SEASONAL VARIATION IN SORGHUM RESISTANCE TO SHOOT FLY

(Atherigona soccata Rondani)

by

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CERTIFICATE

This is to certify that the thesis entitled "**SEASONAL VARIATION IN SORGHUM RESISTANCE TO SHOOT FLY (*Atherigona soccata* Rondani)**" submitted in partial fulfillment of the requirements for the degree of "**Master of Science in Agriculture**" of the Andhra Pradesh Agricultural University, Hyderabad, is a record of the bonafide research work carried out by **MR. MAHAD ABDI FARAH** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of the investigations have been duly acknowledged by the author of the thesis.

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DECLARATION

I declare that the thesis entitled "**SEASONAL VARIATION IN SORGHUM RESISTANCE TO SHOOT FLY** (***Atherigona soccata*** **Rondani)**" is a bonafide record of the work done by me during the period of research at ICRISAT, Patancheru. This thesis has not formed in whole or in part, the basis for the award of any degree or diploma.

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ABSTRACT

The studies on seasonal variation in sorghum (Somalia germplasm) resistance to shoot fly *Atherigona varia soccata* Rondani were conducted in four experimental sowings in three seasons viz. late postrainy season 1990-91, early rainy 1991, and early postrainy 1991-92 at ICRISAT Center. Investigations included evaluation for resistance of the entries to the shoot fly over seasons for less oviposition, less damage resulting in fewer deadhearts and tolerance/recovery resistance.

In view of seasonal variation, entries were assessed in relation to various environmental parameters namely temperature, humidity and rainfall and their influence on varietal resistance was monitored.

INTRODUCTION

CHAPTER I

INTRODUCTION

Sorghum, *Sorghum bicolor* (L.) Moench Graminae is one of the major staple food crops in the semi-arid tropics, and ranks fifth in average production among the world's cereal crops following wheat, rice, corn, and barley (Young and Teetes, 1977). World production of sorghum grain is currently 52 million tonnes which is produced on some 42 million ha (FAO, 1985). It is believed that sorghum originated in eastern Africa (de Wet et al. 1970). But it is presently grown on all six continents. In the technologically advanced countries it is used mainly for animal fodder (Leuschner, 1985), but in the semi-arid tropics where it is a major food source of the population, it is also used as fodder, fuel, and building material. Three-quarters of the world's acreage devoted to sorghum production is located in Africa and India which however, together produce only one third of the world's produce (Swarna, 1991). In Somalia, sorghum is an important food crop and is currently grown on 500,000 ha with very low yields (Mao, 1988). In India, sorghum is the third important cereal after rice and wheat, and is currently grown on 15.3 million hectares (FAO, 1986). Generally, grain yields of sorghum on peasant farms are low, ranging from 500-800 kg ha^{-1} (Sheshu Reddy, 1982).

One of The most important factors that are responsible for low yeilds is losses resulting from insect pest attack. Of the several the thousand accessions of sorghum cultivars available, most are susceptible to at least a hundred species of insects, known to cause various levels of damage (Young and Teetes, 1977). However, the sorghum shoot fly, *Atherigona soccata* Rondani,*Chilo partellus* Swinhoe, and *Busseola fusca* Fuller; head bug, *Calocoris angustatus* Lethiery; and sorghum midge, *Contrania sorghicola* Coquillet are the major species which cause extensive damage to sorghum at different growth stages.

The shoot fly is widely distributed in Asia and Africa. It has been reported in almost all sorghum growing areas of the world. It attacks sorghum from 1 to 4 weeks after seedling emergence and damage is caused by the larvae which after hatching, crawl along the leaf sheath then upwards into the plant whorl from where it migrates dawnwards until it reaches the growing point. Feeding at this point results in death of the central whorl leaf and the typical symptom which is referred to as "deadheart". Fly population varies across seasons and years, depending upon environmental factors and cropping systems. Shoot fly population monitoring with fish meal traps established in Bonka Dryland Agricultural Research Station (BDARS), Somalia, in 1987 showed that the peak emergence of flies occurred between 1-16 July during long rains season. During short rains of

1987-88, peak emergence occured from 19 December to 3 January (Lavigne, 1988). However the identification of the species of *Atherigona* is still unknown and the biology and economic importance of shoot fly in Somalia are yet to be thoroughly studeid.

The majority of the sorghum grown in Somalia belongs to the race durra. It matures early (around 100 days) and has good forage value (Prasada Rao, 1987). It is well adapted to the region for both grain and fodder yield even under biotic (shoot fly and stem borers) and abiotic (terminal drought) stress (Prasada Rao, 1987).

Generally, with the introduction of newly developed high yielding hybrids that are highly susceptible to insect pests, the problem has become more serious (Jotwani, 1981). Recent studeis have also shown that introduced exotic cultivars were not superior to the local sorghum when tested for yield, insect, and disease resistance at BDARS. This was attributed mainly to their lateness in maturity compared to locals (Moa, 1988). Control of shoot fly on sorghum has proven difficult. Cultural practices such as early sowing and the eradication of alternate wild hosts reduce damage but are not always practical. Some of the conventional methods have only been successful when chemicals with high mamalian toxicity and which are not cost effective for subsistence farmers are used.

Plant resistance is important in pest manegement of dry land crops and is of particular relevance in sorghum. The potential of plant breeding for pest resistance is primarily limited by the genetic variation in the host species. The first reported attempt to screen a collection of 214 sorghum lines for shoot fly resistance was by Ponnaiya (1951a). Blum (1976) reported non-preference for oviposition as a primary resistance mechanism for shoot fly in sorghum. At ICRISAT, susceptible cultivars are preferred for egg laying in terms of higher number of eggs per plant and plants with eggs. Doggett (1972) and Blum (1972) have also established the existence of recovery resistance as a secondary mechanism of resistance.Some sorghum cultivars possess high levels of antibiosis in which mortality of first instar larvae was very high, growth of the surviving larvae was significantly lower, and female longevity was also reduced (Raina *et al.* 1981). Maiti *et al.* (1980) suggested that resistant sorghum lines possessed trichomes on the abaxial surface of the leaf and was related to a lesser frequency both of oviposition by the shoot fly and of subsequent larval damage. Agarwal and House (1982) found that the level of resistance was greater when both the glossy (pale green smooth and shining leaves) expression and trichome traits occur together. The movement of freshly hatched larvae to the base of the central shoot is facilitated by the accumulation of dew on the sorghum leaves which may remain wet longer (Raina *et al.* 1981). Leaf

surface wetness (LSW) was shown to be higher in 10 days old seedlings of susceptible sorghum genotyptes than in seedlings of other ages and genotypes (Nwanze *et al.* 1990). Many shoot fly breeding lines with moderate levels of resistance and reasonable yield potential have been developed Ghode 1971, Kundu and Sharma 1975; Sharma *et al.* 1983. Under traditional farming system, where farmers use little or no agricultural inputs, host plant resistance is thus one of the most important components for sound pest management.

The cultivated sorghum of the semi-arid regions of East Africa occur in almost all the sorghum ecological zones of the world (Guiragossian and Peacock, 1986). Indeed environmental conditions that cause plant stresses are all too common and severely effect food production in eastern Africa.Environmental factors can reduce the performance of sorghum thereby altering the suitability of the plant as host to shoot flies.

Ecological resistance results from some temporary shifts in the environmental conditions. Plant development is dependent on temperature suitable for metabolic activity (Threshow, 1970). Water is directly or indirectly required for all life processes and every chemical reaction, mainly photosynthesis and respiration (Threshow, 1970).Moreover, water is a medium in which essential nutrients are carried from the soil solution to the cell. Light is a basic form of

energy that directly or indirectly propels the life processes of most living organisms. Plant response (growth development, differentiation, and reproduction) are determined by the quality, intensity and duration (photoperiod) of light (DiCosmo and Towers, 1984). These ecological factors may influence shoot fly by altering its microenvironment and the chemical and physiological characteristics of its host and therefore, nutritional value of their food. These alterations can lead to changes in the levels of resistance of sorghum to the shoot fly between seasons.

Therefore, a program was developed to screen the collection of Somali sorghum germplasm under sorghumshoot fly infestation at different seasons representing changing environmental conditions. The main objectives of these program were :

OBJECTIVES

1. To evaluate Somali sorghum germplasm at ICRISAT for resistance to the sorghum shoot fly *Atherigona soccata* Rondani across seasons.

2. To study the influence of environmental factors on the resistance of sorghum to shoot fly *A. soccata* Rondani damage.

3. To evaluate the performance and yeild potential of these sorghums under natural shoot fly infestation and no infestation (protected) situations.

REVIEW OF LITERATURE