33	1.50
50	SPV - 104 x IS 2284	0.00	0.00	0.00	6.00	2.00	4.00	3.00	1.00	2.00
51	SPV - 104 x IS 6335	0.00	0.00	0.00	1.33	5.33	3.33	0.67	2.67	1.67
52	SPV - 104 x IS 9471	0.00	0.00	0.00	2.00	0.67	1.33	1.00	0.33	0.67
53	IS 2284 x IS-6335	0.00	0.00	0.00	1.33	4.67	3.00	0.67	2.33	1.50
54	IS 2284 x IS -9471	0.00	0.00	0.00	4.67	6.00	5.33	2.33	3.00	2.67
55	IS 6335 x IS 9471	0.00	0.00	0.00	2.00	0.67	1.33	1.00	0.33	0.67
	Mean	0.02	0.00	0.01	1.42	2.12	1.77	0.72	1.06	0.89
	% increase (+)/decrease(-) over untreated			(-)100.00			(+)49.29			(+)47.00
	% increase over location						176.00 (Akola 95)			

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.014	0.039	0.169	0.168	0.118	0.343
B	0.075	0.208	0.885	2.454	0.623	1.818
A x B	0.106	0.294	1.252	3.471	0.881	2.564

Table 60. Effect of pre-treatment on *C. lunata* (%) (GS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	1.11	7.78	4.44	45.33	45.36	45.35	23.22	26.57	24.90
2	ICSB-101B	28.89	27.78	28.33	45.33	39.32	42.33	37.11	33.55	35.33
3	Akms-14B	6.67	20.00	13.33	24.67	37.36	31.01	15.67	28.68	22.17
4	SRT-26B	20.00	16.67	18.33	48.67	34.00	41.33	34.33	25.33	29.83
5	GJ-35-15-15	6.67	17.78	12.22	49.33	30.68	40.01	28.00	24.23	26.11
6	SPV-946	23.33	15.56	19.45	51.33	28.68	40.01	37.33	22.12	29.73
7	SPV-104	35.56	33.34	34.45	28.67	16.68	22.67	32.11	25.01	28.56
8	IS-2284	12.22	22.22	17.22	43.33	30.68	37.01	27.78	26.45	27.11
9	IS-6335	5.56	17.78	11.67	22.00	14.00	18.00	13.78	15.89	14.83
10	IS-9471	7.78	14.45	11.11	20.00	16.68	18.34	13.89	15.56	14.73
11	SPV-1201 x ICSB-101B	17.78	21.11	19.45	48.67	46.68	47.67	33.22	33.90	33.56
12	SPV-1201 x Akms-14 B	32.22	13.33	22.78	50.67	40.00	45.33	41.45	26.67	34.06
13	SPV-1201 x SRT - 26B	36.67	21.11	28.89	48.00	44.68	46.34	42.33	32.90	37.62
14	SPV-1201 x GJ-35-15-15	48.89	26.67	37.78	34.00	45.36	39.68	41.45	36.01	38.73
15	SPV-1201 x SPV -946	37.78	26.67	32.22	37.33	39.36	38.35	37.56	33.01	35.29
16	SPV-1201 x SPV- 104	34.45	21.11	27.78	48.00	44.00	46.00	41.22	32.56	36.89
17	SPV-1201 x IS -2284	13.33	8.89	11.11	24.67	9.36	17.01	19.00	9.12	14.06
18	SPV-1201 x IS-6335	17.78	12.22	15.00	16.67	8.68	12.67	17.22	10.45	13.84
19	SPV-1201 x IS - 9471	15.56	11.11	13.33	16.00	9.36	12.68	15.78	10.24	13.01
20	ICSB - 101B x AKms 14 B	33.34	40.00	36.67	47.33	32.68	40.01	40.33	36.34	38.34
21	ICSB - 101B x SRT- 26 B	20.00	32.22	26.11	62.00	28.68	45.34	41.00	30.45	35.73
22	ICSB - 101B x GJ-35-15-15	31.11	45.56	38.34	60.67	46.00	53.33	45.89	45.78	45.83
23	ICSB - 101B x SPV - 946	38.89	32.22	35.56	45.33	26.68	36.01	42.11	29.45	35.78
24	ICSB - 101B x SPV - 104	27.78	25.56	26.67	38.67	39.32	38.99	33.22	32.44	32.83
25	ICSB - 101B x IS - 2284	37.78	18.89	28.33	34.00	19.36	26.68	35.89	19.12	27.51
26	ICSB - 101B x IS - 6335	30.00	18.89	24.45	23.33	16.00	19.67	26.67	17.44	22.06
27	ICSB - 101B x IS - 9471	17.78	10.00	13.89	24.00	16.00	20.00	20.89	13.00	16.94
28	AKms - 14 B x SRT - 26B	15.56	14.45	15.00	41.33	48.68	45.01	28.44	31.56	30.00
29	AKms - 14 B x GJ-35-15-15	34.45	31.11	32.78	44.67	50.00	47.33	39.56	40.56	40.06
30	AKms -14 B x SPV - 946	41.11	33.34	37.22	47.33	52.00	49.67	44.22	42.67	43.45
31	AKms - 14 B x SPV - 104	43.34	32.22	37.78	24.00	39.36	31.68	33.67	35.79	34.73
32	AKms - 14 B x IS - 2284	33.34	24.45	28.89	38.00	22.00	30.00	35.67	23.22	29.45
33	AKms - 14 B x IS - 6335	17.78	32.22	25.00	27.33	16.00	21.67	22.56	24.11	23.33
34	AKms - 14 B x IS - 9471	27.78	31.11	29.45	34.00	22.68	28.34	30.89	26.90	28.89

Contd.......

Table 60 . Contd.. ....

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	45.56	24.45	35.00	50.67	42.00	46.33	48.11	33.22	40.67
36	SRT - 26B x SPV - 946	42.22	21.11	31.67	44.67	48.00	46.33	43.45	34.56	39.00
37	SRT - 26B x SPV -104	14.45	13.33	13.89	36.67	36.68	36.67	25.56	25.01	25.28
38	SRT - 26B x IS – 2284	12.22	16.67	14.45	38.00	17.36	27.68	25.11	17.01	21.06
39	SRT - 26B x IS – 6335	14.45	24.45	19.45	31.33	16.68	24.01	22.89	20.56	21.73
40	SRT - 26B x IS – 9471	23.33	12.22	17.78	27.33	20.00	23.67	25.33	16.11	20.72
41	GJ-35-15-15 x SPV - 946	23.33	23.33	23.33	51.33	36.68	44.01	37.33	30.01	33.67
42	GJ-35-15-15 x SPV- 104	21.11	20.00	20.56	41.33	48.00	44.67	31.22	34.00	32.61
43	GJ-35-15-15 x IS - 2284	22.22	13.33	17.78	34.67	21.36	28.01	28.45	17.35	22.90
44	GJ-35-15-15 x IS - 6335	15.56	14.45	15.00	29.33	22.00	25.67	22.44	18.22	20.33
45	GJ-35-15-15 x IS - 9471	20.00	16.67	18.33	28.67	34.00	31.33	24.33	25.33	24.83
46	SPV - 946 x SPV- 104	28.89	18.89	23.89	47.33	36.68	42.01	38.11	27.78	32.95
47	SPV - 946 x IS - 2284	23.33	12.22	17.78	26.00	14.00	20.00	24.67	13.11	18.89
48	SPV - 946 x IS- 6335	14.45	5.56	10.00	28.00	14.00	21.00	21.22	9.78	15.50
49	SPV - 946 x IS 9471	10.00	12.22	11.11	26.00	20.00	23.00	18.00	16.11	17.06
50	SPV - 104 x IS 2284	28.89	22.22	25.56	31.33	18.00	24.67	30.11	20.11	25.11
51	SPV - 104 x IS 6335	22.22	21.11	21.67	30.00	20.68	25.34	26.11	20.90	23.50
52	SPV - 104 x IS 9471	8.89	11.11	10.00	34.00	20.00	27.00	21.44	15.56	18.50
53	IS 2284 x IS-6335	20.00	18.89	19.45	25.33	16.68	21.01	22.67	17.78	20.23
54	IS 2284 x IS -9471	22.22	17.78	20.00	26.00	17.36	21.68	24.11	17.57	20.84
55	IS 6335 x IS 9471	25.56	17.78	21.67	21.33	13.36	17.35	23.45	15.57	19.51
	Mean	23.83	20.65	22.24	36.44	28.89	32.66	30.14	24.77	27.46
	% increase (+)/decrease(-) over untreated			(-)13.34			(-)22.36			(-)17.82
	% increase over location						46.85 (Akola 95)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	1.313	3.642		0.796	2.206		0.754	2.194	
	B	6.890	19.099		4.173	11.568		3.960	11.561	
	A x B	9.744	27.150		5.902	16.360		5.601	16.299	

Table 61. Effect of pre-treatment on other fungi (%) (GS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	16.67	13.33	15.00	20.00	18.67	19.33	18.33	16.00	17.17
2	ICSB-101B	21.11	33.34	27.22	13.33	12.67	13.00	17.22	23.00	20.11
3	Akms-14B	25.56	25.56	25.56	4.67	8.00	6.33	15.11	16.78	15.95
4	SRT-26B	20.00	26.67	23.33	15.33	16.67	16.00	17.67	21.67	19.67
5	GJ-35-15-15	86.67	42.22	64.45	20.00	14.67	17.33	53.34	28.45	40.89
6	SPV-946	24.45	25.56	25.00	23.33	14.00	18.67	23.89	19.78	21.83
7	SPV-104	30.00	23.33	26.67	12.67	7.33	10.00	21.33	15.33	18.33
8	IS-2284	44.45	26.67	35.56	24.67	10.00	17.33	34.56	18.33	26.45
9	IS-6335	40.00	22.22	31.11	20.00	6.67	13.33	30.00	14.45	22.22
10	IS-9471	62.23	33.34	47.78	19.33	6.00	12.67	40.78	19.67	30.22
11	SPV-1201 x ICSB-101B	35.56	14.45	25.00	22.67	18.67	20.67	29.11	16.56	22.83
12	SPV-1201 x Akms-14 B	23.33	18.89	21.11	23.33	18.00	20.67	23.33	18.44	20.89
13	SPV-1201 x SRT - 26B	17.78	12.22	15.00	34.00	20.67	27.33	25.89	16.44	21.17
14	SPV-1201 x GJ-35-15-15	37.78	16.67	27.22	14.00	17.33	15.67	25.89	17.00	21.45
15	SPV-1201 x SPV -946	31.11	14.45	22.78	11.33	18.00	14.67	21.22	16.22	18.72
16	SPV-1201 x SPV- 104	22.22	22.22	22.22	26.67	27.33	27.00	24.45	24.78	24.61
17	SPV-1201 x IS -2284	34.45	15.56	25.00	18.67	9.33	14.00	26.56	12.44	19.50
18	SPV-1201 x IS-6335	31.11	15.56	23.33	18.00	5.33	11.67	24.56	10.44	17.50
19	SPV-1201 x IS - 9471	35.56	15.56	25.56	16.67	5.33	11.00	26.11	10.44	18.28
20	ICSB - 101B x AKms 14 B	21.11	20.00	20.56	16.67	10.67	13.67	18.89	15.33	17.11
21	ICSB - 101B x SRT- 26 B	10.00	11.11	10.56	18.00	10.00	14.00	14.00	10.56	12.28
22	ICSB - 101B x GJ-35-15-15	17.78	18.89	18.33	22.00	8.67	15.33	19.89	13.78	16.83
23	ICSB - 101B x SPV - 946	17.78	24.45	21.11	33.33	10.67	22.00	25.56	17.56	21.56
24	ICSB - 101B x SPV - 104	20.00	24.45	22.22	16.00	11.33	13.67	18.00	17.89	17.95
25	ICSB - 101B x IS - 2284	40.00	7.78	23.89	32.00	10.00	21.00	36.00	8.89	22.45
26	ICSB - 101B x IS - 6335	30.00	15.56	22.78	31.33	8.00	19.67	30.67	11.78	21.22
27	ICSB -101B x IS - 9471	33.34	15.56	24.45	26.00	9.33	17.67	29.67	12.44	21.06
28	AKms - 14 B x SRT - 26B	8.89	11.11	10.00	14.67	18.00	16.33	11.78	14.56	13.17
29	AKms - 14 B x GJ-35-15-15	11.11	14.45	12.78	18.00	18.67	18.33	14.56	16.56	15.56
30	AKms -14 B x SPV - 946	28.89	16.67	22.78	20.67	18.67	19.67	24.78	17.67	21.22
31	AKms - 14 B x SPV - 104	17.78	22.22	20.00	8.00	12.67	10.33	12.89	17.45	15.17
32	AKms - 14 B x IS - 2284	22.22	14.45	18.33	24.00	6.00	15.00	23.11	10.22	16.67
33	AKms - 14 B x IS - 6335	17.78	14.45	16.11	37.33	7.33	22.33	27.56	10.89	19.22
34	AKms - 14 B x IS - 9471	30.00	12.22	21.11	20.67	10.67	15.67	25.33	11.44	18.39

Contd.. .. .. ..

Table 61 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	12.22	10.00	11.11	34.00	19.33	26.67	23.11	14.67	18.89
36	SRT - 26B x SPV - 946	14.45	11.11	12.78	20.00	21.33	20.67	17.22	16.22	16.72
37	SRT - 26B x SPV -104	45.56	12.22	28.89	13.33	18.67	16.00	29.45	15.44	22.45
38	SRT - 26B x IS – 2284	26.67	11.11	18.89	32.00	11.33	21.67	29.33	11.22	20.28
39	SRT - 26B x IS – 6335	16.67	11.11	13.89	24.00	13.33	18.67	20.33	12.22	16.28
40	SRT - 26B x IS – 9471	24.45	7.78	16.11	16.67	14.00	15.33	20.56	10.89	15.72
41	GJ-35-15-15 x SPV - 946	44.45	12.22	28.33	24.00	16.00	20.00	34.22	14.11	24.17
42	GJ-35-15-15 x SPV- 104	13.33	16.67	15.00	17.33	24.00	20.67	15.33	20.33	17.83
43	GJ-35-15-15 x IS - 2284	37.78	15.56	26.67	17.33	14.00	15.67	27.56	14.78	21.17
44	GJ-35-15-15 x IS - 6335	23.33	11.11	17.22	22.00	13.33	17.67	22.67	12.22	17.44
45	GJ-35-15-15 x IS - 9471	25.56	13.33	19.45	22.67	15.33	19.00	24.11	14.33	19.22
46	SPV - 946 x SPV- 104	13.33	11.11	12.22	30.67	22.67	26.67	22.00	16.89	19.44
47	SPV - 946 x IS - 2284	28.89	11.11	20.00	23.33	7.33	15.33	26.11	9.22	17.67
48	SPV - 946 x IS- 6335	34.45	7.78	21.11	26.00	12.00	19.00	30.22	9.89	20.06
49	SPV - 946 x IS 9471	31.11	12.22	21.67	23.33	12.67	18.00	27.22	12.44	19.83
50	SPV - 104 x IS 2284	38.89	26.67	32.78	25.33	12.67	19.00	32.11	19.67	25.89
51	SPV - 104 x IS 6335	20.00	8.89	14.45	29.33	10.67	20.00	24.67	9.78	17.22
52	SPV - 104 x IS 9471	34.45	18.89	26.67	22.67	10.00	16.33	28.56	14.44	21.60
53	IS 2284 x IS-6335	16.67	16.67	16.67	24.67	10.67	17.67	20.67	13.67	17.17
54	IS 2284 x IS -9471	25.56	14.45	20.00	25.33	11.33	18.33	25.45	12.89	19.17
55	IS 6335 x IS 9471	28.89	18.89	23.89	16.67	6.67	11.67	22.78	12.78	17.78
	Mean	27.70	17.09	22.40	21.60	13.14	17.37	24.65	15.12	19.89
	% increase (+)/decrease(-) over untreated			(-)30.30			(-)39.16			(-)38.66
	% increase over location			12.45 (Akola 96)						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.898	2.489		0.675	1.871		1.171	3.407	
	B	4.709	13.052		3.539	9.810		6.147	17.993	
	A x B	6.659	18.459		5.005	13.873		8.694	25.300	

Table 62. Effect of pre-treatment on score (GS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	1.50	1.50	1.50	4.00	3.00	3.50	2.75	2.25	2.50
2	ICSB-101B	4.17	3.50	3.83	4.00	3.00	3.50	4.08	3.25	3.67
3	Akms-14B	2.83	3.50	3.17	5.00	3.50	4.25	3.92	3.50	3.71
4	SRT-26B	3.50	2.83	3.17	3.83	3.00	3.42	3.67	2.92	3.29
5	GJ-35-15-15	2.50	2.67	2.58	3.50	3.00	3.25	3.00	2.83	2.92
6	SPV-946	3.67	3.33	3.50	3.83	2.50	3.17	3.75	2.92	3.33
7	SPV-104	3.50	2.50	3.00	4.50	3.50	4.00	4.00	3.00	3.50
8	IS-2284	2.00	2.00	2.00	2.00	1.00	1.50	2.00	1.50	1.75
9	IS-6335	2.00	2.00	2.00	1.00	1.00	1.00	1.50	1.50	1.50
10	IS-9471	2.00	2.00	2.00	1.00	1.00	1.00	1.50	1.50	1.50
11	SPV-1201 x ICSB-101B	2.83	1.83	2.33	3.00	2.50	2.75	2.92	2.17	2.54
12	SPV-1201 x Akms-14 B	2.83	2.00	2.42	3.00	2.50	2.75	2.92	2.25	2.58
13	SPV-1201 x SRT - 26B	2.67	2.33	2.50	2.83	3.00	2.92	2.75	2.67	2.71
14	SPV-1201 x GJ-35-15-15	3.00	2.50	2.75	2.50	3.00	2.75	2.75	2.75	2.75
15	SPV-1201 x SPV -946	2.83	2.17	2.50	2.83	3.00	2.92	2.83	2.58	2.71
16	SPV-1201 x SPV- 104	3.33	3.00	3.17	3.17	2.83	3.00	3.25	2.92	3.08
17	SPV-1201 x IS -2284	2.00	1.50	1.75	1.00	1.00	1.00	1.50	1.25	1.38
18	SPV-1201 x IS-6335	2.00	1.50	1.75	1.00	1.00	1.00	1.50	1.25	1.38
19	SPV-1201 x IS - 9471	2.00	2.00	2.00	1.00	1.00	1.00	1.50	1.50	1.50
20	ICSB - 101B x AKms 14 B	4.00	2.50	3.25	3.00	3.00	3.00	3.50	2.75	3.13
21	ICSB - 101B x SRT- 26 B	4.17	2.67	3.42	3.00	2.00	2.50	3.58	2.33	2.96
22	ICSB - 101B x GJ-35-15-15	4.17	2.67	3.42	2.67	2.00	2.33	3.42	2.33	2.88
23	ICSB - 101B x SPV - 946	4.33	3.50	3.92	2.67	3.00	2.83	3.50	3.25	3.38
24	ICSB - 101B x SPV - 104	4.83	3.67	4.25	3.33	2.00	2.67	4.08	2.83	3.46
25	ICSB - 101B x IS - 2284	2.00	1.50	1.75	1.33	1.00	1.17	1.67	1.25	1.46
26	ICSB - 101B x IS - 6335	2.00	1.50	1.75	1.00	1.00	1.00	1.50	1.25	1.38
27	ICSB -101B x IS - 9471	2.00	2.00	2.00	1.50	1.00	1.25	1.75	1.50	1.63
28	AKms - 14 B x SRT - 26B	4.00	3.67	3.83	3.00	2.83	2.92	3.50	3.25	3.38
29	AKms - 14 B x GJ-35-15-15	4.00	3.50	3.75	3.00	3.00	3.00	3.50	3.25	3.38
30	AKms -14 B x SPV - 946	3.33	2.83	3.08	3.00	3.00	3.00	3.17	2.92	3.04
31	AKms - 14 B x SPV - 104	4.00	3.00	3.50	3.50	4.00	3.75	3.75	3.50	3.63
32	AKms - 14 B x IS - 2284	2.00	1.83	1.92	2.00	1.00	1.50	2.00	1.42	1.71
33	AKms - 14 B x IS - 6335	2.00	1.50	1.75	1.50	1.00	1.25	1.75	1.25	1.50
34	AKms - 14 B x IS - 9471	1.50	2.00	1.75	2.17	1.00	1.58	1.83	1.50	1.67

Contd.. .. .. ..

Table 62 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	3.00	2.33	2.67	2.83	2.50	2.67	2.92	2.42	2.67
36	SRT-26B x SPV – 946	2.83	2.00	2.42	3.00	2.50	2.75	2.92	2.25	2.58
37	SRT - 26B x SPV –104	1.50	1.50	1.50	3.00	3.00	3.00	2.25	2.25	2.25
38	SRT - 26B x IS – 2284	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
39	SRT - 26B x IS – 6335	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
40	SRT - 26B x IS – 9471	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
41	GJ-35-15-15 x SPV – 946	2.17	1.83	2.00	3.00	2.33	2.67	2.58	2.08	2.33
42	GJ-35-15-15 x SPV- 104	2.83	2.50	2.67	2.33	2.50	2.42	2.58	2.50	2.54
43	GJ-35-15-15 x IS - 2284	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
44	GJ-35-15-15 x IS - 6335	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
45	GJ-35-15-15 x IS - 9471	1.50	1.50	1.50	1.00	2.00	1.50	1.25	1.75	1.50
46	SPV - 946 x SPV- 104	4.00	3.00	3.50	3.33	3.00	3.17	3.67	3.00	3.33
47	SPV - 946 x IS - 2284	1.50	1.50	1.50	1.17	1.00	1.08	1.33	1.25	1.29
48	SPV - 946 x IS- 6335	1.50	1.00	1.25	1.00	1.00	1.00	1.25	1.00	1.13
49	SPV - 946 x IS 9471	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
50	SPV - 104 x IS 2284	2.00	1.50	1.75	1.50	1.00	1.25	1.75	1.25	1.50
51	SPV - 104 x IS 6335	2.50	2.33	2.42	1.50	1.00	1.25	2.00	1.67	1.83
52	SPV - 104 x IS 9471	1.50	2.00	1.75	1.50	2.00	1.75	1.50	2.00	1.75
53	IS 2284 x IS-6335	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
54	IS 2284 x IS -9471	1.50	1.50	1.50	1.50	1.00	1.25	1.50	1.25	1.38
55	IS 6335 x IS 9471	1.50	1.50	1.50	1.00	1.00	1.00	1.25	1.25	1.25
	Mean	2.54	2.17	2.36	2.26	1.96	2.11	2.40	2.07	2.24
	% increase (+)/decrease(-) over untreated			(-)14.56			(-)13.27			(-)13.75
	% increase over location			11.84 (Akola 96)						

	SE (m)	CD 5%	SE (m)	CD 5%	SE (m)	CD 5%
A	0.060	0.166	0.039	0.111	0.047	0.136
B	0.315	0.872	0.210	0.581	0.248	0.736
A x B	0.445	1.223	0.296	0.822	0.350	1.020

Table 63. Effect of pre-treatment on ungerminated (%) seed of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	2.20	4.44	3.32	22.00	24.00	23.00	12.10	14.22	13.16
2	ICSB-101B	25.56	10.00	17.78	23.33	20.00	21.67	24.45	15.00	1972
3	Akms-14B	48.89	41.11	45.00	46.00	31.33	38.67	47.45	36.22	4183
4	SRT-26B	26.67	31.11	28.89	13.33	14.67	14.00	20.00	22.89	2145
5	GJ-35-15-15	2.22	7.78	5.00	18.67	22.67	20.67	10.44	15.22	1283
6	SPV-946	22.22	32.22	27.22	12.67	18.67	15.67	17.45	25.45	2145
7	SPV-104	28.89	17.78	23.33	38.67	42.00	40.33	33.78	29.89	3183
8	IS-2284	12.22	8.89	10.56	6.67	9.33	8.00	9.44	9.11	928
9	IS-6335	2.22	3.33	2.78	6.67	6.67	6.67	4.44	5.00	472
10	IS-9471	1.11	3.33	2.22	6.67	6.00	6.33	3.89	4.67	428
11	SPV-1201 x ICSB-101B	32.22	8.89	20.56	14.67	12.00	13.33	23.45	10.44	1694
12	SPV-1201 x Akms-14 B	32.22	21.11	26.67	17.33	14.67	16.00	24.78	17.89	2133
13	SPV-1201 x SRT - 26B	35.56	16.67	26.11	6.00	10.00	8.00	20.78	13.33	1706
14	SPV-1201 x GJ-35-15-15	3.33	2.22	2.78	39.33	5.33	22.33	21.33	3.78	1256
15	SPV-1201 x SPV -946	7.78	5.56	6.67	34.67	25.33	30.00	21.22	15.44	1833
16	SPV-1201 x SPV- 104	32.22	24.45	28.33	15.33	12.67	14.00	23.78	18.56	21.17
17	SPV-1201 x IS -2284	4.44	3.33	3.89	8.67	4.00	6.33	6.56	3.67	5.11
18	SPV-1201 x IS-6335	17.78	7.78	12.78	4.00	6.67	5.33	10.89	7.22	906
19	SPV-1201 x IS - 9471	20.00	11.11	15.56	4.67	7.33	6.00	12.33	9.22	1078
20	ICSB - 101B x AKms 14 B	34.45	21.11	27.78	21.33	24.00	22.67	27.89	22.56	2522
21	ICSB - 101B x SRT- 26 B	64.45	37.78	51.11	12.00	8.67	10.33	38.22	23.22	3072
22	ICSB - 101B x GJ-35-15-15	41.11	21.11	31.11	12.00	6.00	9.00	26.56	13.56	2006
23	ICSB - 101B x SPV - 946	37.78	20.00	28.89	8.00	10.67	9.33	22.89	15.33	19.11
24	ICSB - 101B x SPV - 104	28.89	27.78	28.33	23.33	19.33	21.33	26.11	23.56	2483
25	ICSB - 101B x IS - 2284	5.56	4.44	5.00	11.33	9.33	10.33	8.44	6.89	767
26	ICSB - 101B x IS - 6335	7.78	5.56	6.67	10.00	6.67	8.33	8.89	6.11	750
27	ICSB -101B x IS - 9471	7.78	5.56	6.67	8.00	6.00	7.00	7.89	5.78	683
28	AKms - 14 B x SRT - 26B	23.33	18.89	21.11	28.00	18.00	23.00	25.67	18.44	2206
29	AKms - 14 B x GJ-35-15-15	38.89	25.56	32.22	18.00	18.67	18.33	28.45	22.11	2528
30	AKms -14 B x SPV - 946	21.11	13.33	17.22	22.67	19.33	21.00	21.89	16.33	19.11
31	AKms - 14 B x SPV - 104	23.33	16.67	20.00	46.00	34.00	40.00	34.67	25.33	3000
32	AKms - 14 B x IS - 2284	21.11	13.33	17.22	20.00	6.00	13.00	20.56	9.67	15.11
33	AKms - 14 B x IS - 6335	10.00	6.67	8.33	6.67	2.67	4.67	8.33	4.67	650
34	AKms - 14 B x IS - 9471	15.56	10.00	12.78	12.00	6.00	9.00	13.78	8.00	1089

Contd.. .. .. ..

Table 63 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	6.67	4.44	5.56	7.33	10.00	8.67	7.00	7.22	7.11
36	SRT-26B x SPV - 946	15.56	12.22	13.89	16.00	14.00	15.00	15.78	13.11	14.44
37	SRT - 26B x SPV -104	7.78	3.33	5.56	30.67	28.00	29.33	19.22	15.67	17.44
38	SRT - 26B x IS – 2284	15.56	17.78	16.67	12.00	21.33	16.67	13.78	19.56	16.67
39	SRT - 26B x IS – 6335	21.11	15.56	18.33	10.00	10.67	10.33	15.56	13.11	14.33
40	SRT - 26B x IS – 9471	17.78	15.56	16.67	10.00	4.67	7.33	13.89	10.11	12.00
41	GJ-35-15-15 x SPV - 946	13.33	5.56	9.44	14.67	12.00	13.33	14.00	8.78	11.39
42	GJ-35-15-15 x SPV- 104	54.45	45.56	50.00	16.67	14.00	15.33	35.56	29.78	32.67
43	GJ-35-15-15 x IS - 2284	14.45	14.45	14.45	9.33	12.00	10.67	11.89	13.22	12.56
44	GJ-35-15-15 x IS - 6335	3.33	1.11	2.22	8.00	10.00	9.00	5.67	5.56	5.61
45	GJ-35-15-15 x IS - 9471	21.11	17.78	19.45	7.33	8.00	7.67	14.22	12.89	13.56
46	SPV - 946 x SPV- 104	48.89	44.45	46.67	15.33	20.00	17.67	32.11	32.22	32.17
47	SPV - 946 x IS - 2284	3.33	1.11	2.22	13.33	7.33	10.33	8.33	4.22	6.28
48	SPV - 946 x IS- 6335	5.56	2.22	3.89	6.67	4.67	5.67	6.11	3.44	4.78
49	SPV - 946 x IS 9471	10.00	10.00	10.00	8.00	10.67	9.33	9.00	10.33	9.67
50	SPV - 104 x IS 2284	18.89	13.33	16.11	11.33	10.67	11.00	15.11	12.00	13.56
51	SPV - 104 x IS 6335	37.78	30.00	33.89	7.33	6.67	7.00	22.56	18.33	20.45
52	SPV - 104 x IS 9471	16.67	14.45	15.56	8.00	6.00	7.00	12.33	10.22	11.28
53	IS 2284 x IS-6335	10.00	1.11	5.56	8.67	7.33	8.00	9.33	4.22	6.78
54	IS 2284 x IS -9471	8.89	2.22	5.56	12.00	16.00	14.00	10.44	9.11	9.78
55	IS 6335 x IS 9471	5.56	2.22	3.89	4.00	5.33	4.67	4.78	3.78	4.28
	Mean	19.91	14.24	17.08	15.19	13.24	14.22	17.55	13.74	15.65
	% increase (+)/decrease(-) over untreated			(-)28.47			(-)12.83			(-)21.71
	% increase over location			16.74 (Akola 96)						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.452	1.252		0.430	1.193		0.589	1.714	
	B	2.368	6.563		2.258	3.258		3.093	9.029	
	A x B	3.348	9.281		3.193	8.8580		4.375	12.731	

Table 64. Effect of pre-treatment on *F. moniliforme* (%) (UGS) of parents and F_1 crosses at Akola 1995 and Akola, 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	2.22	1.11	1.67	8.00	8.00	8.00	5.11	4.56	4.83
2	ICSB-101B	6.67	5.56	6.11	8.67	8.67	8.67	7.67	7.11	7.39
3	Akms-14B	4.44	8.89	6.67	21.33	16.00	18.67	12.89	12.44	12.67
4	SRT-26B	13.33	15.56	14.45	5.33	8.00	6.67	9.33	11.78	10.56
5	GJ-35-15-15	0.00	2.22	1.11	6.67	8.67	7.67	3.33	5.44	4.39
6	SPV-946	5.56	5.56	5.56	6.00	8.00	7.00	5.78	5.78	6.28
7	SPV-104	4.44	10.00	7.22	18.67	14.67	16.67	11.56	12.33	11.94
8	IS-2284	0.00	2.22	1.11	4.00	3.33	3.67	2.00	2.78	2.39
9	IS-6335	0.00	2.22	1.11	2.67	4.00	3.33	1.33	3.11	2.22
10	IS-9471	1.11	1.11	1.11	2.00	2.67	2.33	1.56	1.89	1.72
11	SPV-1201 x ICSB-101B	6.67	2.22	4.44	5.33	4.00	4.67	6.00	3.11	4.56
12	SPV-1201 x Akms-14 B	11.11	6.67	8.89	4.67	5.33	5.00	7.89	6.00	6.94
13	SPV-1201 x SRT - 26B	10.00	7.78	8.89	3.33	4.67	4.00	6.67	6.22	6.44
14	SPV-1201 x GJ-35-15-15	1.11	1.11	1.11	16.67	2.67	9.67	8.89	1.89	5.39
15	SPV-1201 x SPV -946	4.44	3.33	3.89	19.33	14.67	17.00	11.89	9.00	10.44
16	SPV-1201 x SPV- 104	8.89	7.78	8.33	4.67	4.00	4.33	6.78	5.89	6.33
17	SPV-1201 x IS -2284	2.22	2.22	2.22	2.67	2.00	2.33	2.44	2.11	2.28
18	SPV-1201 x IS-6335	6.67	4.44	5.56	2.00	4.00	3.00	4.33	4.22	4.28
19	SPV-1201 x IS - 9471	7.78	4.44	6.11	2.00	2.67	2.33	4.89	3.56	4.22
20	ICSB - 101B x AKms 14 B	13.33	4.44	8.89	6.00	5.33	5.67	9.67	4.89	7.28
21	ICSB - 101B x SRT- 26 B	16.67	7.78	12.22	4.00	0.67	2.33	10.33	4.22	7.28
22	ICSB - 101B x GJ-35-15-15	12.22	5.56	8.89	4.00	2.67	3.33	8.11	4.11	6.11
23	ICSB - 101B x SPV - 946	8.89	6.67	7.78	3.33	2.67	3.00	6.11	4.67	5.39
24	ICSB - 101B x SPV - 104	12.22	7.78	10.00	11.33	8.00	9.67	11.78	7.89	9.83
25	ICSB - 101B x IS - 2284	4.44	2.22	3.33	6.00	1.33	3.67	5.22	1.78	3.50
26	ICSB - 101B x IS - 6335	3.33	5.56	4.44	3.33	2.67	3.00	3.33	4.11	3.72
27	ICSB -101B x IS - 9471	1.11	1.11	1.11	4.00	1.33	2.67	2.56	1.22	1.89
28	AKms - 14 B x SRT - 26B	21.11	16.67	18.89	14.00	5.33	9.67	17.56	11.00	14.28
29	AKms - 14 B x GJ-35-15-15	8.89	10.00	9.44	7.33	5.33	6.33	8.11	7.67	7.89
30	AKms -14 B x SPV - 946	6.67	4.44	5.56	8.00	6.00	7.00	7.33	5.22	6.28
31	AKms - 14 B x SPV - 104	2.22	2.22	2.22	17.33	10.67	14.00	9.78	6.44	8.11
32	AKms - 14 B x IS - 2284	13.33	4.44	8.89	5.33	3.33	4.33	9.33	3.89	6.61
33	AKms - 14 B x IS - 6335	1.11	2.22	1.67	3.33	0.00	1.67	2.22	1.11	1.67
34	AKms - 14 B x IS - 9471	5.56	2.22	3.89	4.67	2.00	3.33	5.11	2.11	3.61

Contd.. .. .. ..

Table 64 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	5.56	4.44	5.00	2.67	6.00	4.33	4.11	5.22	4.67
36	SRT - 26B x SPV - 946	8.89	6.67	7.78	6.67	6.00	6.33	7.78	6.33	7.06
37	SRT - 26B x SPV -104	6.67	2.22	4.44	11.33	14.00	12.67	9.00	8.11	8.56
38	SRT - 26B x IS – 2284	4.44	4.44	4.44	5.33	8.00	6.67	4.89	6.22	5.56
39	SRT - 26B x IS – 6335	10.00	6.67	8.33	3.33	4.00	3.67	6.67	5.33	6.00
40	SRT - 26B x IS – 9471	6.67	8.89	7.78	4.00	1.33	2.67	5.33	5.11	5.22
41	GJ-35-15-15 x SPV - 946	5.56	2.22	3.89	9.33	5.33	7.33	7.44	3.78	5.61
42	GJ-35-15-15 x SPV- 104	32.22	28.89	30.56	5.33	5.33	5.33	18.78	17.11	17.95
43	GJ-35-15-15 x IS - 2284	4.44	3.33	3.89	2.67	5.33	4.00	3.56	4.33	3.94
44	GJ-35-15-15 x IS - 6335	2.22	1.11	1.67	4.00	4.67	4.33	3.11	2.89	3.00
45	GJ-35-15-15 x IS - 9471	6.67	4.44	5.56	4.00	4.00	4.00	5.33	4.22	4.78
46	SPV - 946 x SPV- 104	12.22	13.33	12.78	4.00	7.33	5.67	8.11	10.33	9.22
47	SPV - 946 x IS - 2284	2.22	1.11	1.67	6.67	4.67	5.67	4.44	2.89	3.67
48	SPV - 946 x IS- 6335	1.11	1.11	1.11	4.67	1.33	3.00	2.89	1.22	2.06
49	SPV - 946 x IS 9471	3.33	5.56	4.44	3.33	6.00	4.67	3.33	5.78	4.56
50	SPV - 104 x IS 2284	7.78	5.56	6.67	4.67	6.00	5.33	6.22	5.78	6.00
51	SPV - 104 x IS 6335	20.00	15.56	17.78	1.33	2.67	2.00	10.67	9.11	9.89
52	SPV - 104 x IS 9471	4.44	7.78	6.11	3.33	4.00	3.67	3.89	5.89	4.89
53	IS 2284 x IS-6335	4.44	1.11	2.78	1.33	4.00	2.67	2.89	2.56	2.72
54	IS 2284 x IS -9471	3.33	2.22	2.78	4.00	7.33	5.67	3.67	4.78	4.22
55	IS 6335 x IS 9471	1.11	1.11	1.11	1.33	2.00	1.67	1.22	1.56	1.39
	Mean	6.93	5.56	6.25	6.16	5.32	5.74	6.55	5.44	5.99
	% increase (+)/decrease(-) over untreated			(-)19.76			(-)13.64			(-)16.95
	% increase over location			14.88 (Akola 96)						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.439	1.217		0.353	0.979		0.239	0.695	
	B	2.301	6.380		1.853	5.136		1.253	3.656	
	A x B	3.256	9.022		3.706	7.264		1.520	5.004	

Table 65. Effect of pre-treatment on *F. pallidoroseum* (%) (UGS) of parents and F_1 crosses at Akola 1995 and Akola, 1996

S.N.	Parents/Crosses	Akola-1995			Akola -1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
2	ICSB-101B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Akms-14B	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
4	SRT-26B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	GJ-35-15-15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	SPV-946	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	SPV-104	0.00	0.00	0.00	0.00	8.00	4.00	0.00	4.00	2.00
8	IS-2284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	IS-6335	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	IS-9471	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
11	SPV-1201 x ICSB-101B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	SPV-1201 x Akms-14 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	SPV-1201 x SRT - 26B	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
14	SPV-1201 x GJ-35-15-15	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
15	SPV-1201 x SPV -946	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SPV-1201 x SPV- 104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	SPV-1201 x IS -2284	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
18	SPV-1201 x IS-6335	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	SPV-1201 x IS - 9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	ICSB - 101B x AKms 14 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	ICSB - 101B x SRT- 26 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	ICSB - 101B x GJ-35-15-15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	ICSB - 101B x SPV - 946	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	ICSB - 101B x SPV - 104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	ICSB - 101B x IS - 2284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	ICSB - 101B x IS - 6335	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	ICSB -101B x IS - 9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	AKms - 14 B x SRT - 26B	0.00	0.00	0.00	0.00	2.00	1.00	0.00	1.00	0.50
29	AKms - 14 B x GJ-35-15-15	0.00	0.00	0.00	0.67	0.67	0.67	0.33	0.33	0.33
30	AKms -14 B x SPV - 946	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
31	AKms - 14 B x SPV - 104	0.00	0.00	0.00	0.67	4.67	2.67	0.33	2.33	1.33
32	AKms - 14 B x IS - 2284	0.00	0.00	0.00	2.00	0.00	1.00	1.00	0.00	0.50
33	AKms - 14 B x IS - 6335	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	AKms - 14 B x IS - 9471	0.00	0.00	0.00	0.67	0.00	0.33	0.33	0.00	0.17

Contd.. .. .. ..

Table 65 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	SRT - 26B x SPV - 946	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
37	SRT - 26B x SPV -104	0.00	0.00	0.00	0.67	1.33	1.00	0.33	0.67	0.50
38	SRT - 26B x IS – 2284	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
39	SRT - 26B x IS – 6335	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
40	SRT - 26B x IS – 9471	0.00	0.00	0.00	1.33	0.67	1.00	0.67	0.33	0.50
41	GJ-35-15-15 x SPV - 946	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	GJ-35-15-15 x SPV- 104	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
43	GJ-35-15-15 x IS - 2284	0.00	0.00	0.00	1.33	0.00	0.67	0.67	0.00	0.33
44	GJ-35-15-15 x IS - 6335	0.00	0.00	0.00	1.33	0.67	1.00	0.67	0.33	0.50
45	GJ-35-15-15 x IS - 9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	SPV - 946 x SPV- 104	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
47	SPV - 946 x IS - 2284	0.00	0.00	0.00	2.00	0.67	1.33	1.00	0.33	0.67
48	SPV - 946 x IS- 6335	0.00	0.00	0.00	0.67	0.00	0.33	0.33	0.00	0.17
49	SPV - 946 x IS 9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	SPV - 104 x IS 2284	0.00	0.00	0.00	1.33	0.67	1.00	0.67	0.33	0.50
51	SPV - 104 x IS 6335	0.00	0.00	0.00	0.00	1.33	0.67	0.00	0.67	0.33
52	SPV - 104 x IS 9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	IS 2284 x IS-6335	0.00	0.00	0.00	1.33	1.33	1.33	0.67	0.67	0.67
54	IS 2284 x IS -9471	0.00	0.00	0.00	3.33	0.67	2.00	1.67	0.33	1.00
55	IS 6335 x IS 9471	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.36	0.57	0.47	0.36	0.57	0.47
	% increase (+)/decrease(-) over untreated			NIL			(+)58.00			(+)58.00
	% increase over location						47.00 (Akola 95)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	-	-		0.104	0.288		0.069	0.201	
	B	-	-		0.545	1.510		0.362	1.356	
	A x B	-	-		0.771	2.136		0.512	1.899	

Table 66. Effect of pre-treatment on *C. lunata* (%) (UGS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	0.00	0.00	0.00	10.67	13.33	12.00	5.33	6.67	6.00
2	ICSB-101B	14.45	4.44	9.44	12.67	8.00	10.33	13.56	6.22	9.89
3	Akms-14B	5.56	14.45	10.00	19.33	12.67	16.00	12.44	13.56	13.00
4	SRT-26B	11.11	14.45	12.78	7.33	6.00	6.67	9.22	10.22	9.72
5	GJ-35-15-15	0.00	4.44	2.22	10.67	11.33	11.00	5.33	7.89	6.61
6	SPV-946	15.56	17.78	16.67	6.00	10.67	8.33	10.78	14.22	12.50
7	SPV-104	10.00	6.67	8.33	16.00	16.00	16.00	13.00	11.33	12.17
8	IS-2284	7.78	5.56	6.67	3.33	6.00	4.67	5.56	5.78	5.67
9	IS-6335	2.22	0.00	1.11	4.00	2.67	3.33	3.11	1.33	2.22
10	IS-9471	0.00	0.00	0.00	4.00	2.67	3.33	2.00	1.33	1.67
11	SPV-1201 x ICSB-101B	13.33	4.44	8.89	8.00	8.00	8.00	10.67	6.22	8.44
12	SPV-1201 x Akms-14 B	12.22	5.56	8.89	10.67	7.33	9.00	11.44	6.44	8.94
13	SPV-1201 x SRT - 26B	21.11	6.67	13.89	2.67	4.67	3.67	11.89	5.67	8.78
14	SPV-1201 x GJ-35-15-15	2.22	0.00	1.11	16.67	2.67	9.67	9.44	1.33	5.39
15	SPV-1201 x SPV -946	2.22	2.22	2.22	12.67	10.00	11.33	7.44	6.11	6.78
16	SPV-1201 x SPV- 104	16.67	11.11	13.89	7.33	8.00	7.67	12.00	9.56	10.78
17	SPV-1201 x IS -2284	1.11	0.00	0.56	3.33	2.00	2.67	2.22	1.00	1.61
18	SPV-1201 x IS-6335	4.44	2.22	3.33	1.33	2.00	1.67	2.89	2.11	2.50
19	SPV-1201 x IS - 9471	4.44	4.44	4.44	2.00	4.00	3.00	3.22	4.22	3.72
20	ICSB - 101B x AKms 14 B	16.67	15.56	16.11	12.00	16.67	14.33	14.33	16.11	15.22
21	ICSB - 101B x SRT- 26 B	38.89	24.45	31.67	6.00	6.67	6.33	22.45	15.56	19.00
22	ICSB - 101B x GJ-35-15-15	21.11	15.56	18.33	6.67	3.33	5.00	13.89	9.44	11.67
23	ICSB - 101B x SPV - 946	16.67	12.22	14.45	4.00	7.33	5.67	10.33	9.78	10.06
24	ICSB - 101B x SPV - 104	14.45	11.11	12.78	10.67	10.00	10.33	12.56	10.56	11.56
25	ICSB - 101B x IS - 2284	1.11	0.00	0.56	4.00	7.33	5.67	2.56	3.67	3.11
26	ICSB - 101B x IS - 6335	2.22	0.00	1.11	3.33	2.67	3.00	2.78	1.33	2.06
27	ICSB -101B x IS - 9471	2.22	2.22	2.22	3.33	4.00	3.67	2.78	3.11	2.94
28	AKms - 14 B x SRT - 26B	2.22	2.22	2.22	9.33	9.33	9.33	5.78	5.78	5.78
29	AKms - 14 B x GJ-35-15-15	22.22	11.11	16.67	8.00	12.67	10.33	15.11	11.89	13.50
30	AKms -14 B x SPV - 946	13.33	7.78	10.56	12.00	10.00	11.00	12.67	8.89	10.78
31	AKms - 14 B x SPV - 104	14.45	11.11	12.78	24.00	18.00	21.00	19.22	14.56	16.89
32	AKms - 14 B x IS - 2284	5.56	8.89	7.22	9.33	2.67	6.00	7.44	5.78	6.61
33	AKms - 14 B x IS - 6335	5.56	1.11	3.33	3.33	2.67	3.00	4.44	1.89	3.17
34	AKms - 14 B x IS - 9471	7.78	5.56	6.67	5.33	4.00	4.67	6.56	4.78	5.67

Contd.. .. .. ..

Table 66 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	1.11	0.00	0.56	4.67	3.33	4.00	2.89	1.67	2.28
36	SRT - 26B x SPV - 946	2.22	4.44	3.33	9.33	6.67	8.00	5.78	5.56	5.67
37	SRT - 26B x SPV -104	1.11	1.11	1.11	16.67	11.33	14.00	8.89	6.22	7.56
38	SRT - 26B x IS – 2284	6.67	6.67	6.67	8.00	10.67	9.33	7.33	8.67	8.00
39	SRT - 26B x IS – 6335	10.00	6.67	8.33	5.33	6.00	5.67	7.67	6.33	7.00
40	SRT - 26B x IS – 9471	7.78	5.56	6.67	4.00	2.00	3.00	5.89	3.78	4.83
41	GJ-35-15-15 x SPV - 946	7.78	1.11	4.44	4.67	6.67	5.67	6.22	3.89	5.06
42	GJ-35-15-15 x SPV- 104	14.45	13.33	13.89	8.67	8.00	8.33	11.56	10.67	11.11
43	GJ-35-15-15 x IS - 2284	4.44	8.89	6.67	4.00	6.67	5.33	4.22	7.78	6.00
44	GJ-35-15-15 x IS - 6335	0.00	0.00	0.00	2.67	4.67	3.67	1.33	2.33	1.83
45	GJ-35-15-15 x IS - 9471	10.00	6.67	8.33	3.33	4.00	3.67	6.67	5.33	6.00
46	SPV - 946 x SPV- 104	28.89	23.33	26.11	10.67	10.00	10.33	19.78	16.67	18.22
47	SPV - 946 x IS - 2284	1.11	0.00	0.56	4.67	2.00	3.33	2.89	1.00	1.94
48	SPV - 946 x IS- 6335	0.00	0.00	0.00	1.33	3.33	2.33	0.67	1.67	1.17
49	SPV - 946 x IS 9471	3.33	2.22	2.78	4.67	4.67	4.67	4.00	3.44	3.72
50	SPV - 104 x IS 2284	6.67	4.44	5.56	3.33	3.33	3.33	5.00	3.89	4.44
51	SPV - 104 x IS 6335	13.33	10.00	11.67	6.00	3.33	4.67	9.67	6.67	8.17
52	SPV - 104 x IS 9471	8.89	6.67	7.78	4.67	2.00	3.33	6.78	4.33	5.56
53	IS 2284 x IS-6335	2.22	0.00	1.11	6.00	2.00	4.00	4.11	1.00	2.56
54	IS 2284 x IS -9471	3.33	0.00	1.67	4.00	6.67	5.33	3.67	3.33	3.50
55	IS 6335 x IS 9471	1.11	1.11	1.11	2.00	3.33	2.67	1.56	2.22	1.89
	Mean	8.42	6.10	7.26	7.25	6.65	6.95	7.78	6.38	7.08
	% increase (+)/decrease(-) over untreated			(-)27.55			(-)8.27			(-)17.99
	% increase over location			4.26 (Akola 96)						
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.364	1.010		0.282	0.781		0.213	0.620	
	B	1.911	5.298		1.478	4.096		1.120	3.362	
	A x B	2.703	7.493		2.089	5.792		1.580	4.599	

ıble 67. Effect of pre-treatment on other fungi (%) (UGS) of parents and F_1 crosses at Akola 1995 and Akola 1996

N.	Parents/Crosses	Akola-1995			Akola –1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
	SPV-1201	0.00	0.00	0.00	3.33	1.33	2.33	1.67	0.67	1.17
	ICSB-101B	4.44	0.00	2.22	2.00	2.00	2.00	3.22	1.00	2.11
	Akms-14B	36.67	15.56	26.11	4.67	2.00	3.33	20.67	8.78	14.72
	SRT-26B	1.11	2.22	1.67	0.67	0.67	0.67	0.89	1.44	1.17
	GJ-35-15-15	2.22	1.11	1.67	1.33	2.67	2.00	1.78	1.89	1.83
	SPV-946	2.22	8.89	5.56	2.67	0.00	1.33	2.44	4.44	3.44
	SPV-104	11.11	1.11	6.11	3.33	4.00	3.67	7.22	2.56	4.89
	IS-2284	3.33	2.22	2.78	0.00	0.00	0.00	1.67	1.11	1.39
	IS-6335	0.00	1.11	0.56	0.00	0.00	0.00	0.00	0.56	0.28
)	IS-9471	1.11	2.22	1.67	0.67	0.00	0.33	0.89	1.11	1.00
1	SPV-1201 x ICSB-101B	12.22	2.22	7.22	1.33	0.00	0.67	6.78	1.11	3.94
2	SPV-1201 x Akms-14 B	8.89	8.89	8.89	2.00	1.33	1.67	5.44	5.11	5.28
3	SPV-1201 x SRT - 26B	4.44	2.22	3.33	0.00	0.67	0.33	2.22	1.44	1.83
4	SPV-1201 x GJ-35-15-15	0.00	1.11	0.56	5.33	0.00	2.67	2.67	0.56	1.61
5	SPV-1201 x SPV -946	1.11	0.00	0.56	4.67	0.67	2.67	2.89	0.33	1.61
6	SPV-1201 x SPV- 104	6.67	4.44	5.56	6.00	0.00	3.00	6.33	2.22	4.28
7	SPV-1201 x IS -2284	1.11	0.00	0.56	2.67	0.00	1.33	1.89	0.00	0.94
8	SPV-1201 x IS-6335	6.67	0.00	3.33	0.67	0.00	0.33	3.67	0.00	1.83
9	SPV-1201 x IS - 9471	7.78	1.11	4.44	0.67	0.00	0.33	4.22	0.56	2.39
20	ICSB - 101B x AKms 14 B	4.44	1.11	2.78	2.67	2.67	2.67	3.56	1.89	2.72
21	ICSB - 101B x SRT- 26 B	6.67	5.56	6.11	3.33	2.00	2.67	5.00	3.78	4.39
22	ICSB - 101B x GJ-35-15-15	8.89	0.00	4.44	1.33	0.00	0.67	5.11	0.00	2.56
23	ICSB - 101B x SPV - 946	8.89	1.11	5.00	0.67	0.67	0.67	4.78	0.89	2.83
24	ICSB - 101B x SPV - 104	2.22	7.78	5.00	1.33	1.33	1.33	1.78	4.56	3.17
25	ICSB - 101B x IS - 2284	0.00	2.22	1.11	1.33	0.67	1.00	0.67	1.44	1.06
26	ICSB - 101B x IS - 6335	2.22	0.00	1.11	2.67	0.00	1.33	2.44	0.00	1.22
27	ICSB -101B x IS - 9471	4.44	2.22	3.33	0.67	0.67	0.67	2.56	1.44	2.00
28	AKms - 14 B x SRT - 26B	0.00	0.00	0.00	4.67	1.33	3.00	2.33	0.67	1.50
29	AKms - 14 B x GJ-35-15-15	7.78	4.44	6.11	1.33	0.00	0.67	4.56	2.22	3.39
30	AKms -14 B x SPV - 946	1.11	0.00	0.56	2.67	2.00	2.33	1.89	1.00	1.44
31	AKms - 14 B x SPV - 104	4.44	3.33	3.89	4.00	0.67	2.33	4.22	2.00	3.11
32	AKms - 14 B x IS - 2284	1.11	0.00	0.56	3.33	0.00	1.67	2.22	0.00	1.11
33	AKms - 14 B x IS - 6335	0.00	3.33	1.67	0.00	0.00	0.00	0.00	1.67	0.83
34	AKms - 14 B x IS - 9471	2.22	2.22	2.22	1.33	0.00	0.67	1.78	1.11	1.44

Contd.. .. .. ..

Table 67 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
35	SRT- 26B x GJ-35-15-15	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.33	0.17
36	SRT - 26B x SPV - 946	3.33	1.11	2.22	0.67	0.67	0.67	2.00	0.89	1.44
37	SRT - 26B x SPV -104	0.00	0.00	0.00	2.00	1.33	1.67	1.00	0.67	0.83
38	SRT - 26B x IS – 2284	4.44	0.00	2.22	2.00	2.00	2.00	3.22	1.00	2.11
39	SRT - 26B x IS – 6335	1.11	1.11	1.11	1.33	0.00	0.67	1.22	0.56	0.89
40	SRT - 26B x IS – 9471	3.33	1.11	2.22	0.67	0.00	0.33	2.00	0.56	1.28
41	GJ-35-15-15 x SPV - 946	2.22	2.22	2.22	0.67	0.00	0.33	1.44	1.11	1.28
42	GJ-35-15-15 x SPV- 104	6.67	3.33	5.00	1.33	0.67	1.00	4.00	2.00	3.00
43	GJ-35-15-15 x IS - 2284	5.56	0.00	2.78	1.33	0.00	0.67	3.44	0.00	1.72
44	GJ-35-15-15 x IS - 6335	1.11	0.00	0.56	0.00	0.67	0.33	0.56	0.33	0.44
45	GJ-35-15-15 x IS - 9471	4.44	2.22	3.33	0.00	0.00	0.00	2.22	1.11	1.67
46	SPV - 946 x SPV- 104	7.78	7.78	7.78	1.33	0.67	1.00	4.56	4.22	4.39
47	SPV - 946 x IS - 2284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	SPV - 946 x IS- 6335	1.11	1.11	1.11	0.00	0.00	0.00	0.56	0.56	0.56
49	SPV - 946 x IS 9471	3.33	1.11	2.22	0.00	0.00	0.00	1.67	0.56	1.11
50	SPV - 104 x IS 2284	4.44	3.33	3.89	2.00	0.00	1.00	3.22	1.67	2.44
51	SPV - 104 x IS 6335	5.56	4.44	5.00	0.00	0.00	0.00	2.78	2.22	2.50
52	SPV - 104 x IS 9471	3.33	0.00	1.67	0.00	0.00	0.00	1.67	0.00	0.83
53	IS 2284 x IS-6335	2.22	0.00	1.11	0.00	0.00	0.00	1.11	0.00	0.56
54	IS 2284 x IS -9471	2.22	0.00	1.11	0.67	1.33	1.00	1.44	0.67	1.06
55	IS 6335 x IS 9471	3.33	0.00	1.67	0.67	0.00	0.33	2.00	0.00	1.00
	Mean	4.20	2.12	3.16	1.60	0.64	1.12	2.9	1.38	2.14
	% increase (+)/decrease(-) over untreated			(-)49.52			(-)60.00			(-)52.41
	% increase over location						64.56 (Akola 96)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.411	1.140		0.120	0.333		0.170	0.494	
	B	2.157	5.978		0.631	1.749		0.892	2.421	
	A x B	3.050	8.455		0.892	2.473		1.261	3.670	

Table 68. Effect of pre-treatment on score (UGS) of parents and F_1 crosses at Akola 1995 and Akola 1996

S.N.	Parents/Crosses	Akola-1995			Akola-1996			Pooled over locations		
		Untreated	Treated	Mean	Untreated	Treated	Mean	Untreated	Treated	Mean
1	2	3	4	5	6	7	8	9	10	11
1	SPV-1201	1.00	0.67	0.83	4.50	4.00	4.25	2.75	2.33	254
2	ICSB-101B	4.17	4.00	4.08	4.67	4.00	4.33	4.42	4.00	421
3	Akms-14B	3.00	4.00	3.50	5.00	4.50	4.75	4.00	4.25	4.13
4	SRT-26B	4.00	3.33	3.67	4.00	4.00	4.00	4.00	3.67	383
5	GJ-35-15-15	0.67	2.83	1.75	4.00	4.00	4.00	2.33	3.42	288
6	SPV-946	4.17	3.83	4.00	4.00	3.50	3.75	4.08	3.67	388
7	SPV-104	4.00	3.50	3.75	4.50	4.00	4.25	4.25	3.75	400
8	IS-2284	2.50	2.17	2.33	2.00	2.17	2.08	2.25	2.17	221
9	IS-6335	0.67	1.33	1.00	1.83	1.50	1.67	1.25	1.42	133
10	IS-9471	0.67	1.17	0.92	1.33	1.00	1.17	1.00	1.08	104
11	SPV-1201 x ICSB-101B	3.67	1.50	2.58	3.50	3.50	3.50	3.58	2.50	304
12	SPV-1201 x Akms-14 B	3.50	2.67	3.08	4.33	4.00	4.17	3.92	3.33	363
13	SPV-1201 x SRT - 26B	3.33	2.83	3.08	3.17	4.00	3.58	3.25	3.42	333
14	SPV-1201 x GJ-35-15-15	2.00	0.67	1.33	4.50	4.00	4.25	3.25	2.33	279
15	SPV-1201 x SPV -946	2.83	3.00	2.92	4.50	4.00	4.25	3.67	3.50	358
16	SPV-1201 x SPV- 104	4.00	3.67	3.83	4.00	3.50	3.75	4.00	3.58	379
17	SPV-1201 x IS -2284	1.33	1.50	1.42	0.67	1.17	0.92	1.00	1.33	1.17
18	SPV-1201 x IS-6335	2.50	2.00	2.25	1.17	1.33	1.25	1.83	1.67	176
19	SPV-1201 x IS - 9471	2.33	2.50	2.42	1.50	1.00	1.25	1.92	1.75	183
20	ICSB - 101B x AKms 14 B	5.00	3.00	4.00	4.00	4.00	4.00	4.50	3.50	400
21	ICSB - 101B x SRT- 26 B	4.83	3.67	4.25	4.00	3.50	3.75	4.42	3.58	400
22	ICSB - 101B x GJ-35-15-15	5.00	3.17	4.08	3.67	3.00	3.33	4.33	3.08	371
23	ICSB - 101B x SPV - 946	5.00	4.00	4.50	3.00	4.00	3.50	4.00	4.00	400
24	ICSB - 101B x SPV - 104	5.00	4.00	4.50	4.00	3.00	3.50	4.50	3.50	400
25	ICSB - 101B x IS - 2284	1.33	1.33	1.33	1.83	1.83	1.83	1.58	1.58	158
26	ICSB - 101B x IS - 6335	2.17	1.83	2.00	1.50	1.00	1.25	1.83	1.42	163
27	ICSB -101B x IS - 9471	2.17	1.67	1.92	2.00	1.50	1.75	2.08	1.58	183
28	AKms - 14 B x SRT - 26B	5.00	4.50	4.75	3.50	3.50	3.50	4.25	4.00	4.13
29	AKms - 14 B x GJ-35-15-15	4.67	4.33	4.50	3.50	4.00	3.75	4.08	4.17	4.13
30	AKms -14 B x SPV - 946	4.33	4.00	4.17	4.17	4.00	4.08	4.25	4.00	4.13
31	AKms - 14 B x SPV - 104	5.00	4.00	4.50	4.83	4.33	4.58	4.92	4.17	454
32	AKms - 14 B x IS - 2284	3.00	2.67	2.83	2.00	1.67	1.83	2.50	2.17	233
33	AKms - 14 B x IS - 6335	1.67	1.67	1.67	2.00	0.83	1.42	1.83	1.25	154
34	AKms - 14 B x IS - 9471	2.17	2.50	2.33	3.17	1.50	2.33	2.67	2.00	233

Contd.. .. .. ..

able 68 . Contd.. .... ..

1	2	3	4	5	6	7	8	9	10	11
5	SRT- 26B x GJ-35-15-15	1.83	2.00	1.92	3.83	3.50	3.67	2.83	2.75	2.79
5	SRT - 26B x SPV - 946	3.50	3.00	3.25	4.00	3.50	3.75	3.75	3.25	3.50
7	SRT - 26B x SPV -104	2.17	1.33	1.75	4.00	4.00	4.00	3.08	2.67	2.88
8	SRT - 26B x IS – 2284	2.50	3.00	2.75	2.00	2.00	2.00	2.25	2.50	2.38
9	SRT - 26B x IS – 6335	3.00	2.50	2.75	2.00	2.00	2.00	2.50	2.25	2.38
0	SRT - 26B x IS – 9471	1.83	2.33	2.08	1.83	1.67	1.75	1.83	2.00	1.92
1	GJ-35-15-15 x SPV - 946	3.33	1.83	2.58	3.33	2.83	3.08	3.33	2.33	2.83
2	GJ-35-15-15 x SPV- 104	4.00	3.50	3.75	3.17	3.00	3.08	3.58	3.25	3.42
3	GJ-35-15-15 x IS - 2284	2.33	2.67	2.50	1.00	2.00	1.50	1.67	2.33	2.00
4	GJ-35-15-15 x IS - 6335	1.17	1.50	1.33	1.17	2.00	1.58	1.17	1.75	1.46
15	GJ-35-15-15 x IS - 9471	2.33	2.17	2.25	1.00	3.00	2.00	1.67	2.58	2.13
16	SPV - 946 x SPV- 104	4.67	4.33	4.50	4.00	3.83	3.92	4.33	4.08	4.21
17	SPV - 946 x IS - 2284	1.17	0.50	0.83	2.00	2.00	2.00	1.58	1.25	1.42
18	SPV - 946 x IS- 6335	0.67	0.50	0.58	1.67	1.67	1.67	1.17	1.08	1.13
49	SPV - 946 x IS 9471	2.00	2.17	2.08	2.00	1.83	1.92	2.00	2.00	2.00
50	SPV - 104 x IS 2284	3.00	2.50	2.75	2.00	2.00	2.00	2.50	2.25	2.38
51	SPV - 104 x IS 6335	3.50	3.00	3.25	2.00	2.00	2.00	2.75	2.50	2.63
52	SPV - 104 x IS 9471	2.50	3.00	2.75	2.50	3.00	2.75	2.50	3.00	2.75
53	IS 2284 x IS-6335	2.50	0.00	1.25	1.67	2.00	1.83	2.08	1.00	1.54
54	IS 2284 x IS -9471	2.17	1.00	1.58	2.00	2.00	2.00	2.08	1.50	1.79
55	IS 6335 x IS 9471	1.17	0.83	1.00	1.17	2.00	1.58	1.17	1.42	1.29
	Mean	2.87	2.49	2.68	2.88	2.76	2.82	2.88	2.63	2.76
	% increase (+)/decrease(-) over untreated			(+)13.24			(+)4.16			(+)8.68
	% increase over location						4.96 (Akola 95)			
		SE (m)	CD 5%		SE (m)	CD 5%		SE (m)	CD 5%	
	A	0.092	0.255		.052	0.145		0.045	0.131	
	B	0.484	1.342		0.274	0.760		0.235	0.638	
	A x B	0.685	1.898		0.388	1.075		0.332	0.967	

IX – 1

Table : 69 Correlation coefficient between fungal load of germinated and ungerminated seed (Untreated), Akola and Patancheru, 1996

Sr. No	Characters	Loca -tion	Germi -nated Seed GS	Ungermi -nated seed UGS	*F. m.* GS	*F.p.* GS	*C. lunata* GS	Other fungi GS	Score GS	*F.m.* UGS	*F. p.* UGS	*C. lunata* UGS	Other fungi UGS	Score UGS	TGMR
1	Germinated Seed	A	-	-1.0**	-0.71**	0.21	-0.11	0.66**	-0.69**	-0.95**	-0.04	-0.94**	-0.74**	-0.74**	-0.72**
		P	-	-0.99**	0.58**	0.66**	0.75**	0.58*	-0.77**	-0.96**	-0.80**	-0.82**	-0.52**	-0.83**	-0.87**
2	Ungerminated seed	A		-	-0.71*	-0.21	0.11	-0.66**	0.69**	0.95**	0.04	0.95**	0.75**	0.74**	0.72**
		P		-	-0.58**	-0.66**	-0.75**	-0.58**	0.77**	0.96**	0.80**	0.82**	0.51**	0.83**	0.87**
3	*F. moniliforme* (GS)	A			-	-0.18	0.28*	-0.49**	0.76**	0.72**	-0.06	0.67**	0.38**	0.71**	0.65**
		P			-	0.78**	0.48**	0.17	-0.20	-0.52**	-0.31*	-0.64**	-0.29*	-0.30*	-0.38
4	*F. pallidoroseum* (GS)	A				-	-0.38**	0.11	-0.45**	-0.25	0.55**	-0.25**	-0.25	-0.47**	-0.40**
		P				-	0.56**	0.28*	-0.41**	-0.60**	-0.40**	-0.67**	-0.36**	-0.50**	-0.56**
5	*C. lunata* (GS)	A					-	0.13	0.62**	0.05	-0.25	0.20	0.20	0.63**	0.52**
		P					-	0.71**	-0.43**	-0.77**	-0.55**	-0.56**	-0.32*	-0.43**	-0.61**
6	Other fungi (GS)	A						-	-0.38**	-0.63**	-0.05	-0.60**	-0.46**	-0.37**	-0.42**
		P						-	-0.24	-0.57**	-0.45**	-0.46**	-0.28*	-0.27*	-0.38**
7	Score (GS)	A							-	0.64**	-0.28*	0.72**	0.52*	0.93**	0.85**
		P							-	0.77**	0.67**	0.57**	0.44**	0.94**	0.89**
8	*F. moniliforme* (UGS)	A								-	-0.02	0.82**	0.67**	0.66**	0.62**
		P								-	0.76	0.69**	0.37**	0.82**	0.86**
9	*F. pallidoroseum* (UGS)	A									-	-0.03	-0.05	-0.24	-0.28*
		P									-	0.48**	0.39**	0.71**	0.71**
10	*C. lunata* (UGS)	A										-	0.66**	0.79**	0.77**
		P										-	0.50**	0.62**	0.64**
11	Other fungi (UGS)	A											-	0.56**	0.57**
		P											-	0.42**	0.45**
12	Score (UGS)	A												-	0.86**
		P												-	0.90**

A= Akola
P = Patancheru

* Significant at 5%
** Significant at 1%

GS = Germinated Seed
UGS = Ungerminated seed

F.m. = *F. moniliforme*
F.p. = *F. pallidoroseum*

Table : 70 Correlation coefficient between fungal load of germinated and ungerminated seed (treated), Akola and Patancheru, 1996

Sr. No	Characters	Loca -tion	Germi nated seed	Ungermi- nated seed	*F. m.*	*F.p.*	*C. lunata*	Other fungi	Score	*F. m.*	*F. p.*	*C. lunata*	Other fungi	Score	TGMR
			GS	UGS	GS	GS	GS	GS	GS	UGS	UGS	UGS	UGS	UGS	
1	Germinated Seed	A	-	-0.99**	-0.72**	-0.36**	-0.40**	-0.25	-0.72**	-0.89**	-0.63**	-0.92**	-0.75**	-0.69**	-0.75**
		P	-	-0.99**	0.45**	0.46**	0.60**	0.43**	-0.72**	-0.94**	-0.94**	-0.95**	-0.83**	-0.77**	-0.83**
2	Ungerminated seed	A		-	0.72**	0.36**	0.40**	0.26*	0.73**	0.89**	0.63**	0.92**	0.75**	0.69**	0.75**
		P		-	-0.45**	-0.47**	-0.60**	-0.43**	0.71**	0.94**	0.94**	0.95**	0.83**	0.76**	0.83**
3	*F. moniliforme* (GS)	A			-	0.49**	0.51**	0.33	0.75**	0.70**	0.44**	0.62**	0.54**	0.73**	0.69**
		P			-	0.60**	0.59**	0.46**	-0.04	-0.32*	-0.44**	-0.52**	-0.39**	-0.09	-0.08
4	*F. pallidoroseum* (GS)	A				-	-0.07	-0.08	0.13	0.41**	0.30*	0.21	0.36**	0.19	0.14
		P				-	0.48**	0.36**	-0.22	-0.34**	-0.41**	-0.53**	-0.45**	-0.21	-0.28*
5	*C. lunata* (GS)	A					-	0.76**	0.77**	0.33*	0.01	0.48**	0.23	0.80**	0.71**
		P					-	0.65**	-0.10	-0.53**	-0.56**	-0.60**	-0.54**	-0.14	-0.33*
6	Other fungi (GS)	A						-	0.56**	0.23	-0.04	0.31*	0.06	0.60**	0.59**
		P						-	-0.03	-0.36**	-0.44**	-0.43**	-0.38**	-0.03	-0.15
7	Score (GS)	A							-	0.62**	0.36	0.73**	0.53*	0.95**	0.87**
		P							-	0.71**	0.64**	0.70**	0.54**	0.94**	0.83**
8	*F. moniliforme* (UGS)	A								-	0.47**	0.69**	0.58**	0.61**	0.59**
		P								-	0.90**	0.80**	0.69**	0.78**	0.85**
9	*F. pallidoroseum* UGS)	A									-	0.50**	0.48**	0.26*	0.39**
		P									-	0.86**	0.71**	0.72**	0.76**
10	*C. lunata* (UGS)	A										-	0.69**	0.70**	0.76**
		P										-	0.84**	0.68**	0.74**
11	Other fungi (UGS)	A											-	0.54**	0.68**
		P											-	0.57**	0.66**
12	Score (UGS)	A												-	0.85**
		P												-	0.85**

A= Akola
P = Patancheru

* Significant at 5%
** Significant at 1%

GS = Germinated Seed
UGS = Ungerminated seed

F.m. = *F. moniliforme*
F.p. = *F. pallidoroseum*

IX - III

Table : 71 Correlation coefficient between physical characters, Akola and Patancheru, 1996

Sr. No	Characters	100 grain weight	Grain hardness	End. texture	Ele. Conducti-vity	DTF	Glume covering	Meso. thickness	*F. moniliforme*	*F. pallidoroseum*	*C. lunata*	Other fungi	TGMR	Germination
1	100 grain weight	A	0.09	-0.02	0.11	0.22	-0.26*	0.21	0.28*	-0.26*	0.25	0.07	0.40**	-0.22
		P	0.03	0.09	0.14	-0.02	-0.25	-0.02	0.02	-0.11	-0.12	0.03	0.08	0.01
2	Grain hardness	A		-0.61**	0.15	0.42**	0.19	0.13	0.10	-0.32*	0.17	0.10	0.05	-0.07
		P		-0.33*	-0.19	0.39**	-0.05	0.07	-0.26*	-0.11	0.25	0.50**	-0.23	0.30*
3	End. texture	A			-0.51**	-0.54	0.01	-0.39*	-0.35**	0.41**	-0.52**	0.14	-0.39**	-0.41**
		P			-0.54**	-0.51**	0.06	-0.55**	-0.59**	-0.17	-0.24	0.06	-0.87**	0.52**
4	Ele. conductivity	A				0.54**	-0.07	0.56**	0.67**	-0.33*	0.61**	-0.44**	0.64**	-0.66**
		P				0.40**	-0.12	0.59**	0.72**	0.08	0.23	-0.31**	0.82**	-0.82**
5	DTF	A					-0.33*	0.41**	0.37**	-0.32*	0.37**	-0.19	0.29*	-0.38**
		P					-0.05	0.39**	0.31*	0.26*	0.46**	0.24	0.34**	-0.20
6	Glu. covering	A						-0.14	-0.13	-0.12	-0.19	-0.04	-0.10	0.06
		P						-0.13	-0.06	0.02	-0.04	-0.07	-0.05	0.11
7	Meso. thickness	A							0.51**	-0.38**	0.68**	-0.20	0.65**	-0.57**
		P							0.58**	0.18	0.14	-0.10	0.64**	-0.53**
8	*F. moniliforme*	A								-0.19	0.45**	-0.52	0.68**	-0.82**
		P								0.49**	-0.08	-0.50**	0.77**	-0.76**
9	*F. pallidoroseum*	A									-0.40**	0.02	-0.41**	0.28*
		P									-0.17	-0.18	0.19	-0.19
10	*C. lunata*	A										0.01	0.73**	-0.59**
		P										0.23	0.19	-0.23
11	Other fungi	A											-0.31*	0.56**
		P											-0.24	0.41**
12	TGMR	A												-0.78**
		P												-0.83

* Significant at 5% A = Akola

** Significant at 1% P = Patancheru

X - IV

Table 72 Correlation coefficient between biochemical characters, Akola, 1995

Sr. No	Characters	Protein	Soluble sugars	Tannins	Flavan-4-ols	Grain hardness	TGMR
1	Protein	-	0.27*	0.01	-0.15	0.29*	0.16
2	Soluble sugars			0.35**	0.24	0.26*	-0.26*
3	Tannins				0.73**	-0.37**	-0.75**
4	Flavan-4-ols					-0.59**	-0.78**
5	Grain hardness						- 0.30*

* Significant at 5% ** Significant at 1%

Table :73 Correlation coefficient between protein fractions and physical characters Akola and Patancheru, 1996

Sr No	Characters	Albumin and Gobulin	Prolamin	Cross link Prolamin	Glutelin like	Glutelin	Resi-dues	Meso carp thick-ness	Endos-perm texture	Germina-tion	Grain hardness
1	Alb. & Glob.	-	0.55*	0.36*	-0.73**	-0.78**	-0.10	0.09	-0.45**	-0.37	0.24
2	Prolamin			0.64**	-0.69**	-0.66**	0.34	0.35	-0.73**	-0.69**	0.63**
3	Cross link Prol.				-0.58**	-0.59**	0.11	0.42*	-0.57**	-0.60**	0.55**
4	Glutelin like					0.72**	-0.18	-0.20	0.62**	0.57**	-0.47**
5	Glutelin						-0.07	-0.34	0.52**	0.56**	-0.42*
6	Residues							0.10	-0.10	-0.32	0.02
7	Meso. thickness								-0.33	-0.48**	0.41*
8	End. texture									0.44*	0.77**
9	Germination										-0.38*

* Significant of 5% ** Significant at 1%

Table: 74 GCA effects in parents of 10 × 10 diallel of F_1 crosses and F_2 progenies

Sr. No	Characters	SPV-1201		ICSB-101B		AKms-14B		SRT-26B		GJ-35-15-15		SPV-946		SPV-104		IS-2284		IS-6335		IS-9471	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
1	100 grain weight	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
2	Grain hardness	-	+	-	+	+	+	+	+	+	+	-	+	-	+	-	+	+	+	+	+
3	Endosperm texture	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
4	Electrical conductivity	-	+	-	+	-	-	-	+	-	+	-	+	-	+	-	+	-	+	-	-
5	DTF	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Plant height	+	-	+	+	+	-	+	-	+	+	+	+	+	-	+	-	+	-	+	+
7	Cob length	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Glume covering	-	+	+	+	-	+	-	+	-	-	-	-	-	-	+	-	-	+	+	-
9	Mesocarp thickness	+	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-
10	TGMR	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Germination	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	*F. moniliforme*	-	+	-	-	-	-	-	-	-	+	-	+	-	+	-	+	-	+	-	+
13	*F. pallidoroseum*	-	-	-	-	+	-	-	-	+	-	+	-	+	-	-	-	-	-	+	-
14	*C. lunata*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
15	Other fungi	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+	-	+	+	-	-
16	Proteins	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
17	Soluble sugars	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
18	Tannins	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-
19	Flavan-4-ols	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-

\+ Significant and desirable general combining ability estimates

\- Non-significant and undesirable general combining ability estimates

X – 2

Table : 75 Superior combinations showing significant sca effects for germination (%) with their desirable sca effects for various components

Sr. No	Desirable crosses for germination (%) on the basis of sca effects of F_1 crosses	Sca estimates for germination (%) in F_1 crosses	Sca estimates for germination (%) in F_2 progenies	Significant sca effects for components characters in F_1 crosses	Significant sca effects for components characters in F_2 progenies
1	AKms-14B x IS-6335	15.785**	9.286**	100 grain weight, electrical conductivity, DTF, mesocarp thickness, TGMR, *F. moniliforme*, protein, tannins and flavan-4-ols	Electrical conductivity and TGMR.
2	AKms-14B x IS-9471	12.769**	6.604**	Electrical conductivity, DTF, TGMR, soluble sugars, tannins and flavan-4-ols	TGMR
3	IS-2284 x IS-6335	10.839**	-4.031	Endosperm texture, plant height and tannins	-
4	ICSB-101B x IS-9471	10.526**	4.832	Mesocarp thickness and tannins	-
5	SPV-104 x IS-9471	10.111**	1.296	Electrical conductivity, DTF, mesocarp thickness, TGMR, tannins and flavan-4-ols	-
6	SPV-104 x IS-2284	9.925**	3.796	Electrical conductivity, mesocarp thickness, *F. moniliforme*, protein, tannins and flavan-4-ols	Electrical conductivity
7	ICSB-101B x IS-2284	9.225**	1.152	Mesocarp thickness, TGMR, *F. pallidoroseum* and tannins	Glume covering
8	SPV-104 x IS-6335	8.824**	-1.337	Electrical conductivity, DTF, cob length, protein, tannins and flavan-4-ols	-
9	SPV-1201 x SRT-26B	8.229**	8.270**	100 grain weight	-
10	GJ-35-15-15 x IS-6335	7.987**	-1.102	DTF, mesocarp thickness and flavan-4-ols	-

Table : 76 Gene action of various parameters related to grain mold resistance in 10 × 10 diallel (F_1-F_2) progenies of sorghum lines

Sr.No.	Characters	Gene action in	
		F_1 diallel	F_2 diallel
1	100 grain weight	Additive	-
2	Grain hardness	Additive	Non-additive
3	Endosperm texture	Additive	-
4	Electrical conductivity	Non-additive	Additive
5	DTF	Non-additive	-
6	Plant height	Non-additive	Additive
7	Cob length	Additive	Additive
8	Glume covering	Additive	Non-additive
9	Mesocarp thickness	Non-additive	-
10	TGMR	Additive	Additive
11	Germination	Non-additive	Non-additive
12	*F. moniliforme*	Additive	Additive/ Non-additive
13	*F. pallidoroseum*	Non-additive	Non-additive
14	*C. lunata*	Additive	Additive
15	Other fungi	Non-additive	Additive
16	Proteins	Non-additive	-
17	Soluble sugars	Non-additive	-
18	Tannins	Additive	-
19	Flavan-4-ols	Additive	-

X – 4

Table: 77 Heterotic crosses for germination (%) showing heterosis and heterobeltiosis for other characters

Sr. No	Superior crosses for germination(%) on basis of mean performance	Mean germination of (%) of crosses	Mean performance of P_1	Mean performance of P_2	Heterosis for germination (%) over mid parent H_1	Heterosis for germination (%) over better parent H_2	Significant heterosis for component characters: Over mid parent H_1 (%)	Over better parent H_2 (%)
1	ICSB-101B x IS-2284	90.00	36.75	71.75	51.76**	24.28**	Electrical conductivity, mesocarp thickness, TGMR, *F. pallidoroseum*, tannins and flavan-4-ols	Electrical conductivity, glume covering, mesocarp thickness, TGMR and flavan-4-ols
2	ICSB-101B x IS-6335	89.75	36.75	69.50	51.44**	24.69**	Electrical conductivity, DTF, mesocarp thickness, TGMR, *F. moniliforme* and flavan-4-ols	Electrical conductivity, DTF, mesococarp thickness, TGMR, *F. moniliforme* and *C. lunata*
3	ICSB-101B x IS-9471	88.25	36.75	63.75	57.68**	33.45**	Electrical conductivity, mesocarp thickness, TGMR, tannins and flavan-4-ols	Electrical conductivity, glume covering, mesocarp thickness, TGMR, *F. moniliforme C. lunata*
4	SPV-1201 x IS-2284	86.75	48.75	71.75	39.30**	22.50**	Mesocarp thickness, TGMR and flavan-4-ols	Electrical conductivity, mesocarp thickness and TGMR,
5	AKms-14B x IS-6335	85.50	15.75	69.50	76.76**	20.08*	100 grain weight, electrical conductivity, DTF, mesocarp thickness, TGMR *F. moniliforme*, tannins and flavan-4-ols	Electrical conductivity, DTF, mesocarp thickness, TGMR and *F. moniliforme*
6	GJ-35-15-15 x IS-6335	84.75	51.00	69.50	38.09**	19.76*	Electrical conductivity, DTF, mesocrp thickness, TGMR and flavan-4-ols	Electrical conductivity, DTF, mesocarp thickness, TGMR and *C. lunata*
7	SRT-26B x IS-9471	84.25	46.75	63.75	33.73**	19.74*	Electrical conductivity, mesocarp thickness, TGMR, tannins and flavan-4-ols	Electrical conductivity, mesocarp thickness, TGMR *F. moniliforme* and *C. lunata*
8	IS-2284 x IS-9471	84.00	71.75	63.75	19.83**	15.09	Glume covering and mesocarp thickness	Mesocarp thickness and glume covering
9	SRT-26B x IS-6335	82.75	46.75	69.50	33.03**	15.63	100 grain weight, electrical conductivity, DTF, mesocarp thickness, TGMR *C. lunata*, tannins and flavan-4-ols	Electrical conductivity, DTF, mesocarp thickness, TGMR and *C. lunata*
10	SPV-104 x IS-6335	81.75	28.00	69.50	50.32**	13.79	Electrical conductivity, DTF, cob length, mesocarp thickness, *F. moniliforme*, soluble sugars, tannins and flavan-4-ols	Electrical conductivity, DTF, mesocarp thickness, TGMR and *F. moniliforme*

APPENDIX – XI-1

Table 78. Composition of stain

Mac Grunwald's stain	
Methylene blue	0.5%
Eosin Y	0.5% in methanol
Pianeze III b	
Malachite green	0.5 g
Acid fuschin	0.1 g
Martin gleb	0.01 g
Water	150 ml
Ethanol (95%)	50 ml

Host tissues staining green and fungal mycelium deep pink in lignified and non-lignified tissue.

APPENDIX – XI-1

Table 78. Composition of stain

Mac Grunwald's stain	
Methylene blue	0.5%
Eosin Y	0.5% in methanol
Pianeze III b	
Malachite green	0.5 g
Acid fuschin	0.1 g
Martin gleb	0.01 g
Water	150 ml
Ethanol (95%)	50 ml

Host tissues staining green and fungal mycelium deep pink in lignified and non-lignified tissue.

VITA

PAGE : 301

VITA

Gulab Daultrao Agarkar was borne on August 30th 1947 at Loni-District Amravati. He completed his higher secondary school certificate examination in 1964 from Smt. Ramparibai Chandak High School, Loni, in first division, B.Sc. (Agri.) from Shri Shivaji Agriculture College, Amravati in 1969, and stood 10th in order of merit and M.Sc. (Agri.) in Plant Pathology in 1971 in first division from College of Agriculture, Nagpur, Dr. PDKV, Akola.

He was appointed as Agricultural Officer in 1971 at Agriculture. Research Station, Washim. He was selected as Asstt. Prof. of Plant Pathology in 1977 and till 1993 he was at College of Agriculture Akola. In 1993 he was selected for Ph.D. in service training and served for three years in Sorghum Research Unit as a Sorghum Pathologist. In 1998 he was again posted at College of Agriculture Akola and presently working at same place.

He has published five research articles in National Journals, participated and presented nearly 10 papers in National symposia and workshops. He has guided two students for thesis in M.Sc. (Agri.). He is associated with the release of sorghum hybrids SPH-840 and pre-release hybrids SPH-792, SPH-1010, and W-815 and W-2019 at the State level.

THESIS ABSTRACT

PAGES : 302 – 304

THESIS ABSTRACT

a)	Title of the thesis		Mechanism and genetics of grain mould resistance in sorghum".
b)	Full name of student	:	Gulab Daulatrao Agarkar
c)	Name and Address of major Advisor	:	Dr. R.B. Somani, Asso. Prof. of Plant Pathology & Head Deptt. of Agro-Product Processing Centre, Dr.P.D.K.V., Akola – 444 104
d)	Degree to be awarded	:	Ph.D.
e)	Year of award of degree	:	1999
f)	Major subject	:	Plant Pathology
g)	Total number of pages	:	304
h)	Number of words in abstract	:	696
i)	Signature of student	:	
j)	Signature, Name and Address of the forwarding authority	:	(Dr. N.L. Peshney) Head, Uni. Deptt.of Plant Pathology Dr. PDKV, Akola

ABSTRACT

Grain mold of sorghum is a complex problem involving several fungal species. Resistance to grain mold in sorghum is known to be imparted by various factors associated with host genotypes, fungal species and their interactions. The objectives of the present investigations were to : determine infection sites and colonization by major mold fungi (*Fusarium moniliforme, F. pallidoroseum* and *Curvularia lunata)*; determine physical, physiological and biochemical mechanism of resistance and determine genetics

and heretability of various host factors contributing to grain mold resistance in selected sorghum lines.

The experimental comprised of 10 divergent parents and their 45 F_1 corsses and 45 F_2, progenies of partial diallel, Experiments were conducted at two locations, Akola under natural condition during 1995 and 1996 and at Patancheru under controlled condition during 1996. Data were analyzed using model I, method 2 of Griffings (1956b) further extended by Singh (1973a, 1973b).

Data were recorded on agronomic, physical, pathological and biochemical parameters. Superior combination showing significant sca effects for germination with their desirable sca effects were observed in crosses Akms 14B x IS-6335, Akms 14B x IS-9471 and SPV-1201 x SRT - 26B. On the basis of superior mean performance in germination, four crosses viz. ICSB-101B x IS-2284, ICSB-101B x IS-6335, ICSB-101B x IS-9471 and SPV-1201 x IS 2284, were selected to understand significant heterosis for component characters. The results revealed that electrical conductivity, mesocarp thickness, thresh grain mold rating (TGMR), glume covering, tannins and flavan-4-ols are the major components imparting resistance. As regards to gene action governing inheritance, it was noticed that in F_1 diallel the gene action was non-additive for electrical conductivity, mesocarp thickness, germination, proteins, and it was additive for grain hardness, glume covering, TGMR, *F. moniliforme, C. lunata,* tannins and flavan-4-ols, whereas, in F_2 diallel, gene action changed for grain hardness and electrical conductivity.

Over all there was decrease in 100-grain weight, grain hardness, germination, *C. lunata* and fungal load; and increase in electrical conductivity, TGMR, *F. moniliforme* and *F. pallidoroseum* load at Patancheru compared with Akola location. *F. moniliforme*, *C. lunata*, and *F. pallidoroseum* were important mold fungi, at Patancheru, while *C. lunata* and *F. moniliforme* were important at Akola. *F. pallidoroseum* remained a minor mold fungi at Akola. In general more fungal load was recorded at Akola during 1996 than in 1995. Pre-treatment with $HgCl_2$ reduced fungal load of grain deteriorating fungi and improved seed germination, except *C. lunata* at Patancheru. However, fungal load of all fungi was reduced at Akola in both seasons.

Soluble sugars could not show any effect on grain mold resistance. However, tannins and flavan-4-ols were important biochemical parameters conferring resistance to grain mold singles or in combination. Prolamin and cross-link prolamin were recorded low in colored grain parents and crosses, have resistance to grain mold in colored grain could be attributed to tannins and flavan-4-ols. Prolamin and cross-link prolamin were more in white grain thus contribute for mold resistance. *Fusarial* infection (both species) takes place through hilar areas, however, *Curvularial* infection takes place from both ends i.e. hilar and stylar or directly through pericarp.

Germinated seed (treated with $HgCl_2$) showed significant negative association with fungal load of all fungi at Akola, while it was positive at Patancheru. Ungerminated seed exhibited positive with fungal load of all fungi and score, negative with germination and positive with TGMR. Grain hardness had significantly negative correlation with endosperm texture, however, endosperm texture showed negative association with electrical conductivity, mesocarp thickness, *F. moniliforme, C. lunata* and TGMR. Mesocarp thickness exhibited positive correlation with *F. moniliforme, C. lunata* and TGMR and negative with germination. Prolamin and cross-link prolamin had showed positive correlation with grain hardness, however it was negative with endosperm texture and germination.

Considering the above results it is concluded that :

1. Parental lines IS-9471, SPV-1201, IS-6335, GJ-35-35-15 and IS-2284 with high gca effect for most of the characters contributing towards resistance to grain mold may be utilized in hybrid breeding program.
2. The cross : Akms 14B x IS-6335, ICSB-101B x IS-9471, ICSB-101B x IS-2284, SPV-104 x IS-6335, GJ-35-35-15 x IS-335 and SPV-1201 x SRT-26B exhibited high gca effects, desirable heterosis for most of the characters and additive gene action for important traits (agronomic, physical and biochemical) related to grain mold resistance. Therefore it is suggested that these crosses and their progenies may be utilized to generate better tolerance to grain mold infection.
3. Important traits imparting resistance to grain mold fungi are : low electrical conductivity, thin mesocarp, low TGMR, grain hardness, more glume covering, more tannins, more flavan-4-ols, more prolamin and cross-link prolamin.