Chickpea Breeding
Progress Report-10

CHICKPEA BREEDING

REPORT OF WORK

June 1980 - May 1981

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

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FOREWORD

This is an informal publication reporting work conducted by the Chickpea Breeding Subprogram in 1980-81. It is intended mainly for our own use and for the use of cooperators associated closely with the program, who have grown and are familiar with the materials described. For this reason we document all we have done in some detail. We list the crosses made and give the parentage of the segregating populations and more advanced materials we have grown. The report is large but we have omitted some tables by referring to previous reports of work, for example, R.O.W. 1979-80.

The data obtained from some of the trials is extremely variable and should be viewed with caution. Also statistical analysis is superficial and much remains still to be done, especially in summarising across seasons to measure progress. Some of the work will be contributed to scientific journals but much will not be reported elsewhere and so is reported here.

International nurseries and trials are mentioned only, but they form a major part of our operation and are described fully in a separate report (Progress Report No. 11) in preparation. A list of the seed materials distributed also forms the subject of a separate report (Progress Report No. 9).

Senior staff remained for the most part unchanged although Dr. Onkar Singh rejoined in August 1980 following completion of his Ph.D. Dr. H. D. Upadhyaya joined as Research Fellow in November 1980 and Dr. K.S. Prakash in March 1981. This season we commenced testing work at the College of Agriculture Farm, Gwalior under the supervision of Mr. M. D. Gupta, Senior Research Technician of ICRISAT. A staff list is given on Page i and a list of the projects on Page ii, with the names of the scientists responsible.

We acknowledge the participation of all those who cooperated in the assembly of the data and hope that some of the materials generated and described herein will prove to be of value to those who use them.

STAFF

Dr. Y.L. Nene	Leader, Pulses Improvement Program
Dr. J.B. Smithson	Principal Chickpea Breeder
Dr. K.B. Singh	Plant Breeder (Chickpea) (ICARDA, Aleppo, Syria)
Dr. Onkar Singh	Plant Breeder (Hissar)
Dr. S.C. Sethi	Plant Breeder (Hissar)
Dr. C.L.L. Gowda	Plant Breeder
Dr. Jagdish Kumar	Plant Breeder
Dr. H.D. Upadhyaya*	Research Fellow
Dr. K.S. Prakash*	Research Fellow
Mr. D.M. Pawar	Senior Supervisor (Hissar)
Mr. J.H. Miranda	Research Technician
Mr. B. Venkateswar Rao	Technical Assistant
Mr. Omvir Singh Tomar	Technical Assistant (Hissar)
Mr. Rajiv Kumar Kapoor*	Technical Assistant
Mr. Arvind Shukla*	Technical Assistant
Mr. Mohd. Aziz	Field Assistant II
Mr. Ramkishore	Field Assistant (Hissar)
Mr. S.C. Saxena	Field Assistant
Mr. K.J. Reddy	Field Assistant
Mr. Sube Singh	Field Assistant (Hissar)
Mr. K. Shivraj	Field Assistant
Mr. K. Shankeriah	Field Assistant
Mr. Eashwariah	Field Assistant
Mr. A.J. Rama Rao	Secretary II
Mr. Mewa Singh	Clerk/Typist (Hissar)
Miss Gyaneshwari Shukla	Clerk/Typist
Mr. Syed Liaqatullah	Driver/General Assistant
Mr. Zama Shah Khan	Driver/General Assistant
Mr. Phul Singh	Driver/General Assistant (Hissar)
Mr. Kashi Ram**	Security Guard II (Hissar)

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* Joined the program during the year.

** Joined in April 1979.

CHICKPEA BREEDING

LIST OF APPROVED PROJECTS

No.	Title	Project Scientist	Cooperator(s)
CP-brd-1	Development of desi cultivars and superior breeding lines	S.C. Sethi C.L.L. Gowda Onkar Singh	M.P. Haware S.S. Lateef U. Singh M.V. Reddy
CP-brd-2	Development of kabuli cultivars and superior breeding material	J. Kumar S.C. Sethi	M.P. Haware S.S. Lateef U. Singh M.V. Reddy
CP-brd-5	Breeding for adaptation to late sowing	S.C. Sethi	C.L.L. Gowda J. Kumar M.P. Haware M.V. Reddy U. Singh
CP-brd-6	Development of high protein breeding lines	J. Kumar	U. Singh
CP-brd-7	Breeding for new plant types	C.L.L. Gowda Onkar Singh	N.P. Saxena
CP-brd-8	Studies on desi-kabuli introgression	C.L.L. Gowda	J. Kumar
CP-brd-9	Comparison of breeding methods	S.C. Sethi	C.L.L. Gowda J. Kumar
CP-brd-11	International Cooperation	J.B. Smithson J. Kumar	Y.L. Nene W. Reed P.J. Dart
CP-brd-12	Genetic studies of qualitative and quantitative characterss	S.C. Sethi	J. Kumar C.L.L. Gowda
CP-brd-13	Breeding chickpeas for early sowing	C.L.L. Gowda	R.P.S. Pundir
CP-brd-14	Studies of desi-kabuli introgression	C.L.L. Gowda	S.C. Sethi J. Kumar
CP-brd/ path-16	Breeding for disease resistance	J. Kumar M.P. Haware M.V. Reddy	S.C. Sethi C.L.L. Gowda
CP-brd/ ent-17	Breeding for reduced susceptibility to *Heliothis*	C.L.L. Gowda S.S. Lateef	S.C. Sethi J. Kumar

CONTENTS

INTRODUCTION

The report describes work carried out in 1980-81.

The projects have been restructured since 1979-80 but the content remains the same. Breeding for early planting in peninsular India and for disease and insect resistance have been removed from the other projects and allotted separate project numbers, CP-brd-13, CP-brd/path-16 and CP-brd/ent-17 respectively. A fourth new project has been created (CP-brd-14) to cover a study of desi-kabuli introgression.

Project CP-brd-1, the development of desi cultivars, from which most of the entries in international nurseries and trials and our contributions to coordinated trials arise, continues to have most emphasis. However, breeding for disease and insect resistance have expanded. Entries from CP-brd/path-16 are now being contributed to international nurseries and coordinated trials and soon some will derive also from CP-brd/ent-17.

Project CP-brd-2, the development of kabuli cultivars, continues at Hissar and has contributed three entries for coordinated trials this season.

In Projects CP-brd-1 and -2 bulk methods of breeding are employed and we are in the process of monitoring their effectiveness.

Project CP-brd-7, breeding for tall, double-podded and multiseeded types, is also receiving greater emphasis. CP-brd-5 is concerned with breeding for late planting in north India. In CP-brd-6 we are monitoring the seed protein contents of advanced breeding lines, examining the inheritance of seed protein and have initiated a breeding program to improve seed protein content. CP-brd-8, -9 and the new -14 are basic studies of breeding methodology and CP-brd-12, the inheritance of various characteristics of value in plant improvement.

The extension of the materials and ideas generated in these projects are the subjects of Project CP-brd-11, international cooperation, which includes workshops and conferences, visits between ICRISAT and other centers, and training.

The main features of the climates at Hyderabad and Hissar are illustrated in Figure 1. The season was not favourable for chickpea. In south and central India the rains ceased in mid-September, so that soil moisture was depleted early, and the yields of all but the shortest duration materials were reduced at Hyderabad. Fusarium wilt and salinity also caused considerable plant mortality. In north India rainfall was heavier than normal during the cropping season and at Hissar, Botrytis gray mold and Ascochyta blight caused considerable damage to the chickpea crop, reducing yields and invalidating data from many of the trials. In particular, no data are reported from the F1/F2 and F2 diallel and line x tester sets and other F2 and F3 trials at Hissar but the entries and their parentage are listed in an appendix to Project CP-brd-1 as those with sufficient seed were advanced for further testing and selection in the following season.

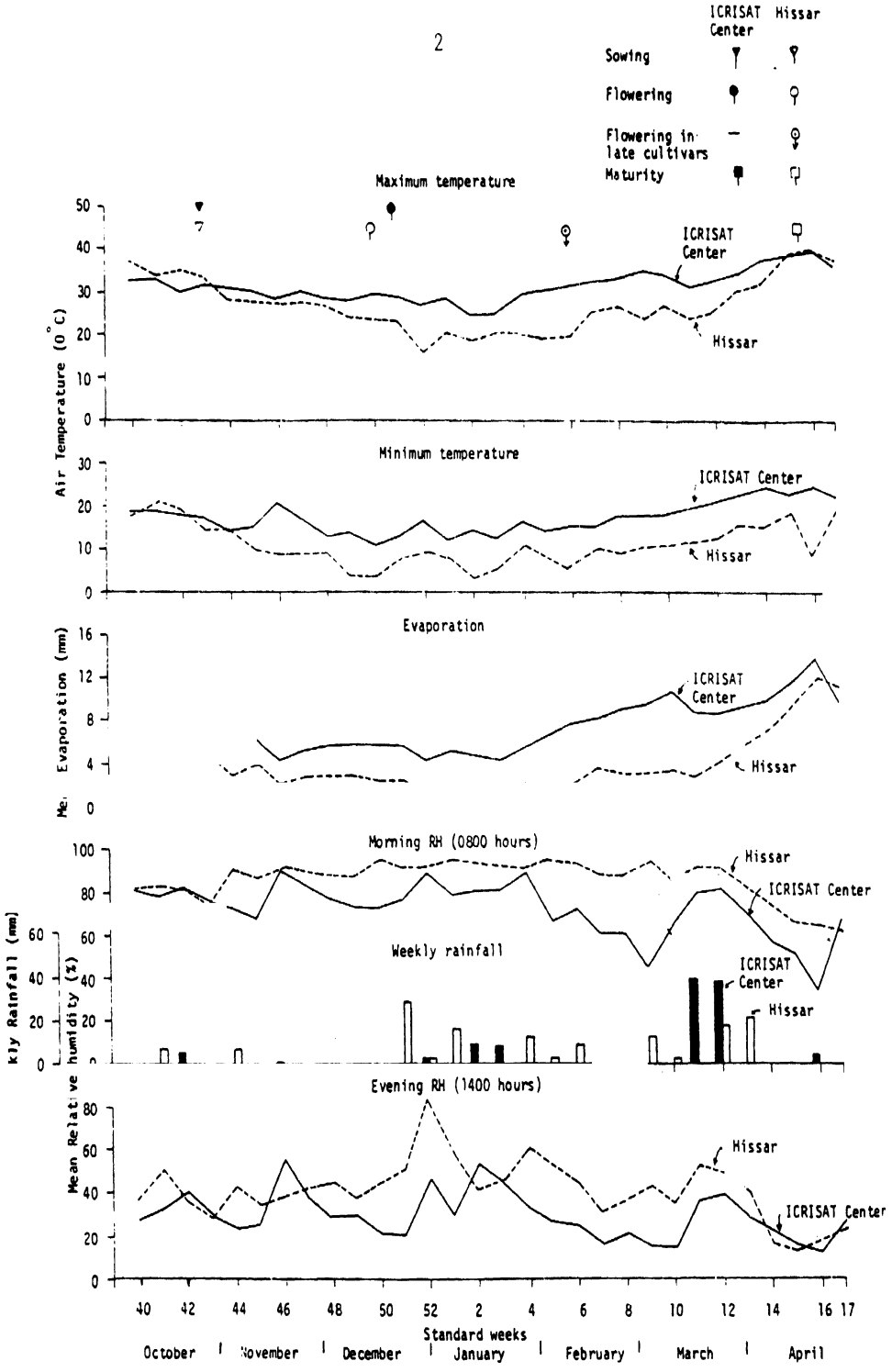

Figure 1. Graphic representation of weather data at HAU farm, Hissar and ICRISAT Center, Patancheru during chickpea growing season, 1980/81.

SUMMARY

CP-brd-1: Development of desi cultivars and superior breeding lines.

1. Three hundred and ninety four desi entries were included in the crossing block and we used 146 to make 298 crosses.

2. F_1(85) and F_2(231) generations showed good agreement in replicated tests. Variation was predominantly additive but there were non additive effects in some sets for some characters.

3. A further 46 F_2s and 12 F_3s were included in multilocational trials conducted as part of AICPIP.

4. We included 133 F_3s in replicated tests at Hyderabad, Hissar and Gwalior. None were superior to the checks but we selected 70 high, intermediate and poor yielders at each location to sow as F_4 bulks for single plant selection in 1980-81.

5. From the F_3 trials in 1979-80 we selected and grew 80 and 110 F_4 bulks at Hyderabad and Hissar, respectively. At Hyderabad, there was little correlation with performance in 1979-80, but we selected over 3000 single plants for progeny rows in 1981-82. At Hissar 963 plants surviving *Botrytis* damage were selected for advancing.

6. We grew over six thousand rows of nearly four thousand progenies at Hyderabad and Hissar and selected 120 rows for international nurseries and preliminary trials and 2398 single plants for further progeny tests.

7. In preliminary yield trials a few entries gave higher yields than the checks and will be included in international nurseries in 1981-82.

CP-brd-2: Development of kabuli cultivars and superior breeding lines.

8. We included 82 kabuli genotypes in the crossing block and made 96 crosses involving 29 different parents.

9. In a line x tester set of 39 F_1s GCA estimates were much higher than those of SCA.

10. We tested 124 F_2s and 34 F_3s in replicated trials and the best have been selected for F_3 trials or F_4 bulks in 1981-82.

11. A further 2400 F_2 and more advanced populations and progenies were also grown and 262 were bulked and 653 single plants selected for further testing.

12. One hundred and seventy five F_5 and more advanced lines were evaluated in replicated trials. In all the trials there were entries with significantly higher yields than the check (L-550) and several have been selected for trials in 1981-82, including two for coordinated trials.

CP-brd-5: Breeding for adaptation to late sowing.

13. All the trials at Hissar were badly affected by disease, especially *Botrytis*, and yields were low and extremely variable.

14. There was good agreement between F_1 and F_2 performance in a late sown replicated trial of 21 crosses. We selected 733 single plants in unreplicated plots of the same crosses.

15. We grew 12 contrasting genotypes, and 45 desi and 20 kabuli genotypes in replicated trials under normal and late sown conditions. The results were highly variable and the tests will be replicated in 1981-82.

16. We also evaluated 500 germplasm accessions in normal and late-sown and high fertility conditions and a few, which survived *Botrytis* will be tested further next season.

CP-brd-6: Development of high protein breeding lines.

17. We continued to monitor the seed protein contents of crossing block and international and coordinated trial entries.

18. T-1-A maintained its high protein percentage.

19. Seed inoculation with *Rhizobium* did not improve the seed protein content of the produce.

20. There were wide ranges in seed protein percentage among most sets and many entries were significantly better than the checks.

21. F_3 progenies of crosses of T-1-A showed seed protein percentages similar to T-1-A.

CP-brd-7: Breeding for new plant types.

a. Tall types

22. We crossed 5 tall and 8 conventional type genotypes in a line x tester set and made a diallel cross of 3 short and 3 long duration tall lines from earlier crosses.

23. In an 8x6 line x tester F_1 trial variation was predominantly additive for all characters measured.

24. We selected 399 single plants in 78 F_2 bulks grown at Hyderabad.

25. At Hyderabad, 47 F_3 bulks were grown and 133 single plants selected and at Hissar we selected 467 single plants in F_3 bulks (52) and progeny rows (45).

26. We grew 661 F_4 to F_7 progenies at Hyderabad and 1415 at Hissar and selected 311 and 379 single plants respectively and 25 rows at Hissar.

27. In collaboration with the physiologist, promising tall types from earlier crosses were compared with conventional plant types in replicated trials at Hyderabad and Hissar at a range of plant populations and irrigation treatments. At Hyderabad Annigeri gave significantly higher yields than the best tall type and seed yields were improved by irrigation, to which tall types responded best. At Hissar the data were very variable. In no case, was there a significant interaction between plant type and plant population.

b. Multi seeded and double podded types.

28. We made a diallel cross of five multiseeded lines and also crossed them with six double-podded genotypes.

29. The F_1s of an 8x4 double podded line x multiseeded tester set were evaluated at Hissar. GCA variances were generally higher than those due to SCA.

30. We sowed 24 F_2s of an earlier 6x4 line x tester set of double podded and multi seeded types, but seeds/pod were not high.

31. Eighty one F_3 progenies with higher numbers of seeds per pod were harvested from over 500 progenies sown at Hyderabad and Hissar.

CP-brd-8: Evaluation of recurrent selection as a breeding method.

32. We tested F_5 progenies of the first selective mating series at Hyderabad but most were killed by wilt so we will test surviving lines in 1981-82.

CP-brd-9: Comparison of breeding methods.

33. The F_4 generations of six crosses to compare the pedigree, bulk and single pod descent methods of breeding were advanced at Hyderabad.

34. The F_1 and F_2 generations of a study of the variation generated by single and multiple crosses were advanced in Kashmir off-season and at Hyderabad in the main season.

CP-brd-11: International cooperation.

35. We distributed 99 sets of seven different trials to 41 cooperators in 17 countries.

36. We also supplied 1761 seed samples in response to specific requests.

37. New desi and kabuli entries were contributed to coordinated trials and others were continued. ICCC-4 and -13 were in the GCVT for the third year.

38. Thirteen breeders from the Indian national program visited Hyderabad or Hissar and selected breeding materials for their centers.

39. Visits by Chickpea Breeding Subprogram staff to other centers increased considerably both in India and elsewhere.

CP-brd-13: Breeding chickpea for early sowing.

40. We made 20 crosses among genotypes which have performed well under early sown conditions.

41. Forty seven entries with good performance when sown early were evaluated in early and normal sown situations at Hyderabad. The normal sowing produced the best yield but had to be irrigated for emergence while the early sowing was not irrigated. There were significant differences among entries and some sown early were not significantly poorer than the highest yielding entry sown at the normal time.

42. We also tested 248 germplasm accessions in early sown conditions in replicated trials and selected the best entries for further testing in 1981-82.

CP-brd-14: Studies of desi-kabuli introgression.

43. The F_1s of a 6x6 diallel of three desi and three kabuli types were grown off season in Kashmir.

44. The F_2s were evaluated in a trial at Hyderabad. The data were variable but their variances tended to be associated more with parental divergence than with sub group type. The proportions of the different seed types in DxK F_2s was influenced by parentage.

CP-brd-path-16: Breeding for disease resistance.

45. We made 20 crosses involving wilt resistant parents.

46. Eight F_2 populations were screened in the wilt sick plot at Hyderabad and we selected 85 resistant plants of good appearance. We also selected 199 plants among 39 F_2s and 34 F_3s grown in the wilt sick plot at Hissar.

47. We also grew 5546 F_3 to F_5 and backcross progenies and bulks at Hyderabad and selected nearly 2000 single plants and 479 lines.

48. At Hissar we sowed 574 F_4 and more advanced progenies and selected 30 plants and 5 rows. In addition, 1315 progenies from the desi and kabuli projects were screened and 185 plants and 20 lines were selected.

49. Around 200 resistant breeding lines were evaluated in replicated trials at Hyderabad and Hissar and the best will be advanced to international nurseries and other trials in 1981-82.

50. We made 8 crosses to transfer stunt resistance to desi and kabuli cultivars.

51. L-550, Pant G-114 and were crossed on to 31 desi genotypes resistant to *Ascochyta* blight at ICARDA in 1979-80. We also made 39 crosses of resistant kabuli and intermediate seed types.

52. We advanced F_2s of crosses to combine stunt with wilt (10) and *Ascochyta* (4) resistance.

CP-brd-17: Breeding for reduced susceptibility to *Heliothis*.

53. Diallels were made among desi (6x6) and kabuli (4x4) resistant genotypes and 18 crosses between adapted and low borer lines.

54. Twenty one F_1s were advanced in Kashmir and single plants were selected in F_2 populations of these and 21 crosses made in 1978-79 under unsprayed conditions at Hyderabad.

55. We also grew 121 F_3 progenies of earlier crosses in unsprayed conditions at Hyderabad and selected resistant plants. The correlation between the borer damages of F_2 single plants and their F_3 progenies was low (0.26) but positive and significantly greater than zero.

56. In trials of short and medium duration resistant and breeders lines at Hyderabad, seed yields were less in protected than in unprotected conditions. There were significant interactions between entries and insecticide protection for seed yield which may have been partly due to differential responses to insecticide.

PROJECT 1 : DEVELOPMENT OF DESI CULTIVARS AND SUPERIOR BREEDING LINES

OBJECTIVES : a. To breed high yielding and disease resistant desi cultivars with stability of performance and consumer acceptance.

b. To contribute advanced breeding lines and segregating material to desi chickpea growing countries.

INTRODUCTION

The development of short duration desi genotypes suited to conditions represented by south India proceeds at Hyderabad and of long duration desi types for situations similar to north India at Hissar.

Formerly, the project has encompassed four main strategies: breeding for yield, for disease resistance, for reduced susceptibility to *Heliothis* and for early sowing. Project 1 now covers only breeding for yield, the others having been included in separate projects. Breeding for early planting is now Project 13; for disease resistance, Project 16; and, reduced susceptibility to *Heliothis*, Project 17.

Prior to 1978/79, conventional pedigree methods were used almost exclusively but the low heritabilities and high magnitudes of genotype x environment interactions recorded in the case of seed yield suggested that such methods would be ineffective in selecting for improvement in this characteristic.

In 1978/79, therefore, replicated yield trials of F_2 and F_3 populations at more than one location were initiated to enable the identification of widely and specifically adapted crosses and to make available segregating materials for selection at individual locations. The success of this strategy is too early to assess. F_2 trials are now in the third and the F_3s in the second year and the first selections have just been made in selected F_4 bulks. However, while in the F_2 trials several entries have been superior to the checks at individual and across locations, in F_3 trials most bulks have been inferior which may be due to heterosis although many of the crosses have involved parents of too long duration for peninsular India.

Each year, advanced lines emerging from crosses made earlier and advanced through pedigree methods have been contributed to international nurseries and several have subsequently performed well in International trials and trials of the All India Coordinated Pulse Improvement Project.

HYBRIDISATION

A total of 394 desi genotypes was sown in crossing blocks at Hyderabad and Hissar, comprising materials of different characteristics for use as parents in various crossing programs and a working germplasm collection of other, contrasting genotypes.

Eighteen countries were represented, with India and Iran the main contributors (Table 1.1). Crossing blocks were sown 2 to 3 weeks apart at both locations to synchronise flowering of early and late maturing types. Records of morphological and seed characteristics were taken for each of the lines in the first sowing at Hyderabad and these are shown in Tables 1.2 (desi) and 2.1 (kabuli types).

The numbers of crosses made in the desi project are summarised in Table 1.3.

Line x tester sets were planned to combine seed yield and wide adaptation in short and long duration desis at Hyderabad and Hissar, respectively. The parents of the crosses and the reasons for their inclusion are listed in Table 1.4.

At Hyderabad F_1 seeds were obtained of all crosses except one but at Hissar many combinations were not obtained due to *Botrytis* and other disease problems. All F_1s are being multiplied in Kashmir to obtain F_2 seeds for 1981/82.

Table 1.1. The countries of origin of desi types included in crossing blocks at Hyderabad and Hissar, 1980-81.

Country	No. of strains	Country	No. of strains
India	225	Iraq	1
Iran	71	Jordan	1
ICRISAT	59	Morocco	1
Pakistan	10	Netherlands	1
Mexico	6	Nigeria	1
Ethiopia	3	Sri Lanka	1
USA	3	Turkey	1
Algeria	1	USSR	1
Cyprus	1	Unknown	6
Greece	1		
		Total	394

Table 1.2. Morphological and seed characteristics of desi entries in crossing block, ICRISAT Center (Patancheru), 1980-81.

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch (No.)	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
4918*	Anniseri	India	48	24	32	SS	2.7	2.7	64	121	1.14	B	18.5
5006	Attock-234	Pakistan	86	30	26	SS	3.3	5.7	51	133	1.02	YR	12.3
12230	B-106	India	72	37	27	SS	2.3	3.3	48	121	1.40	YB	10.5
4919	B-108	India	71	54	44	SS	2.3	5.0	76	124	1.21	YB	12.5
11141*	BDN-9-3	India	48	22	27	SS	2.7	0.7	37	114	1.08	B	13.9
5026	BA-1	India	77	42	31	SS	2.0	4.0	57	127	1.07	YB	17.6
8294*	BG-203	India	71	36	22	SE	4.0	5.0	55	115	1.27	YB	10.7
12260*	BG-209	India	60	37	30	SS	3.3	5.3	68	110	1.47	YB	12.1
11088	BG-212	India	63	28	27	SS	2.0	1.0	26	124	1.08	B	10.9
12261	BG-244	India	59	32	27	SS	2.3	3.7	63	115	1.02	YB	17.2
4930	C-214	India	82	37	34	SS	2.7	5.7	73	129	-	YB	11.9
4935*	C-235	India	75	40	25	SS	2.7	4.3	44	124	1.34	B	11.7
5063	Caina	Iran	48	49	42	SS	2.0	3.7	75	113	1.23	YB	12.4
4934*	Chafa	India	76	26	30	SS	2.3	3.3	83	113	1.20	YB	14.3
5061*	Check-2	India	73	40	32	SE	2.3	3.3	62	125	1.05	YB	19.6
10596*	Cull-327	India	86	37	32	SS	2.3	4.0	80	128	1.13	YB	10.8
10130*	CPS-1	India	51	38	39	SS	1.7	3.7	84	115	1.12	YB	17.3
4936	E-100	Greece	81	55	38	ER	2.7	4.7	51	134	1.00	B	29.9
4939*	F-61	India	72	36	37	SS	2.3	4.7	83	121	1.37	YB	11.3
4940	F-187	India	77	42	29	SS	2.7	5.3	92	125	1.15	YB	13.5
4948*	G-130	India	77	44	42	SS	3.7	9.7	157	124	1.10	YB	13.1
4942	F-272	India	88	42	38	SS	3.0	7.3	105	129	1.11	YB	12.1
4943	F-370	India	88	40	33	SS	2.3	5.7	103	129	1.18	Y	14.0
4944*	F-378	India	76	30	20	SE	2.3	4.0	48	121	1.06	YB	11.2
4946	F-496	India	81	41	25	SS	2.3	5.0	71	127	1.06	YB	13.0
4950	G-543	India	71	41	34	SS	2.3	4.7	101	125	1.37	YR	11.1
10829	G-549	India	77	43	47	SS	3.3	5.0	124	126	1.09	YB	13.3
5183	GG-549	India	75	43	36	SS	3.0	5.3	93	127	1.05	YB	11.7
11508*	GL-769	India	58	43	27	SS	2.7	4.0	58	110	1.43	YB	12.1
12313	GL-1227	India	73	32	30	SE	2.7	3.7	45	122	1.26	B	10.5
12314*	GNG-16	India	58	39	29	SS	2.7	4.3	69	111	1.17	YB	14.1
4953	GW-5/7	India	46	35	27	SS	2.3	0.7	41	113	1.00	YB	30.0
-*	H 76-49	India	58	39	19	SE	2.3	1.7	20	110	1.00	YB	9.7
4954*	H-208	India	71	37	35	SE	3.3	5.0	77	121	1.14	YB	12.2
4955	H-223	India	71	35	33	SS	2.0	4.0	64	120	1.30	B	11.0
4956	H-355	India	81	39	31	SS	3.0	4.0	85	128	1.04	YR	11.1
10805	H-556-1	India	81	43	42	SS	2.3	2.7	71	125	1.10	Y	11.4
12202	HMS-1	India	75	50	27	SE	2.7	5.7	101	124	1.10	YB	15.2
12203	HMS-2	India	53	31	28	SS	2.3	3.0	101	112	1.37	YB	12.2
12204	HMS-3	India	42	30	21	SS	2.0	1.3	21	128	1.00	YB	16.8
12205*	HMS-4	India	48	31	23	SS	2.3	3.0	54	115	1.13	YB	12.5
12206*	HMS-5	India	51	26	26	SS	2.0	1.7	50	117	1.12	YB	10.4
11520*	HMS-6	India	77	37	28	SS	2.3	4.0	34	125	1.24	YB	12.1
12207	HMS-7	India	42	23	28	SS	2.3	2.7	55	114	1.13	YR	13.6
12208*	HMS-8	India	75	42	31	SE	2.3	3.7	56	125	1.50	YR	10.6
12209	HMS-9	India	75	42	40	SS	2.7	1.3	31	127	1.58	YR	19.2
12210*	HMS-10	India	40	36	34	SS	2.7	1.0	30	127	1.00	YR	16.7
12211	HMS-11	India	46	25	21	SS	1.7	1.3	41	126	1.02	B	14.5
12212	HMS-12	India	41	26	19	SS	2.0	2.7	34	121	1.15	YB	14.7
12213*	HMS-13	India	71	30	22	SS	2.7	4.0	45	124	1.29	YR	11.4

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
12214	HMS-14	India	62	31	23	SS	2.0	3.7	45	128	1.24	YB	12.1
12215	HMS-15	India	46	30	28	SS	1.7	2.0	51	119	1.59	YB	12.6
12216	HMS-16	India	42	24	22	SS	2.3	0.7	34	114	1.62	YB	13.2
12217	HMS-17	India	48	33	27	SS	3.0	3.7	61	121	1.18	YB	13.6
12218	HMS-18	India	55	28	24	SS	2.3	2.0	42	117	1.36	YB	12.1
12219	HMS-19	India	76	43	41	SE	3.0	6.3	132	126	1.04	DB	14.9
12220	HMS-20	India	45	26	28	SS	2.0	0.3	70	117	1.26	YB	12.3
12221	HMS-21	India	54	32	34	SS	2.7	4.7	86	117	1.17	YB	11.0
12222	HMS-22	India	81	46	36	SS	4.0	6.3	109	125	1.08	YB	14.1
11521	HMS-23	India	77	28	23	SS	2.7	4.0	40	125	1.23	YB	10.4
12223	HMS-24	India	61	34	27	SS	2.3	1.7	79	126	1.01	YB	14.9
12224	HMS-25	India	48	29	28	SS	2.7	1.0	52	126	1.06	YB	13.6
12225	HMS-26	India	70	32	33	SS	2.3	2.3	49	125	1.37	YB	11.1
12226	HMS-27	India	62	63	30	SS	2.7	4.0	94	125	1.36	YB	10.8
12227	HMS-28	India	48	29	24	SS	2.0	1.0	39	125	1.26	YB	17.7
12228	HMS-29	India	74	37	32	SS	2.3	5.0	83	125	1.19	YB	11.5
12229	HMS-30	India	50	34	33	SS	2.0	3.3	76	117	1.24	YB	12.0
11522	ICCC-1	ICRISAT	48	37	29	SS	2.0	3.0	45	115	1.02	YB	16.5
11523	ICCC-2	ICRISAT	88	37	32	SS	2.7	3.7	53	131	1.15	YB	10.8
11524	ICCC-3	ICRISAT	69	44	21	SE	3.7	4.3	81	115	1.28	B	14.9
11525	ICCC-4	ICRISAT	65	33	40	SE	2.0	3.0	50	121	1.04	YB	13.3
11526	ICCC-5	ICRISAT	71	38	34	SS	2.3	4.0	119	122	1.04	Y	12.1
11527	ICCC-6	ICRISAT	48	30	25	SS	1.7	2.0	44	115	1.09	YB	16.9
11528	ICCC-7	ICRISAT	71	45	35	SS	2.0	2.7	66	119	1.12	YB	14.6
11529	ICCC-8	ICRISAT	48	30	24	SS	2.0	1.3	32	114	1.00	YB	21.5
11530	ICCC-9	ICRISAT	48	23	24	SS	2.7	1.7	53	115	1.05	B	14.9
11531	ICCC-10	ICRISAT	90	36	34	SS	4.7	7.7	159	131	1.09	B	10.8
11532	ICCC-11	ICRISAT	77	54	29	SS	2.3	4.3	59	133	1.05	YB	14.1
11533	ICCC-12	ICRISAT	75	35	31	SS	2.0	4.3	44	125	1.14	YB	15.6
11534	ICCC-13	ICRISAT	65	35	20	SE	2.3	3.3	47	115	1.04	Y	13.2
11535	ICCC-14	ICRISAT	65	36	28	SS	2.0	1.7	34	117	1.00	YB	17.5
11536	ICCC-15	ICRISAT	72	40	26	SE	3.3	4.0	53	124	1.21	YB	13.5
11537	ICCC-16	ICRISAT	71	39	31	SS	2.7	4.7	65	124	1.03	YB	12.9
11538	ICCC-17	ICRISAT	70	36	28	SE	2.7	3.0	56	125	1.08	B	16.1
11539	ICCC-18	ICRISAT	52	34	36	SS	2.0	3.0	42	120	1.00	YB	17.4
11540	ICCC-19	ICRISAT	65	37	21	SS	2.0	3.3	47	120	1.02	YB	22.8
11541	ICCC-20	ICRISAT	71	34	38	SE	3.7	6.3	116	121	1.04	Y	12.7
11542	ICCC-21	ICRISAT	61	38	27	SS	2.7	3.3	78	115	1.05	B	23.4
11264	ICCC-22	ICRISAT	65	39	28	SE	2.0	3.0	46	115	1.13	YB	22.7
12316	ICCC-23	ICRISAT	75	45	40	SS	1.3	2.0	64	124	1.09	Y	18.1
ICCL-78004	H-208 × T-3	ICRISAT	51	35	33	SS	3.3	4.7	101	115	1.06	YB	17.5
ICCL-78005	H-208 × USA-613	ICRISAT	71	45	37	SE	2.3	5.3	73	121	1.06	YB	15.4
ICCL-78021	JG-62 × Ranney	ICRISAT	48	30	28	SE	2.7	2.7	67	115	1.05	YB	14.5
ICCL-78023	K-850 × H-208	ICRISAT	71	33	24	SE	2.3	2.0	42	121	1.45	YB	13.3
ICCL-78043	L-550 × T-3	ICRISAT	79	27	25	SS	2.0	1.3	20	126	1.15	Y	16.3
ICCL-78054	CP-66 × BEG-482	ICRISAT	73	43	33	SE	1.7	4.3	71	125	1.18	YB	11.8
ICCL-78073	K-850 × H-223	ICRISAT	68	28	26	SE	3.3	2.3	40	117	1.35	B	21.3
ICCL-78153	[(H-208×CP-66)×(H-208×F-496)]	ICRISAT	86	40	34	SS	3.0	3.7	46	130	1.28	B	11.6
ICCL-79003	NEC-1572 × (JG-62 × P-1630)	ICRISAT	57	39	30	SE	2.3	2.3	49	114	1.10	YB	14.8
ICCL-79004	NEC-249 × Bremizado	ICRISAT	67	33	27	SE	2.7	3.0	69	115	1.05	YB	14.6

Contd....Table 1.2.

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
ICCL-79006*	[(JG-62xC-235)x(K-850xBG-1)]	ICRISAT	71	43	26	SE	2.3	4.7	68	115	1.38	YB	15.7
ICCL-79008*	[(GW-5/7xPant G-104)x(JG-62xC-156)]	ICRISAT	67	35	29	SS	2.3	4.7	127	114	1.14	YB	14.9
ICCL-79065*	[(P-99xF-378)x(E-100xBEG-482)]	ICRISAT	62	39	34	SE	3.7	8.3	141	113	1.28	YB	11.1
ICCL-79067*	C-214 x WFWG-III	ICRISAT	65	37	20	SS	3.0	4.0	47	115	1.17	B	12.4
ICCL-79080*	F-61 x (Pant G-102 x USA-613)	ICRISAT	73	36	32	SE	3.3	3.3	58	121	1.43	YB	12.3
ICCL-79085*	F-61 x P-272	ICRISAT	69	43	38	SE	4.0	5.3	76	115	1.10	YB	13.9
6067	JG-39	India	71	34	28	SS	2.3	4.0	72	127	1.06	YB	12.4
4951*	JG-62	India	48	24	24	SS	2.7	2.0	54	107	1.17	YB	12.9
6098*	JG-74	India	48	28	31	SS	3.0	3.0	40	112	1.05	YB	15.7
4916	JG-221	India	48	33	21	SS	2.0	2.3	39	121	1.13	YB	16.5
8542	JM-583	Netherlands	77	40	27	SS	2.3	3.3	49	128	1.04	YB	11.7
4963	K-468	India	73	33	24	SS	2.3	4.3	67	126	1.13	YB	10.4
5003*	K-850	India	65	39	16	SE	3.3	4.7	41	114	1.09	YB	26.9
7509	Kaka	Iran	71	48	30	SS	2.3	3.7	59	135	1.37	BL	10.3
-*	Line No. 646	-	38	38	19	SE	1.7	1.7	18	121	1.28	YB	15.4
-	Line No. 689	-	81	49	37	SE	2.3	3.3	74	128	1.04	LY	13.2
-*	Line No. 707	-	41	41	25	SE	2.3	2.7	52	117	1.02	LB	12.9
-*	Line No. 708	-	38	42	32	SE	2.0	2.0	48	121	1.17	B	13.8
-	Line No. 978	-	59	46	37	SE	2.7	2.7	85	115	1.02	LB	12.8
4984*	N-59	India	51	28	34	SS	2.0	3.0	50	117	1.02	YB	19.4
6153	NEC-18	Jordan	73	39	30	SS	3.0	4.0	72	125	1.07	YB	12.2
6285*	NEC-177	Pakistan	77	39	22	SE	3.7	4.3	29	124	1.13	YB	12.1
7734	NEC-240	USA	81	39	29	SS	2.7	5.7	76	128	1.03	YB	12.2
7735*	NEC-249	India	51	46	33	SS	2.3	2.7	74	114	1.11	YB	12.9
6364	NEC-308	Iran	88	29	31	SS	2.3	5.7	59	133	1.00	YB	11.5
8970	NEC-318	Iran	90	31	27	SS	2.7	5.3	77	134	1.04	YB	12.0
6371	NEC-321	Iran	81	33	25	SS	2.3	5.3	96	129	1.36	YB	9.6
6433	NEC-417	Iran	86	34	40	SS	2.7	6.0	102	129	1.36	DR	8.9
9001	NEC-426	Iran	65	26	21	SS	2.0	3.3	64	124	1.09	DB	12.9
9003	NEC-431	Iran	55	28	27	SS	2.3	4.7	75	117	1.07	YB	11.4
9009	NEC-451	Iran	62	29	34	SS	2.0	3.0	54	124	1.02	YB	18.2
6462	NEC-472	Iran	88	31	26	SS	3.0	6.7	73	133	1.08	YB	9.5
6509	NEC-555	Iran	96	34	35	SS	4.3	7.7	74	135	1.30	YB	9.8
9060	NEC-578	Iran	88	31	38	SS	2.3	6.0	88	129	1.11	DB	11.0
6524	NEC-584	Iran	72	31	30	SS	2.3	4.7	51	130	1.29	YB	10.9
6563	NEC-639	Iran	88	36	36	SS	2.3	5.0	58	131	1.07	YB	12.0
6611	NEC-694	Iran	73	42	28	SS	2.7	4.0	72	125	1.35	YB	11.5
7749	NEC-695	Iran	77	30	25	SS	2.0	3.7	45	126	1.36	YB	11.4
9080	NEC-701	Iran	81	36	29	SS	2.0	4.3	43	127	1.02	YB	13.1
6626	NEC-714	Iran	83	33	27	SS	2.0	5.0	60	129	1.05	YB	10.9
9080	NEC-746	Iran	88	44	37	SS	2.7	4.3	71	129	1.06	YB	11.5
6671*	NEC-790	Iran	65	30	30	SS	2.0	3.3	60	117	1.00	YB	23.0
6679	NEC-802	Iran	63	37	30	SS	2.0	3.7	59	125	1.12	YB	20.1
6708	NEC-850	Iran	88	33	26	SS	1.7	3.7	46	130	1.00	YB	12.4
6743	NEC-900	Iran	69	36	29	SS	2.3	3.0	62	125	1.29	YB	12.2
6805	NEC-970	Iran	75	42	25	SS	2.3	3.0	33	126	1.00	YB	20.9
6808	NEC-974	Iran	69	32	29	SS	2.0	3.7	76	123	1.04	YB	12.5
6680	NEC-1089	Iran	67	22	19	SS	1.7	1.7	55	124	1.11	YB	10.7
9214*	NEC-1431	Iran	81	33	35	SS	3.0	2.3	-	135	-	BL	8.8
7111	NEC-1470	Iran	52	31	29	SS	2.0	3.7	82	114	1.14	YB	12.4

Contd....Table 1.2.

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
	NEC-1621	India	57	27	31	SS	2.0	3.0	75	124	1.09	YB	14.4
7248	NEC-1639	Pakistan	88	30	24	SS	3.0	6.3	70	133	1.04	Y	10.9
7266	NEC-2305	USA	86	36	37	SS	2.3	4.0	49	130	1.18	YB	16.9
8158	NEC-2330	Pakistan	90	36	22	SS	2.0	3.3	40	133	1.05	YB	11.2
8181	NEC-2368	Ethiopia	86	35	26	SS	2.0	5.0	46	130	1.28	YB	11.8
8209	NEC-2404	India	73	35	30	SS	2.3	4.7	73	125	1.36	YB	11.1
8241	NEC-2413	India	88	36	30	SS	3.0	5.7	67	130	1.09	YB	11.1
8250	NEC-2415	India	83	36	32	SS	2.7	5.7	77	133	1.04	YB	10.8
8252*	NP-81	India	48	25	20	SS	2.3	4.0	52	134	1.10	YB	11.1
5402	P-18	India	60	36	32	SS	2.0	3.7	89	117	1.12	YB	14.4
25*	P-36	India	71	25	23	SS	2.0	2.0	32	124	1.16	YB	11.6
43	P-45	India	69	34	31	SS	2.0	4.3	80	124	1.03	YB	12.5
57	P-47	India	55	37	32	SS	2.0	3.0	76	119	1.03	B	15.0
60	P-60-1	India	97	35	33	SS	3.0	9.7	-	137	-	BL	9.1
76*	P-74	India	80	33	30	SS	2.7	5.0	-	127	-	YB	11.3
94*	P-82	India	69	34	30	SS	2.3	4.0	60	124	1.28	YB	11.8
104	P-99	India	65	37	29	SS	2.3	5.3	88	115	1.18	YB	13.9
121	P-127	India	65	31	36	SS	2.0	4.0	84	117	1.03	YB	14.4
151*	P-129	India	72	34	34	SS	4.0	5.7	73	121	1.45	BB	9.2
154	P-156	India	81	43	31	SS	2.3	6.3	105	127	1.08	YB	18.2
190*	P-165	India	57	28	27	SS	2.3	3.0	52	126	1.00	YB	12.6
202	P-180	India	62	38	38	SS	2.0	3.7	68	117	1.01	BB	14.0
228	P-212-1	India	61	35	32	SS	2.0	3.7	75	121	1.03	BB	12.5
267	P-221	India	83	31	49	SS	2.3	5.3	-	134	-	BL	9.1
280*	P-228	India	86	25	33	SS	2.3	3.3	-	134	-	BL	10.0
292*	P-236-2	India	81	40	36	SS	3.0	7.0	75	127	1.12	YB	12.7
308	P-253	India	55	25	24	SS	2.0	0.7	34	120	1.24	YB	12.4
338	P-258	India	77	40	34	SS	2.7	5.0	81	125	1.06	YB	19.2
346*	P-289	India	65	26	25	SS	2.3	2.6	61	119	1.10	B	12.3
391*	P-319-1	India	81	37	27	SS	2.7	5.0	68	127	1.21	YB	18.8
435*	P-324	India	55	35	27	SS	2.3	3.3	92	115	1.13	YB	13.4
438*	P-326	India	71	37	26	SS	3.0	5.7	98	123	1.47	YB	10.8
440*	P-345-1	India	68	32	32	SS	2.0	4.7	82	117	1.27	YB	10.3
460	P-358-1	India	88	31	21	SS	2.3	5.0	-	139	-	YB	11.3
478*	P-392	India	55	22	17	SS	1.7	1.3	25	117	1.00	BB	11.8
516	P-394	India	55	24	24	SS	2.0	1.0	48	117	1.02	YB	13.1
519	P-424	India	69	40	36	SS	3.0	2.3	75	125	1.34	YB	17.0
539	P-427	India	71	42	41	SS	2.3	5.0	98	126	1.16	YB	9.8
546	P-436	India	51	31	28	SS	2.0	4.3	116	108	1.16	YB	13.3
552	P-436-2	India	53	40	36	SS	3.0	2.0	57	119	1.04	YB	17.3
554	P-453-2	India	70	34	28	SE	2.0	2.0	49	117	1.20	YB	11.4
575*	P-479	India	76	29	23	SS	2.7	6.0	-	113	-	BL	8.4
607	P-492	India	81	42	36	SS	2.3	4.3	57	129	1.07	YB	13.0
623	P-502-1	India	88	34	34	SS	2.7	6.3	-	152	-	BL	8.6
641*	P-517	India	61	30	33	SS	3.0	3.0	88	120	1.03	YB	12.3
658*	P-600	India	71	37	30	SS	3.3	6.0	75	125	1.06	YB	10.8
757	P-601	India	77	36	22	SS	2.7	3.7	55	129	1.35	Y	11.9
758*	P-630-2	India	72	35	26	SS	3.0	6.7	-	127	-	YB	10.7
799*	P-631	India	77	32	24	SS	2.3	4.0	-	126	-	YB	10.8
800*	P-633	India	77	33	25	SS	1.7	4.7	-	126	-	YB	10.6
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Contd....Table 1.2.

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
858	P-678	India	55	26	25	SS	2.3	1.3	77	126	1.00	YB	11.9
881	P-698-2	India	76	46	35	SE	2.3	2.7	43	121	1.26	B	14.2
-	P-735-2	-	72	37	30	SS	2.0	4.7	99	125	1.24	LY	11.4
954	P-753	India	81	40	25	SS	2.7	4.0	47	129	1.02	YB	12.7
1009	P-840	Morocco	71	39	35	SS	2.7	5.0	87	124	1.22	YB	11.6
947	P-744-2	India	88	37	20	SS	4.0	5.0	46	133	1.08	YB	10.8
1023	P-853	USSR	77	35	31	SS	3.0	6.3	61	125	1.33	G	12.0
1030	P-861	Iran	71	29	24	SS	3.7	4.7	52	126	1.42	DB	16.8
1035	P-868	India	76	40	37	SS	3.0	4.7	93	127	1.16	YB	10.4
1062*	P-906	Pakistan	88	32	21	SS	3.0	6.3	-	134	-	YB	11.5
1082	P-946	Iran	71	47	37	SS	3.3	4.3	88	124	1.30	YB	11.8
1088	P-949-1	Iran	62	35	36	SS	2.0	3.7	87	117	1.21	DB	12.7
1096	P-965-1	Iran	75	41	37	SS	2.7	3.7	75	126	1.45	YB	10.3
1109*	P-992	Pakistan	88	41	39	SS	2.7	5.7	42	128	1.19	YB	18.4
1110	P-993	Pakistan	88	38	29	SS	3.0	4.7	52	128	1.08	YB	13.3
1121*	P-1004	Iran	81	30	28	SS	2.7	9.3	-	131	-	BL	9.9
1134	P-1027-1	India	75	42	33	SS	4.0	5.0	98	126	1.09	LY	12.1
1136*	P-1034	India	81	30	24	SS	2.7	5.3	-	131	-	YB	11.4
1140	P-1037	India	71	39	32	SS	3.7	3.7	88	126	1.13	DB	11.8
1143	P-1041-1	India	70	40	68	SS	2.3	3.7	80	125	1.38	LY	12.6
1144	P-1042	India	70	44	37	SS	2.3	5.3	102	125	1.46	LY	12.7
1156*	P-1067-1	Pakistan	67	36	28	SE	2.0	2.7	38	117	1.13	YB	19.4
1160	P-1071-1	India	81	40	22	SS	2.7	5.0	78	129	1.03	YB	9.8
1164	P-1081-1	Nigeria	69	38	26	SS	2.7	4.7	83	124	1.18	LO	11.9
1166	P-1092	India	71	43	45	SS	4.3	6.7	91	126	1.04	YB	15.2
1168*	P-1098	India	90	32	31	SS	2.0	3.0	-	124	-	BL	8.3
1201	P-1117-3	India	55	36	22	SE	2.7	2.7	74	114	1.18	YB	15.6
7681	P-1179	India	48	25	22	SS	2.0	2.7	36	114	1.25	YB	17.2
1342	P-1209-1	India	81	46	39	SS	2.7	7.0	182	125	1.02	YB	12.0
1375	P-1229	India	44	36	24	SE	3.0	4.3	80	112	1.14	YB	16.7
1376	P-1231	India	51	34	34	SS	3.7	2.7	52	117	1.05	B	22.5
1404	P-1247	India	76	42	31	SS	3.3	5.7	84	125	1.01	YB	11.9
1416*	P-1252-1	India	77	31	24	SS	3.0	4.7	-	126	-	YB	10.6
1421	P-1255-2	India	49	32	42	SS	3.0	1.7	79	113	1.39	YB	13.0
1426	P-1257	India	48	30	37	SS	2.7	2.7	88	113	1.33	YB	12.9
1428	P-1258	India	55	36	34	SS	2.7	5.3	82	115	1.13	YB	11.9
1443*	P-1265	India	71	38	25	SS	2.7	4.3	49	121	1.35	YB	18.5
1447	P-1267-2	India	73	39	22	SE	2.7	4.0	53	121	1.26	YB	13.8
1450*	P-1270	India	68	22	22	SS	2.0	2.3	47	119	1.00	YB	11.2
1457	P-1273-1	India	61	33	25	SS	2.7	4.0	62	117	1.53	DB	10.3
1467*	P-1279-1	India	90	30	28	SS	2.7	6.7	-	136	-	BL	8.1
1468*	P-1279-2	India	90	30	27	SS	2.0	3.3	-	134	-	BL	8.6
1471	P-1281	India	59	30	32	SS	3.3	1.7	48	115	1.04	B	16.8
1519	P-1305-1	India	50	31	33	SS	2.7	3.7	66	124	1.06	YB	20.8
1525*	P-1308	India	77	36	33	SS	2.3	6.0	-	128	-	YB	11.1
1565*	P-1329	India	59	44	29	SE	2.7	4.3	140	115	1.32	YB	15.9
1576	P-1334-1	India	71	37	25	SS	1.7	2.3	57	122	1.05	YB	11.5
1591*	P-1343-1	India	80	35	36	SS	2.3	4.3	-	134	-	BL	9.3
1749	P-1437	India	73	42	28	SS	3.0	3.3	48	121	1.13	YB	13.9
1754*	P-1441	India	81	35	29	SS	2.7	5.0	-	127	-	YB	11.5

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
1762*	P-1443-3	India	73	38	23	SS	2.0	4.0	-	125	-	YB	12.3
1809*	P-1469-1	India	77	34	23	SS	2.7	4.0	-	126	-	YB	11.5
1821	P-1479-2	India	77	40	40	SS	3.0	3.0	55	128	1.23	DB	9.7
1836	P-1485-1	India	71	42	32	SE	2.0	3.0	30	127	1.06	B	30.8
1838	P-1486	India	76	43	36	SE	2.7	5.7	57	129	1.10	YB	20.6
1844	P-1488-1	India	89	36	28	SS	2.3	3.3	57	133	1.14	B	11.0
1848	P-1491	India	80	41	31	SE	3.0	1.3	30	129	1.00	B	21.1
1854*	P-1496-1	India	77	36	33	SS	2.7	5.3	-	127	-	YB	11.8
1856	P-1497	India	52	23	26	SS	2.7	2.0	52	125	1.23	B	17.4
1867	P-1501-3	India	81	46	34	SS	3.0	3.7	63	117	1.06	YB	14.7
1873	P-1502-3	India	71	35	30	SS	3.3	5.7	89	121	1.05	B	14.3
1881*	P-1506-3	India	77	33	22	SS	2.3	4.0	-	126	-	YB	11.4
1891	P-1514	India	69	24	24	SS	1.6	1.3	23	120	1.00	YB	14.4
1909	P-1539-1	India	77	38	32	SS	3.0	3.7	106	127	1.24	YB	12.1
1963*	P-1588	India	73	38	31	SS	2.7	5.3	-	125	-	YB	11.5
1967	P-1590	India	81	35	26	SS	2.0	4.3	46	126	1.24	YB	10.4
1973*	P-1596	India	77	33	25	SS	2.0	4.0	-	126	-	YB	11.2
1974	P-1596-1	India	91	48	33	SS	3.0	4.3	43	136	1.00	B	18.9
1983*	P-1605	India	77	29	16	SS	2.0	1.7	-	127	-	YB	11.6
1994	P-1613	India	60	44	35	SS	3.0	4.3	94	125	1.00	YB	13.9
2041	P-1642	India	88	33	25	SS	2.7	4.3	48	133	1.08	YB	13.8
2066	P-1663	India	88	31	23	SS	2.0	3.3	30	133	1.10	DB	11.3
2072	P-1670	India	69	29	29	SS	2.3	3.0	51	120	1.18	YB	11.0
852	P-672-2	India	63	38	29	SE	2.7	4.3	71	114	1.16	YB	13.6
2077*	P-1675	Mexico	79	33	34	SS	2.3	3.0	37	126	1.00	B	14.6
2086	P-1683	Mexico	67	33	32	SS	2.0	3.7	54	121	1.26	YB	12.8
2089	P-1684	Mexico	71	24	28	SS	2.0	2.0	39	124	1.21	YB	10.7
2104	P-1696-1	Mexico	67	29	24	SS	1.3	2.0	44	125	1.27	YB	10.6
2160*	P-1741-1	Mexico	81	31	28	SS	2.0	3.0	-	134	-	BL	8.8
2191	P-1766	India	90	34	29	SS	2.7	4.3	37	133	1.08	B	10.5
2204	P-1774	Sri Lanka	77	43	28	SS	3.0	5.0	105	125	1.07	YB	11.3
2210	P-1781	Algeria	83	44	31	SS	3.7	5.3	59	127	1.69	YB	11.7
2217	P-1786	Iran	86	43	32	SS	3.0	6.7	82	127	1.01	YB	12.4
2230	P-1798	Pakistan	69	41	39	SS	2.0	5.7	74	117	1.11	LO	11.1
2233	P-1805	Iraq	83	44	38	SS	2.0	4.7	90	128	1.07	YB	10.7
2236	P-1807	India	91	37	21	SS	3.3	6.7	47	133	1.04	YB	11.6
2254	P-1841-1	Iran	77	35	31	SS	3.0	6.0	70	126	1.07	YB	11.8
2265	P-1861	Iran	91	35	23	SS	2.7	4.7	50	133	1.04	B	11.7
2267	P-1863	Iran	88	46	40	SS	2.3	5.7	60	127	1.02	YB	11.1
2292	P-1936	Iran	73	33	27	SS	2.0	2.7	30	127	1.06	YB	8.4
2306	P-1972-1	Iran	77	34	21	SS	2.7	5.3	56	127	1.01	Y	11.5
2315	P-1985-2	Iran	59	25	24	SS	1.7	2.0	25	121	1.00	DB	13.2
2316	P-1985-3	Iran	44	27	42	SS	2.0	2.3	78	115	1.17	YB	13.3
2334	P-2019-1	Iran	83	40	36	SS	3.0	6.7	77	128	1.06	YB	11.5
2388*	P-2161	Iran	89	40	37	SS	2.7	7.7	167	133	1.22	YB	11.8
2427	P-2202-2	Iran	63	35	34	SS	4.0	4.7	85	134	1.08	LY	13.6
2483	P-2305	Iran	82	44	41	SS	5.0	8.0	136	127	1.61	YB	11.7
2548	P-2520	Iran	55	36	26	SS	3.0	3.3	40	113	1.70	Y	16.6
2566	P-2559	Iran	55	27	28	SS	2.0	3.3	44	126	1.05	YB	17.8
2604	P-2617-1	Iran	81	36	36	SS	3.0	6.3	87	130	1.00	YB	11.7

Contd....Table 1.2.

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
2660	P-2686-2	Iran	48	27	26	SS	2.0	3.0	46	120	1.02	YB	16.5
2713	P-2808	Iran	81	35	25	SS	2.3	3.3	94	128	1.17	YB	10.9
2784	P-2974	Iran	81	43	44	SS	2.7	3.3	80	127	1.00	LB	18.1
2796*	P-2994	Iran	78	31	28	SS	2.7	5.0	48	121	1.15	BL	8.5
2883	P-3251	Iran	62	20	21	SS	2.7	2.3	29	119	1.14	YB	10.9
2927	P-3327	Iran	71	41	33	SS	2.7	4.0	73	123	1.04	YB	10.9
3099	P-3614	Iran	48	24	30	SS	2.3	2.3	57	114	1.23	YB	14.6
3145	P-3665-1	Iran	48	35	28	SS	2.7	2.3	77	121	1.09	YB	13.5
3103	P-3617	Iran	67	21	29	SS	1.7	2.0	61	124	1.08	YB	10.3
3210	P-3765	Iran	71	38	25	SS	1.7	3.7	59	124	1.22	YB	13.0
3396*	P-4083	Iran	48	30	24	SS	3.0	2.0	56	107	1.02	YB	14.6
3405*	P-4089-1	Pakistan	61	23	22	SS	2.0	3.7	42	117	1.00	YB	13.7
3439*	P-4116-1	Iran	67	22	27	SS	2.3	3.7	39	119	1.51	YB	11.8
3500*	P-4203	Turkey	48	29	26	SS	2.3	4.0	76	111	1.20	YB	13.2
3539	P-4237	India	48	20	17	SS	2.0	1.0	37	114	1.00	YB	15.6
3637	P-4292	Iran	67	37	26	SS	1.7	3.3	71	119	1.00	YB	15.4
3651	P-4301	Iran	62	51	39	SS	2.3	2.7	33	121	1.06	YB	16.5
3684	P-4321-2	Iran	65	33	35	SS	3.0	4.0	66	117	1.18	YB	10.8
3735	P-4353-1	Iran	72	30	28	SS	2.7	2.0	39	126	1.36	YB	10.1
3839	P-4477	Iran	63	32	27	SS	2.7	5.0	65	115	1.02	B	16.1
3881	P-4549	Iran	81	42	35	ER	2.0	1.0	38	134	1.00	BL	10.3
3926	P-4614-1	Iran	65	32	32	SS	2.3	3.7	119	117	1.11	YB	11.4
4149	P-4968	Iran	54	33	31	SS	2.0	3.7	74	112	1.09	Y	14.8
4454	P-5462	Cyprus	65	47	34	SS	3.0	5.3	98	130	1.20	LY	13.6
4464	P-5482	Iran	71	45	32	SS	2.3	4.0	69	128	1.07	YB	11.8
4519	P-6067	India	63	22	22	SS	2.0	2.7	64	117	1.08	YB	11.0
4544	P-6090	India	57	41	33	SS	3.0	4.0	73	125	1.23	YB	13.3
4552*	P-6099	India	67	42	28	SE	3.0	3.7	49	123	1.14	YB	18.8
4562	P-6108	India	71	35	30	SS	2.7	4.3	61	126	1.23	YB	11.7
4651	P-6244	India	69	29	30	SS	2.7	3.3	62	125	1.13	YB	12.9
12320	P-10165	India	81	49	38	ER	1.3	3.0	36	133	1.06	LY	14.9
12321	P-10167	India	88	43	42	ER	2.3	4.3	67	134	1.03	LY	13.6
12323	P-10171	India	107	62	36	FR	2.0	2.3	11	152	1.36	BL	20.8
4989	Pant G-104	India	62	30	26	SS	2.7	4.7	48	121	1.15	YB	13.6
10135	Pant G-113	India	71	33	26	SS	3.3	4.0	72	126	1.12	YB	14.4
10136*	Pant G-114	India	71	35	25	SS	2.7	5.0	84	121	1.47	YB	11.6
10137	Pant G-115	India	71	29	26	SS	1.7	3.0	38	126	1.24	YB	11.0
11889	Para-109	India	50	31	26	SS	3.0	3.7	89	96	1.04	Y	18.5
11890	Para-110	India	58	39	28	SE	3.3	6.7	54	106	1.24	YB	11.0
10104	P-6131	India	59	25	27	SS	2.7	4.3	72	121	1.11	YB	11.9
11891	Para-116	India	50	36	33	SS	3.0	5.0	45	106	1.22	YB	11.9
11892	Para-119	India	50	39	38	SS	2.7	4.0	98	106	1.03	YB	14.9
11893	Para-123	India	50	31	40	SS	2.7	2.7	61	107	1.13	Y	14.9
10080	PG-72-8	India	77	38	35	SS	3.3	6.7	136	129	1.09	YB	11.8
10081	PG-72-84	India	73	37	25	SS	2.0	3.3	57	129	1.37	YB	11.2
12196*	Phule G-1	India	48	20	34	SS	2.0	1.7	69	112	1.02	Y	16.4
12199*	Phule G-4	India	48	31	34	SB	2.7	2.0	52	112	1.00	B	22.2
5434	Ponaflar-2	India	49	9	29	S	2.3	4.7	59	121	1.19	YB	14.0
10894	PP-1	India	97	34	29	SS	2.0	3.7	33	133	1.03	DB	12.2
5430*	Pusa-63	India	77	40	26	SE	2.0	3.7	57	125	1.16	YB	11.9

Contd....Table 1.2.

IC/ICC/ ICCL No.	Cultivar/ Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant spread (cm)	Growth habit	Primary branch No.	Secondary branch No.	Pod No.	Days to maturity	Seed No./ pod	Seed color	Weight of 100 seeds (g)
4994	Radhey	India	61	29	30	SS	2.0	3.7	33	115	1.09	YB	21.3
10919*	RPSP-322-1	India	81	31	29	SS	2.7	4.3	51	135	1.25	YB	12.5
4992	RS-11	India	88	33	31	SS	2.7	6.7	82	133	1.11	YB	11.0
8589*	SL-972-A	Ethiopia	51	23	22	SS	1.7	1.3	40	120	1.30	YB	10.6
8397*	T-1-A	India	77	33	41	SS	2.3	7.7	131	135	1.18	DB	8.2
4998	T-3	India	81	34	35	SS	3.3	7.7	84	131	1.04	YB	18.5
5864	T-3 Gwalior	India	50	30	27	SS	2.3	2.0	42	128	1.12	YB	12.9
883	T-32	India	73	27	35	SS	2.0	3.7	67	129	1.00	DB	11.4
5001	USA-613	USA	88	36	33	SS	2.7	5.0	123	152	1.05	YB	15.6
5585*	V-165	Mexico	88	35	34	SS	2.3	4.7	52	129	1.21	YB	12.2
8933*	WR-315	India	51	33	26	SS	2.3	2.3	66	114	1.24	YR	13.1
7526*	24-B	Ethiopia	55	39	30	SS	1.7	3.0	56	121	1.64	Y	12.4
506-EB*	P-386	India	48	33	28	SS	2.7	3.0	45	112	1.40	YB	15.1
731-9-2-1H-B-B-EB-EB*	H-208 x F-61	ICRISAT	80	39	36	SS	3.3	3.3	71	126	1.21	YB	11.9
738-8-1-1P-BP-EB3*	H-208 x BEG-482	ICRISAT	33	27	36	SS	3.0	1.3	121	99	1.09	YB	13.3
1381-EB4*	P-1234-1	India	48	35	34	SS	2.0	1.7	71	112	1.21	YB	16.8
1477-EB4*	P-1283	India	75	37	26	SS	2.0	2.3	52	120	1.23	YB	20.0
3474-EB4*	P-4160	Iran	76	43	37	SS	2.7	6.7	60	127	1.43	YB	11.8
4662-EB4*	P-6254	India	81	43	34	SS	2.3	4.3	64	126	1.83	YB	12.3
5634-EB4*	Ludhiana-3	India	81	39	31	SS	2.0	2.0	44	126	1.27	YB	11.1
5800-EB4*	Gram-21 Ujjain	India	52	37	23	SS	2.3	3.7	64	106	1.03	YB	14.5
6663-EB4*	NEC-764	Iran	72	40	35	SE	2.3	2.7	55	121	1.11	YB	13.7
7320-11-2-1H-B-EB3*	H-208 x RS-11	ICRISAT	81	35	30	SS	2.7	4.0	53	129	1.17	YB	10.7
73179-24-1-1H-B-EB	G-130 x P-5409	ICRISAT	73	35	28	SS	2.3	4.3	48	121	1.26	YB	12.0
73213-9-1-3H-B-EB3*	GW-5/7 x H-223	ICRISAT	58	49	26	SE	2.3	2.7	36	112	1.17	YB	13.7
73213-9-3H-B-EB3	GW-5/7 x H-223	ICRISAT	76	45	37	SE	2.3	2.7	52	128	1.08	YB	14.0
7477-EB-EB-EB	F-404 x (L-550 x P-1780)	ICRISAT	69	37	29	SS	2.3	3.3	60	119	1.23	YB	16.2
8334-EB4*	F-3	India	48	35	31	SS	2.3	4.0	78	113	1.24	YB	13.4
10619-EB-EB3*	G-130	India	53	32	24	SS	2.0	3.0	53	114	1.08	YB	11.9
11099-EB3*	JG-1254	India	69	36	26	SE	3.0	3.7	53	120	1.09	YB	17.1
4935*	C-235-EB	India	75	38	32	SS	2.7	4.7	79	128	1.10	YB	11.2
7343-14-3-B-BH-BH	H-208 x USA-613	ICRISAT	65	31	19	SE	2.7	2.0	41	115	1.05	YB	24.0
7357-22-3-B-BH-BH*	L-550 x K-468	ICRISAT	65	34	33	SS	2.3	2.0	58	120	1.09	YB	19.9
7389-18-6-B-BH-BH*	K-850 x F-378	ICRISAT	51	34	22	SS	2.7	4.3	64	111	1.14	DB	23.2
73111-8-2-B-BP*	K-850 x H-208	ICRISAT	69	40	17	SE	2.7	3.0	35	117	1.11	Y	14.8
73154-12-1-1P-BP*	JG-62 x No.42	ICRISAT	71	41	21	SE	2.3	4.0	56	121	1.00	LO	14.8
73167-5-3-B-BH-BH*	JG-62 x F-496	ICRISAT	59	43	33	SE	2.7	4.3	112	115	1.10	YB	13.8
73187-3-3-3H-BP*	G-130 x JG-24	ICRISAT	81	40	34	SS	2.3	3.3	47	127	1.19	Y	13.1
7570-1-1P-1H-BH*	G-130 x K-1189	ICRISAT	88	52	31	FR	2.7	4.7	50	134	1.22	YB	13.2
7570-3-1P-1P-BP*	G-130 x K-1189	ICRISAT	71	65	49	SE	3.0	4.0	130	127	1.35	DB	10.7
7570-48-1P-2H-BH*	G-130 x K-1189	ICRISAT	86	49	41	ER	4.3	7.3	140	134	1.11	YB	11.2
7573-4-1P-1P-BP*	F-378 x K-1184	ICRISAT	70	48	19	ER	1.7	0.7	24	121	1.04	YB	17.6
7573-74-1P-3P-BP*	F-378 x K-1184	ICRISAT	68	50	30	ER	2.3	3.3	57	119	1.14	LB	14.3
75123-19-1F-1H-BH*	P-2426-1 x K-1170	ICRISAT	97	48	46	ER	4.3	8.3	160	137	1.15	YB	17.2

* Entries used in crosses.

Table 1.3. Numbers of crosses made in desi project at Hyderabad and Hissar, 1980/81.

Purpose	Type	Hyderabad	Hissar	Total
Desi-short duration	Line x tester	119	-	119
Desi-long duration	Line x tester	-	126	126
Insect resistance	Diallel	15	-)	33
	Others	18	-)	
Disease resistance				
Early sowing	Various	20	-	20
	Total	172	126	298

Table 1.4. Parents involved in line x tester crosses in short and long duration desi types, 1980/81 and reasons for inclusion.

Line	
HYDERABAD	
Lines	
JG-74	Wilt resistant
P-127	Good performance, Ethiopia
P-324)	Good performance, ICCT-DS
P-326)	
ICCC-1	
ICCL-78005	Good performance, ICCT-DS
ICCL-78021	Good performance, ICSN-DS
ICCL-78023)	
ICCL-78043)	Good performance, Bangladesh
ICCL-78054)	
ICCL-78073)	
ICCL-79003)	
ICCL-79004)	Good performance, ICSN-DS
ICCL-79006)	
ICCL-79008)	
Testers	
Annigeri)	Good performance in GCVT
BDN-9-3)	
ICCC-9	
K-850	Good yield, large seed, good nodulation, drought tolerance
P-1675	Mexican origin, large seed

Contd....Table 1.4.

Line	
Testers (...)	
Phule G-1)	Good performance in GCVT
Phule G-4)	
24-B	Ethiopian origin
HISSAR	
Lines	
ICCC-4)	
ICCC-13)	
BG-209)	
H-76-49)	Good performance in GCVT
GL-769)	
GNG-16)	
ICCL-79065)	
ICCL-79067)	Good performance in ICSN-DL
ICCL-79080)	
ICCL-79085)	
ICCC-3	Good performance in Mexico
ICCC-11	Good performance in Pakistan
ICCC-17)	Good performance in ICCT-DL
ICCC-20)	
ICCL-78153	Good performance at Hissar
Testers	
H-208	Good performance in GCVT
K-850	Large seed, late wilter, good nodulation, drought resistant
NEC-177)	
P-326)	Good performance in ICCT-DL
P-2161)	
Pant G-114)	
G-130)	
F-378)	Good performance in GCVT
BG-203)	
C-235)	

F_1 GENERATION

Off-season nurseries

F_1s of two 10 x 10 diallel series for Hyderabad and Hissar and a 10 x 5 line x tester set for Hyderabad, the parents of which were listed in the 1979/80 Report of Work, were multiplied off-season at Tapperwaripora in Kashmir. The crop was sown in early June and matured in late August/early September in good time for preparation for sowing in the following rainy season.

In addition, 21 single crosses for *Heliothis* resistance, 5 threeway crosses to combine *Heliothis* and wilt resistance, 10 single crosses for early planting, and 18 crosses for incorporating resistance to stunt and *Ascochyta* blight were planted in the off-season nursery at ICRISAT Center under polyscrim covers. Sowing was done on 1 July and harvesting was undertaken in the second week of October.

F_1/F_2 GENERATIONS

Replicated tests

Replicated tests of F_1/F_2 and F_2 generations were sown at Hyderabad as randomised complete blocks with three replications in 4 m long rows 60 cm apart. The F_1s, parents and checks were in one and the F_2s in two row plots.

Days to flowering, the numbers of primary and secondary branches, plant height, days to maturity, pod number, seeds per pod and seed yield were recorded for five to ten random plants in each plot, these numbers being reduced in some plots due to wilt. Mean values were used for combining ability analysis according to Griffing (1956) Method 2, Model I, for the diallels, and Kempthorne (1957), for the line x tester series.

F_1/F_2 10 x 5 line x tester trial: The entries comprised 45 F_1s, 50 F_2s and 15 parents of the 10 x 5 line x tester of crosses made in 1979/80 and the checks Annigeri and G-130. F_1 combinations involving IC-7389-18-3-B-BP were omitted due to shortage of seed.

The characteristics of the parents, F_1s and F_2s are shown in Tables 1.5 to 1.7. There were significant differences among F_1s in all characteristics except numbers of primary and secondary branches, and among F_2s except for numbers of primary branches, pods and seeds per plant (Table 1.8). In most cases, the differences were due to differences among lines and/or testers although there were significant L x T interactions for pods, seeds and yield per plant and seeds per pod among F_1s and days to flowering, plant height and seed size among F_2s.

Table 1.5. Characteristics of parents in 10 x 5 line x tester trial at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ plant	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
Testers										
Annigeri	47.5	101.9	32.4	2.7	5.9	149.1	172.6	19.1	1.16	31.2
Phule G-4	45.4	102.4	33.0	3.0	5.5	165.5	173.0	23.3	1.06	40.7
JG-74	47.5	98.6	35.7	2.8	5.6	116.2	127.7	15.6	1.11	20.2
ICCC-4	65.3	104.8	36.0	2.9	7.0	87.9	93.8	12.3	1.09	11.4
H-208	65.1	109.8	38.5	2.8	6.7	97.7	117.7	11.4	1.23	13.4
Lines										
ICCC-7	65.0	108.1	42.8	3.3	7.1	110.0	125.6	13.7	1.14	17.5
ICCC-9	46.2	103.7	32.4	3.4	5.3	167.6	182.0	16.5	1.09	30.3
ICCC-14	60.8	106.3	40.1	2.7	5.3	73.1	79.0	15.9	1.11	12.7
ICCC-15	65.3	109.0	41.1	3.4	6.6	111.8	126.3	13.4	1.13	16.9
ICCC-16	59.5	104.5	35.8	3.3	6.5	93.0	97.1	12.8	1.05	12.9
73129-16-1-B-BP	51.1	100.7	36.1	2.5	5.5	131.6	142.3	14.1	1.08	20.3
73111-8-2-B-BP	65.9	112.5	35.9	2.9	7.0	106.1	125.0	14.0	1.17	17.7
7394-14-2-B-BP	57.6	102.5	34.2	2.9	5.8	156.9	168.1	16.4	1.07	27.3
7389-18-3-B-BP	55.2	105.6	34.9	2.5	4.4	88.9	96.0	21.8	1.09	21.2
7341-8-1-B-BP	62.2	109.3	36.2	3.0	6.4	113.7	130.4	13.8	1.15	18.1
Checks										
Annigeri	46.9	99.2	33.4	2.8	6.3	119.7	139.7	19.0	1.17	26.8
G-130	66.0	114.7	37.6	3.2	7.5	76.4	92.4	11.8	1.21	10.7
Mean	56.1	103.5	36.9	3.0	6.3	123.2	137.2	15.8	1.13	21.9
S.E.	1.35	1.91	1.32	0.26	0.64	18.08	20.83	0.71	0.05	3.72
C.V.	4.2	3.2	6.2	15.3	17.6	25.4	26.3	7.7	7.5	29.5

Table 1.6. Plant characteristics of F_1s and F_2s in 10 x 5 line x tester trial at Hyderabad, 1980/81.

	Days to 50% flowering		Days to maturity		Plant height(cm)		Primary branches		Secondary branches	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-7946	56.6	57.7	101.0	104.8	38.5	38.3	2.7	3.0	5.7	7.0
IC-7947	45.1	45.9	100.1	102.0	29.9	33.6	2.5	2.7	4.6	5.9
IC-7948	53.3	55.5	99.7	104.5	36.0	36.8	3.2	2.7	5.7	5.9
IC-7949	57.5	57.3	104.5	105.6	39.2	38.2	2.7	2.8	6.4	6.7
IC-7950	55.0	57.2	102.9	104.0	36.0	38.2	3.4	3.3	7.1	6.6
IC-7951	48.1	48.7	102.1	101.1	32.3	34.2	2.5	3.1	4.8	5.2
IC-7952	53.3	57.3	102.6	106.1	39.1	32.3	3.1	2.9	7.3	5.5
IC-7953	55.1	58.1	102.6	103.3	32.2	35.0	2.5	2.9	5.9	5.9
IC-7954	ND	48.2	ND	103.5	ND	33.1	ND	2.7	ND	4.7
IC-7955	56.7	55.1	105.2	104.0	34.9	34.8	3.1	3.1	5.7	7.3
IC-7956	56.6	58.2	106.4	103.1	44.1	39.4	2.7	2.7	6.5	6.2
IC-7957	52.5	54.9	103.8	101.8	37.9	39.9	2.7	3.0	6.5	6.0
IC-7958	53.8	51.8	100.7	100.9	39.7	37.2	3.1	2.6	5.8	5.2
IC-7959	56.5	54.6	103.3	102.5	39.6	37.6	3.0	3.2	5.9	6.4
IC-7960	55.1	58.1	102.7	101.1	35.6	39.6	3.1	3.0	8.1	6.7
IC-7961	48.6	51.8	100.3	102.6	37.9	34.7	2.5	2.8	5.5	5.3
IC-7962	60.4	59.5	105.6	104.5	40.1	39.8	3.3	3.1	7.5	6.4
IC-7963	52.8	53.7	99.8	103.3	34.5	36.3	2.8	2.9	5.2	5.0
IC-7964	ND	55.1	ND	103.2	ND	36.6	ND	3.0	ND	7.6
IC-7965	53.5	55.5	101.8	102.6	35.1	37.1	2.9	2.8	6.6	5.1
IC-7966	52.9	56.9	102.7	104.1	37.9	37.6	3.2	2.7	5.5	6.1
IC-7967	46.2	50.8	99.3	98.8	36.1	37.3	2.9	2.6	4.5	5.6
IC-7968	51.4	51.9	98.5	99.4	38.1	36.5	2.7	2.8	6.5	5.9
IC-7969	54.5	54.5	100.4	100.4	37.6	38.1	3.1	2.9	6.4	5.3
IC-7970	49.5	55.4	100.1	101.4	36.2	37.8	2.9	3.0	6.3	6.5
IC-7971	46.8	49.8	96.5	97.9	36.0	38.1	3.0	2.7	5.8	5.8
IC-7972	51.7	55.9	101.7	101.8	36.8	37.4	3.3	3.1	6.4	6.7
IC-7973	48.4	50.8	96.6	100.0	32.6	35.7	2.9	2.8	4.9	5.5
IC-7974	ND	51.1	ND	98.5	ND	35.0	ND	2.7	ND	5.1
IC-7975	53.0	53.3	102.0	101.3	35.0	36.5	2.6	2.9	6.6	6.8
IC-7976	62.1	59.8	108.9	106.2	41.0	39.5	3.1	3.0	6.5	6.9

Contd....Table 1.6.

	Days to 50% flowering		Days to maturity		Plant height(cm)		Primary branches		Secondary branches	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-7977	52.7	58.2	101.8	103.0	35.8	37.1	2.9	2.9	6.1	6.5
IC-7978	55.3	58.2	103.7	105.1	38.1	38.9	2.7	3.2	6.3	6.2
IC-7979	58.7	61.2	106.5	106.4	42.2	36.2	3.9	3.5	7.4	7.5
IC-7980	60.1	63.0	99.5	110.6	35.3	34.2	3.2	2.9	6.2	4.8
IC-7981	52.8	51.2	100.9	100.8	32.8	37.7	3.0	3.1	5.8	6.7
IC-7982	61.7	60.9	101.1	107.4	35.8	35.8	3.5	3.2	7.0	7.6
IC-7983	56.4	62.1	100.2	106.4	36.0	32.6	3.0	3.0	6.5	5.9
IC-7984	ND	54.3	ND	100.8	ND	36.6	ND	2.9	ND	7.0
IC-7985	54.9	59.2	101.7	104.0	34.9	35.9	3.3	3.0	6.1	6.5
IC-7986	62.8	61.8	106.9	109.2	41.0	39.8	3.4	3.1	7.4	6.8
IC-7987	54.9	57.1	102.3	105.4	34.7	37.4	2.5	3.1	4.9	6.9
IC-7988	60.9	61.8	104.3	109.3	39.8	36.3	3.2	3.2	6.7	6.6
IC-7989	63.3	63.6	106.5	108.2	41.4	40.9	3.3	3.3	7.9	6.6
IC-7990	61.1	63.5	101.4	104.5	38.3	35.9	3.6	2.6	6.2	5.8
IC-7991	55.7	57.0	104.3	103.4	39.0	35.7	2.8	3.1	6.7	6.4
IC-7992	65.8	64.5	112.7	106.8	37.0	40.0	2.5	3.3	6.4	8.2
IC-7993	58.9	62.1	108.0	107.9	36.4	38.3	3.7	3.2	7.8	7.2
IC-7994	ND	59.2	ND	101.8	ND	36.7	ND	3.3	ND	7.1
IC-7995	63.4	62.2	107.7	106.1	36.0	40.2	3.3	3.2	8.0	7.7
Mean	55.2	56.5	102.7	103.6	37.0	36.9	3.0	3.0	6.3	6.3
S.E.	1.35		1.91		1.32		0.26		0.64	
C.V.	4.2		3.2		6.2		15.3		17.6	

Table 1.7. Yield characteristics of F_1s and F_2s in 10 x 5 line x tester trial at Hyderabad, 1980/81.

	Pod number		Seed number		g/100 seeds		Seeds/pod		Yield/plant (g)	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-7946	117.4	124.1	125.5	135.7	17.3	16.9	1.07	1.09	22.1	23.1
IC-7947	79.3	131.1	95.8	148.0	18.7	18.9	1.49	1.13	17.8	28.1
IC-7948	133.5	101.6	155.5	116.3	17.6	18.2	1.17	1.16	27.6	21.2
IC-7949	129.8	134.6	137.6	153.8	16.0	16.6	1.07	1.15	22.3	26.0
IC-7950	142.9	123.0	157.8	136.1	16.1	15.0	1.13	1.14	27.0	20.3
IC-7951	95.7	162.5	107.2	185.5	17.5	18.4	1.15	1.14	19.4	33.7
IC-7952	149.3	94.6	169.9	106.9	18.7	16.0	1.15	1.14	31.7	17.0
IC-7953	156.5	123.3	164.7	132.2	17.8	19.9	1.06	1.09	29.4	26.5
IC-7954	ND	116.7	ND	130.4	ND	20.3	ND	1.13	ND	26.5
IC-7955	119.8	135.6	136.5	159.3	16.8	17.7	1.18	1.17	23.0	27.5
IC-7956	93.3	107.0	97.7	114.7	18.1	18.2	1.05	1.07	17.9	20.9
IC-7957	150.2	142.3	156.6	150.5	18.5	18.3	1.05	1.06	28.8	27.4
IC-7958	100.9	110.4	110.5	125.7	18.0	18.7	1.13	1.13	20.1	22.8
IC-7959	100.6	126.5	104.9	133.5	18.1	18.8	1.08	1.07	19.2	25.7
IC-7960	160.3	120.1	172.1	126.2	17.9	17.1	1.08	1.06	29.7	21.5
IC-7961	132.9	131.2	148.3	141.9	17.9	18.0	1.15	1.09	27.2	26.5
IC-7962	115.2	101.9	119.9	107.3	17.0	19.7	1.03	1.05	19.6	20.8
IC-7963	126.8	110.8	129.7	118.4	19.2	20.6	1.03	1.07	24.7	23.7
IC-7964	ND	144.8	ND	159.9	ND	17.5	ND	1.14	ND	28.2
IC-7965	134.0	82.0	145.5	87.8	18.1	21.5	1.10	1.09	25.7	18.4
IC-7966	137.7	123.1	148.2	132.8	15.8	15.1	1.10	1.09	24.0	20.0
IC-7967	141.5	132.1	146.2	135.5	16.1	15.3	1.05	1.03	24.2	20.6
IC-7968	118.1	114.8	132.5	129.1	14.5	15.0	1.11	1.15	19.7	19.1
IC-7969	140.1	129.8	154.1	141.2	14.4	14.6	1.09	1.10	22.4	20.5
IC-7970	113.3	148.5	126.7	158.8	13.8	15.5	1.13	1.08	17.8	24.8
IC-7971	118.5	123.4	132.7	133.4	16.2	16.3	1.13	1.09	21.8	21.6
IC-7972	173.3	152.9	193.5	168.1	16.3	16.0	1.12	1.12	31.8	26.7
IC-7973	102.0	141.7	108.5	147.1	16.6	16.1	1.07	1.05	17.9	23.8
IC-7974	ND	90.9	ND	100.1	ND	18.7	ND	1.09	ND	18.3
IC-7975	192.8	167.4	219.2	181.5	15.3	15.7	1.15	1.09	33.5	28.8
IC-7976	114.2	112.5	126.5	128.2	13.4	14.7	1.12	1.14	17.0	18.6

Contd....Table 1.7.

	Pod number		Seed number		g/100 seeds		Seeds/pod		Yield/plant(g)	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-7977	132.8	120.2	141.8	141.0	15.0	13.7	1.08	1.15	21.4	20.0
IC-7978	103.7	95.7	118.0	109.3	14.3	14.6	1.13	1.15	17.1	15.9
IC-7979	162.7	154.4	183.9	175.7	14.5	13.9	1.13	1.11	26.8	24.6
IC-7980	83.2	79.9	88.4	87.0	11.0	12.6	1.05	1.18	10.4	11.1
IC-7981	107.4	134.5	117.2	155.6	15.5	15.9	1.10	1.17	18.5	25.0
IC-7982	97.4	119.6	111.5	141.6	13.4	13.5	1.13	1.18	14.9	19.5
IC-7983	128.0	117.9	146.2	125.6	14.5	14.1	1.17	1.07	22.0	17.6
IC-7984	ND	160.2	ND	173.9	ND	19.5	ND	1.08	ND	33.9
IC-7985	114.7	112.7	139.0	132.4	14.7	13.1	1.21	1.15	20.7	17.7
IC-7986	156.7	117.8	190.3	148.1	12.7	13.5	1.20	1.27	24.5	20.0
IC-7987	107.4	136.8	117.7	151.1	14.0	13.5	1.09	1.11	16.8	20.7
IC-7988	128.3	103.0	160.9	122.0	12.8	13.6	1.25	1.22	20.7	16.4
IC-7989	168.7	138.2	204.0	161.8	13.3	12.1	1.21	1.18	27.1	19.4
IC-7990	86.1	87.0	94.2	105.9	10.3	11.6	1.09	1.23	9.8	12.5
IC-7991	143.9	129.4	162.3	147.2	13.5	13.5	1.13	1.14	21.9	20.0
IC-7992	89.8	138.2	107.1	168.1	11.7	14.3	1.20	1.24	12.3	24.3
IC-7993	148.7	119.5	163.1	128.0	15.6	15.1	1.09	1.09	26.2	19.3
IC-7994	ND	126.4	ND	147.5	ND	17.0	ND	1.15	ND	24.3
IC-7995	100.3	126.6	116.6	148.4	13.4	13.4	1.18	1.21	15.5	20.4
Mean	125.5	123.6	139.7	137.9	15.6	16.2	1.13	1.13	22.0	22.2
S.E.	18.08		20.83		0.71		0.05		3.72	
C.V.	25.4		26.3		7.7		7.5		29.5	

Table 1.8. Mean squares from analysis of variance of 10 x 5 line by tester trial at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pod no.	Seed no.	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
Overall										
Reps	6.58_{**}	114.90_{**}	23.54_{**}	0.07	3.82_{**}	18.58_{**}	290.74_{**}	11.67_{**}	0.02	38.26_{**}
Trts	84.59	35.11	19.26	0.23	2.14	1763.31	2246.74	19.13	0.01	94.81
Error	5.44	10.93	5.26	0.21	1.22	980.18	1301.91	1.49	0.01	41.56
F_1s										
Reps	2.70_{**}	13.35_{**}	15.95_{**}	0.22	1.61	1004.67_{**}	713.66_{**}	4.89_{**}	0.01_{**}	38.27_{**}
Entries	71.80_{**}	31.16_{**}	24.48_{**}	0.36	2.34_{*}	2056.51	2781.01	14.80_{**}	0.02_{**}	90.62_{**}
Testers	410.88_{**}	132.83_{**}	43.65_{**}	0.57	4.63_{*}	1597.42	2233.83	125.33_{**}	0.04	194.06
Lines	147.87	44.70	76.92	0.48	4.24	950.00_{**}	1322.55_{**}	10.69	0.01_{**}	39.03_{*}
L x T	10.39	15.06	8.97	0.30	1.59	2390.52	3214.02	2.01	0.02	90.60
Error	6.96	11.80	5.66	0.32	1.56	1121.79	1475.05	1.79	0.01	48.79
F_2s										
Reps	8.54_{**}	79.18_{**}	15.05_{**}	0.40	4.42_{**}	503.93	1264.10	4.61_{**}	0.01_{**}	57.25_{*}
Entries	59.25_{**}	25.17_{**}	12.42_{**}	0.13_{**}	2.04_{**}	1209.06	1530.95	17.83_{**}	0.01_{**}	64.33_{**}
Testers	355.33_{**}	157.22_{**}	34.65_{**}	0.45	5.67	932.45	1369.09	136.81_{**}	0.05_{**}	143.65_{*}
Lines	116.89_{**}	33.89	16.56_{*}	0.11	1.90	1604.19	1948.33	19.13_{**}	0.01	98.70
L x T	11.94	8.32	8.91	0.10	1.68	1141.01	1444.59	4.29	0.003	46.93
Error	4.67	7.57	4.99	0.12	1.05	892.81	1207.67	1.52	0.003	37.68

The general combining ability effects of parents, and the variance components due to GCA and SCA based on the F_1s are presented in Table 1.9. Among the testers, Annigeri and JG-74 showed negative and significant GCA effects for days to 50% flowering and can be used for breeding earliness. Annigeri and Phule G-4 showed significant positive GCA effects for seed weight, and non-significant positive values for yield.

Among the lines tested, ICCC-9 and 73129-16-1-B-BP were good for early flowering, while ICCC-9 and 7394-14-2-B-BP were good for seed weight. Although none showed significant GCA values for yield, ICCC-15, 7394-14-2-B-BP and 7341-8-1-B-BP were comparatively good.

GCA variances were high for days to flowering and maturity, plant height, and seed weight, while SCA variances were higher for pod number, seed number and yield.

F_1/F_2 9x9 diallel trial at Hyderabad. The entries comprised 36 F_1s and F_2s and nine parents. There were significant differences among entries for all characters (Tables 1.10 to 1.13). The majority of the variation was accounted for by GCA effects confirming again the importance of additive components of variation (Table 1.10). SCA effects were significant for all characters except seeds per pod on the basis of the F_1s but only for time to flowering and maturity, number of secondary branches and seed size, when based on the F_2s and they were, in every case, of much lower magnitude than GCA effects.

Similar estimates of the GCA effects of the parents were obtained from the analysis of the F_1s and F_2s (Tables 1.14 and 1.15). P-1353 was the best general combiner for yield and numbers of pods and seeds per plant; followed by K-850 which also showed good general combining ability for seed size. The poorest general combiner for yield was P-4203. Phule G-3 and BDN-9-3 were the best general combiners for reduced time to flowering and maturity.

Non-replicated

Surplus seed of 178 F_1s from each of the projects were sown at Hyderabad to advance to F_2 generation.

F_2 GENERATION

F_2 multilocation trial-1

The trial included 46 F_2 populations and 2 common and 2 local checks and was sown at several locations as part of the AICPIP. The results are reported elsewhere.

Table 1.9. General combining abilities of parents and variance components in F_1 10 x 5 line x tester set at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pod no.	Seed no.	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
Testers										
Annigeri	-1.85**	-0.39	-1.65**	-0.16	-0.39	-0.64	-0.76	1.79**	0.04*	2.48
Phule G-4	-0.82**	0.01**	1.33	-0.11	0.09	-1.73	-8.00	2.50	-0.05	1.65
JG-74	-4.77**	-2.93	-0.74	-0.04	-0.41	11.92	11.59	-0.16**	-0.02	1.68*
ICCC-4	1.93**	0.01**	-0.12*	0.17	0.14*	-9.54	-9.42	-1.56**	-0.002	-3.23*
H-208	5.51	3.31	1.18	0.14	0.58	-0.01	6.58	-2.57	0.04*	-2.57
S.E.(g_i)	0.51	0.66	0.46	0.11	0.24	6.45	7.39	0.26	0.02	1.34
Lines										
ICCC-7	2.94**	2.48**	3.50**	0.01*	0.02*	-1.69	-2.06	-0.12*	-0.02	-0.89
ICCC-9	-4.96	-1.23	-2.10*	-0.29	-0.98	-3.31	-8.06	0.84	0.03	-0.20
ICCC-14	-0.32**	-1.31	1.34**	-0.02	-0.10	-8.64	-4.21	-0.16	0.03	-0.96
ICCC-15	2.84	1.55	3.01	0.19	0.49	14.84	17.21	-0.34**	-0.01	1.56
ICCC-16	0.89**	-1.38*	-0.72*	0.24	0.47	-8.40	-11.84	-1.78	-0.03	-3.09
73129-16-1-B-BP	-4.86**	-1.86*	-1.38	-0.26	-0.56	-5.87	-6.15	0.52	0.01	-0.23
73111-8-2-B-BP	3.33	2.03	0.84**	0.12	0.61	-0.55	0.69	-0.19**	0.003	0.07
7394-14-2-B-BP	-0.92	-1.27	-2.66**	-0.03	-0.26	6.84	2.74	1.16	-0.04	2.06
7341-8-1-B-BP	1.05	0.99	-1.83	0.03	0.29	6.77	11.68	0.08	0.04	1.67
S.E.(g_i)	0.68	0.89	0.63	0.14	0.32	8.65	9.92	0.34	0.03	1.81
Variance components:										
GCA	12.81	3.51	2.44	0.01	0.13	-53.18	-68.37	3.14	-	1.24
SCA	1.41	1.09	1.10	-0.01	0.09	422.91	579.66	0.07	-	13.94

Table 1.10. Mean squares from analysis of variance of 9 x 9 diallel trial at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ plant	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
Overall										
Reps	53.3	345.4**	123.6**	4.68**	32.04**	4959**	9410**	48.89**	0.010**	371.7**
Treatments	87.5	74.9	67.5	0.56	6.60	4879	6631	29.69	0.039	146.1
Error	12.4	23.3	7.5	0.27	2.28	2045	2715	3.88	0.010	62.85
F_1s and parents										
GCA	88.1**	66.4**	80.9**	0.27**	3.27**	3152**	5559**	35.56**	0.033**	91.0**
SCA	12.8**	11.5**	5.8**	0.13**	1.86**	998**	1094**	2.38**	0.003	32.0**
Error	3.0	6.0	1.7	0.06	0.45	387	519	1.12	0.003	12.0
F_2s and parents										
GCA	87.3**	63.3**	66.5**	0.38**	4.46**	2976**	3495**	11.12**	0.027**	42.7**
SCA	8.6**	11.3**	2.7	0.09	1.07*	496	710	1.91**	0.003	20.8
Error	3.1	5.2	2.1	0.07	0.70	6.19	8.11	0.86	0.003	19.5

Table 1.11. Characteristics of parents in 9 x 9 diallel trial at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds plant	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
ICCC-4	63.7	107.0	32.4	3.5	8.0	114.5	128.0	13.1	1.10	15.4
K-850	61.9	109.1	37.6	3.0	6.9	101.4	110.6	26.9	1.09	27.8
Phule G-3	46.5	95.4	28.5	2.4	4.6	109.0	120.3	18.2	1.13	20.8
P-4203	57.0	94.0	31.8	4.0	11.0	190.0	166.0	12.3	1.00	23.5
P-1198-1	59.5	105.9	32.3	3.0	5.0	126.7	130.9	11.5	1.02	15.4
24-B	54.0	100.5	41.6	2.7	5.7	144.6	202.7	15.7	1.42	22.6
BDN-9-3	50.2	99.4	30.4	3.2	6.3	160.1	188.4	15.7	1.21	25.0
P-1675	69.8	115.9	38.1	3.7	9.8	134.6	144.9	16.0	1.08	21.9
P-1353	63.0	109.2	36.2	3.2	7.0	168.9	178.5	13.7	1.07	22.9

Table 1.12. Plant characteristics of F_1s and F_2s in 9 x 9 diallel trial at Hyderabad, 1980/81.

	Days to 50% flowering		Days to maturity		Plant height(cm)		Primary branches		Secondary branches	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-791	61.1	61.5	105.7	109.3	35.3	36.8	3.3	3.7	6.7	8.5
IC-792	57.6	59.5	97.2	95.8	24.0	30.4	2.6	3.1	7.0	6.9
IC-793	67.0	56.2	107.0	100.0	32.0	35.8	3.0	3.4	10.0	5.7
IC-794	61.9	60.6	105.7	104.8	31.6	31.5	2.9	3.5	6.4	6.4
IC-795	55.0	56.4	104.7	101.4	33.9	40.4	3.3	2.5	6.6	5.5
IC-796	56.9	53.0	102.3	102.3	31.6	32.3	2.9	3.3	6.3	6.8
IC-798	57.4	60.5	103.0	105.1	31.5	34.0	2.8	3.4	5.6	7.9
IC-799	58.7	59.2	106.0	105.3	37.6	34.6	3.7	3.1	7.9	7.3
IC-7910	52.1	50.9	98.6	99.2	34.3	30.1	3.0	2.8	6.1	5.5
IC-7911	55.5	58.0	102.5	106.9	31.3	34.2	3.2	3.7	5.6	7.5
IC-7912	50.9	59.3	105.3	104.8	33.4	34.5	3.8	2.9	7.1	6.0
IC-7913	58.4	59.7	101.8	107.4	41.1	42.1	3.0	2.8	7.8	6.5
IC-7914	53.7	55.0	99.6	103.1	34.4	35.6	2.8	3.0	6.9	6.3
IC-7916	60.1	63.6	101.3	105.8	38.0	37.4	3.4	2.8	7.9	7.1
IC-7917	59.5	59.5	106.0	104.2	35.5	36.0	3.7	3.4	7.7	7.3
IC-7918	45.5	57.1	94.5	107.7	24.0	29.7	3.0	3.5	5.0	8.4
IC-7919	53.2	52.9	102.5	100.0	30.3	30.5	2.2	2.7	4.6	4.9
IC-7920	52.7	53.6	100.8	101.4	37.2	35.2	2.7	2.9	5.2	6.2
IC-7921	47.1	48.2	99.5	100.6	28.0	28.9	2.8	3.0	6.5	5.9
IC-7923	52.2	55.6	96.4	100.4	30.1	33.7	3.1	3.3	4.4	6.4
IC-7924	52.0	51.4	98.1	101.4	34.5	30.8	3.9	3.4	7.2	9.6
IC-7925	56.2	47.4	105.2	95.6	29.0	27.4	3.0	3.3	5.5	6.2
IC-7926	50.8	55.1	95.1	103.3	35.9	35.3	2.9	2.6	4.1	5.2
IC-7927	47.6	52.2	94.8	103.5	24.1	30.0	3.0	2.9	4.8	6.8
IC-7929	51.7	56.7	99.1	105.5	32.3	33.4	2.5	3.3	4.9	7.5
IC-7930	52.4	56.3	98.0	104.9	29.3	32.8	3.3	3.4	6.0	7.4
IC-7931	55.5	59.2	101.4	105.0	40.1	38.4	2.8	2.6	6.5	5.4
IC-7932	52.2	52.3	98.6	100.3	32.6	31.0	2.7	2.9	5.5	5.8
IC-7934	54.0	59.1	102.3	108.3	33.6	36.4	2.8	3.5	6.0	7.9
IC-7935	56.5	58.7	101.9	102.5	32.7	36.0	3.2	3.7	6.0	7.0
IC-7936	56.2	58.8	101.6	102.4	41.9	39.6	3.3	2.9	6.2	5.8

Contd....Table 1.12.

	Days to 50% flowering		Days to maturity		Plant height(cm)		Primary branches		Secondary branches	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-7938	56.7	61.2	110.5	113.5	41.3	43.3	3.1	2.8	5.5	7.3
IC-7939	57.4	62.7	105.3	109.6	37.9	36.4	3.4	3.7	7.2	7.4
IC-7941	54.6	56.2	102.7	104.1	35.5	34.4	3.8	3.3	8.2	7.5
IC-7942	58.5	53.8	105.3	103.1	34.1	32.0	3.2	3.3	6.1	7.2
IC-7945	60.6	62.6	102.5	109.2	34.7	38.5	3.2	3.5	6.6	7.3
Mean	55.3	56.8	101.7	103.8	33.5	34.4	3.1	3.2	6.3	6.8
S.E.	1.73	1.77	2.44	2.27	1.31	1.45	0.25	0.26	0.67	0.83
C.V.	6.2	6.2	4.8	4.4	7.8	8.4	16.3	16.3	20.8	24.4

Table 1.13. Yield characteristics of F_1s and F_2s in 9 x 9 diallel trial at Hyderabad, 1980/81.

	Pods/plant		Seeds/plant		Weight of 100 seeds(g)		Seeds/pod		Yield/plant(g)	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-791	73.2	123.7	82.4	144.3	20.0	22.8	1.12	1.17	14.6	28.5
IC-792	67.1	58.9	73.0	81.7	13.9	18.8	1.03	1.27	9.3	9.7
IC-793	145.0	111.4	168.0	111.3	16.9	11.4	1.04	1.02	24.5	12.7
IC-794	106.4	113.5	123.9	125.5	13.8	14.1	1.16	1.11	15.0	17.2
IC-795	118.9	129.7	163.2	181.8	15.8	14.9	1.41	1.40	18.3	19.4
IC-796	121.9	189.5	136.2	212.9	13.4	15.8	1.13	1.13	16.3	30.2
IC-798	70.9	115.6	74.8	127.5	13.7	16.4	1.04	1.11	10.6	19.4
IC-799	168.8	147.2	190.3	173.5	16.3	16.3	1.15	1.19	26.7	23.8
IC-7910	88.6	84.9	107.1	94.4	17.7	19.3	1.19	1.13	17.8	16.7
IC-7911	61.7	119.3	65.3	134.9	18.0	18.2	1.07	1.13	11.5	22.2
IC-7912	97.2	86.8	109.7	95.3	19.3	20.9	1.17	1.10	18.7	18.4
IC-7913	140.2	107.2	175.4	135.9	21.0	21.0	1.25	1.26	30.2	22.5
IC-7914	131.1	125.1	149.7	137.5	22.1	20.0	1.14	1.11	28.8	24.2
IC-7916	113.4	112.5	122.4	122.1	20.1	20.7	1.09	1.08	23.3	23.2
IC-7917	142.3	146.6	155.6	158.6	20.5	20.8	1.11	1.08	28.9	30.2
IC-7918	62.0	163.0	72.5	199.9	16.3	16.5	1.08	1.19	10.1	28.4
IC-7919	130.5	99.5	138.0	114.9	16.1	16.3	1.09	1.17	21.4	16.2
IC-7920	93.4	131.5	118.3	158.4	17.3	16.1	1.31	1.21	15.6	21.8
IC-7921	131.8	135.1	149.3	155.8	15.4	17.8	1.13	1.14	21.0	25.0
IC-7923	72.5	70.8	75.3	78.1	16.9	16.0	1.01	1.19	12.2	11.2
IC-7924	197.7	167.0	226.2	187.5	19.4	17.6	1.16	1.14	37.4	28.7
IC-7925	77.5	117.7	85.0	135.7	15.5	15.7	1.05	1.17	12.3	18.6
IC-7926	108.1	148.8	140.1	193.1	12.5	15.4	1.14	1.34	13.5	24.1
IC-7927	52.0	179.5	59.8	206.9	14.2	14.7	1.30	1.17	6.8	27.4
IC-7929	83.3	174.9	86.8	197.2	14.2	15.3	1.05	1.11	13.1	26.0
IC-7930	128.0	168.6	137.3	183.7	13.9	14.2	1.09	1.10	19.0	24.4
IC-7931	137.8	116.5	176.1	141.7	15.6	14.5	1.29	1.26	21.4	16.8
IC-7932	114.4	144.1	132.4	171.3	14.0	13.9	1.19	1.16	16.1	21.3
IC-7934	129.8	173.0	142.8	183.6	16.7	17.7	1.08	1.09	21.6	30.1
IC-7935	126.9	177.3	137.9	196.7	17.0	14.1	1.11	1.12	19.9	25.2
IC-7936	180.0	119.1	221.3	139.6	15.3	14.0	1.23	1.20	27.8	16.4

Contd....Table 1.13.

	Pods/plant		Seeds/plant		Weight of 100 seeds(g)		Seeds/pod		Yield/plant(g)	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
IC-7938	118.2	124.9	133.3	149.9	16.9	17.4	1.13	1.18	19.8	21.7
IC-7939	197.8	152.9	229.4	180.4	14.6	16.0	1.16	1.21	29.1	23.9
IC-7941	167.1	139.0	182.8	148.9	16.1	17.3	1.09	1.10	26.6	23.7
IC-7942	154.0	161.4	176.4	180.0	16.2	14.8	1.12	1.11	23.7	23.6
IC-7945	140.0	135.6	152.2	149.1	15.2	16.1	1.09	1.10	21.6	22.1
Mean	118.2	132.6	135.3	152.0	16.4	16.9	1.14	1.16	19.8	21.7
S.E.	19.66	24.89	22.78	28.52	1.06	0.93	0.05	0.05	3.46	4.42
C.V.	32.2	37.2	32.9	37.4	13.0	11.2	8.4	8.3	34.7	40.2

Table 1.14. General combining abilities of parents from F_1s in 9 x 9 diallel trial at Hyderabad, 1980/81.

	Days to 50 flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ plant	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
ICCC-4	4.01^{**}_{**}	2.15^{**}_{*}	-1.27^{**}_{**}	0.04	0.70^{**}_{*}	-11.0^{*}_{**}	-10.8_{**}	-1.20^{**}_{**}	-0.007	-3.06^{**}_{**}
K-850	1.47_{**}	1.54_{**}	2.02_{**}	0.09_{**}	0.43_{**}	-15.6_{**}	-18.0_{**}	4.48	-0.003	2.68
Phule G-3	-4.85_{**}	-3.97_{**}	-3.37_{**}	-0.27	-0.87	-14.6_{*}	-17.0_{**}	0.54_{**}	-0.009_{**}	-1.23_{**}
P-4203	-1.64	-3.44	-3.17_{*}	0.08_{*}	0.28_{**}	-11.3	-21.8	-1.56_{**}	-0.049	-3.83_{*}
P-1198-1	0.05	1.16	-0.76_{**}	-0.14	-0.66_{*}	-4.4_{**}	-7.2_{**}	-1.13	-0.016_{**}	-2.09_{*}
24-B	-0.74_{**}	0.01_{*}	5.11_{**}	-0.12	-0.40	14.7_{*}	34.1_{**}	-0.26	0.127_{*}	1.91
BDN-9-3	-2.89_{**}	-1.72_{**}	-1.21_{**}	-0.02	-0.16	13.7	18.0	-0.47	0.034_{**}	1.56
P-1675	2.53_{**}	2.51_{*}	1.54_{**}	0.10_{**}	0.35	-5.2_{**}	-11.5_{**}	-0.13	-0.055	-0.69_{**}
P-1353	2.07	1.76	1.12	0.25	0.34	33.7	34.1	-0.26	-0.023	4.74
S.E.(g_i)	0.491	0.693	0.373	0.071	0.191	5.59	6.47	0.301	0.014	0.985

Table 1.15. General combining abilities of parents from F_2s in 9 x 9 diallel trial at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ plant	Weight of 100 seeds (g)	Seeds/ pod	Yield/ plant (g)
ICCC-4	2.12^{**}_{**}	-0.06_{**}	-0.31_{**}	0.12	0.21	-10.9_{**}	-10.0_{**}	-0.82^{**}_{**}	0.008	-2.56^{*}
K-850	1.83_{**}	1.83_{**}	1.62_{**}	-0.06_{**}	-0.00_{*}	-20.8_{**}	-25.5_{*}	4.70_{**}	-0.025	1.95
Phule G-3	-4.43_{**}	-3.76_{**}	-3.42_{**}	-0.20_{**}	-0.50_{**}	-19.1_{**}	-19.4_{*}	0.83_{**}	0.015	-1.88
P-4203	-1.64	-2.11	-1.98_{**}	0.22	0.74_{**}	20.5	15.5	-1.79_{**}	-0.026_{*}	0.97
P-1198-1	-0.22	-0.51	-1.26_{**}	-0.06_{**}	-0.81_{**}	- 5.1	- 8.9	-1.41	-0.029_{**}	-2.33
24-B	0.33_{**}	0.57_{**}	4.53_{**}	-0.31	-0.72	-1.6_{*}	14.7_{*}	-0.46_{*}	0.123_{*}	-0.74
BDN-9-3	-3.75_{**}	-1.86_{**}	-1.77_{**}	-0.06_{**}	-0.35_{**}	15.9	18.7	-0.56	0.000_{**}	1.98
P-1675	4.00_{**}	4.09_{**}	2.11	0.16_{**}	0.91_{*}	-2.1_{*}	-7.1_{**}	0.28_{**}	-0.036_{*}	0.09
P-1353	1.77	1.82	0.50	0.20	0.53	23.3	22.0	-0.77	-0.032	2.52*
S.E.(g_i)	0.504	0.645	0.412	0.072	0.237	7.07	8.11	0.264	0.014	1.257

F_2 trial-2 10 x 10 diallel

The F_2 10 x 10 diallel trial including 45 F_2s and the ten parents was sown at Hyderabad as a randomised complete block with three replications. Plot size was 4 rows, 4 m long and 60 cms apart. Days to flowering, days to maturity, 100-seed weight and yield (kg/ha) were recorded by plot, and a visual assessment was made of appearance near maturity. Analysis was according to Griffing (1956). The results are presented in Tables 1.16 to 1.18.

There were significant differences among entries for all characteristics (Table 1.16). The major part of the variation was due to differences among parents in general combining ability which were very highly significant in every case. Differences in specific combining ability were also significant for all characters but of a much lower magnitudes so that GCA/SCA ratios ranged from 6.88 to 51.4, indicating the predominance of additive genetic variance in these combinations.

Table 1.16. Mean squares from analysis of variance of 10 x 10 F_2 diallel trial at Hyderabad, 1980/81.

	d.f.	DFF	DM	Weight of 100 seeds (g)	Seed yield (kg/ha)	Visual score
Replications	2	21.32	129.62	65.34	6196922	0.09
Entries	54	202.21**	124.81**	64.58**	525521*	1.51**
Error	108	13.75	11.58	3.35	285724	0.19
GCA	9	344.69**	204.84**	117.71**	608472**	2.5143**
SCA	45	11.94**	8.96**	2.29**	88514	0.1004*
Error	108	4.58	3.86	1.12	95241	0.0633
GCA/SCA Ratio		28.87	22.86	51.40	6.88	25.04

* and ** denote significance at 5% and 1% levels of probability, respectivel

GCA effects (Table 1.17) differed significantly from zero except in the case of K-850 for days to flowering, Annigeri for seed size, Giza and ICCC-1 for visual score, and Giza, ICCC-1, P-2591 and P-9800 for seed yield. The correlations between parental means and GCA effects were high for all characters. Annigeri and JG-62 were the best general combiners for earliness P-9800 for seed size; K-850, JG-62 and Annigeri for seed yield and JG-62 for visual score.

Table 1.17. Means and general combining ability effects of parents in 10 x 10 F_2 diallel at Hyderabad, 1980/81.

Parents	Days to 50% flowering		Days to maturity		Weight of 100 seeds (g)		Seed yield (kg/ha)		Visual score	
	Mean	GCA	Mean	GCA	Mean	GCA	Mean	GCA	Mean	GCA
Annigeri	46.0	-8.02^{**}_{**}	109.3	-4.22^{**}	18.9	-0.08_{**}	1405	233.6^{**}	2.33	-0.37^{**}
Giza	55.3	-2.11_{**}	120.3	0.39_{**}	14.3	-3.17_{**}	1214	-100.8	3.67	0.09
ICCC-1	50.0	-4.11_{**}	113.7	-3.21_{**}	18.9	-0.87_{**}	1483	72.9_{**}	2.83	-0.09_{**}
ICCC-2	86.0	9.81_{**}	128.0	5.33_{**}	12.1	-3.53_{**}	896	-334.2_{**}	4.17	0.80_{**}
JG-62	47.7	-4.49_{**}	107.7	-6.99_{**}	14.7	-2.52_{**}	1706	241.4_{**}	1.83	-0.66_{**}
JM-482	72.0	6.06_{**}	125.0	3.51_{**}	17.0	-1.34_{**}	1222	-274.2_{*}	3.17	0.34_{*}
No.501	65.3	3.67_{**}	126.3	4.17_{*}	29.6	3.81_{**}	1298	-163.0	3.17	0.14_{**}
P-2591	48.7	-2.16_{*}	118.0	1.23_{**}	18.3	-0.91_{**}	2208	112.4	2.33	-0.25_{**}
P-9800	61.0	1.23	122.7	2.78_{**}	32.0	5.81_{**}	1285	-93.5_{**}	4.00	0.47
K-850	57.3	0.12	109.0	-2.99	26.2	2.80	2176	305.3	1.83	-0.46
r	0.96		0.97		0.99				0.95	
S.E.(g_i)	0.586		0.538		0.290		84.52		0.069	

Specific combining ability effects (Table 1.18) were generally low and non-significant. Annigeri x ICCC-2 and P-9800, Giza x No. 501, and ICCC-2 x JG-62 and JM-482 were the best specific combiners for days to flowering; No. 501 x P-9800 for seed size; and Annigeri x Giza for seed yield.

Table 1.18. Estimates of specific combining ability effects in 10 x 10 F_2 diallel at Hyderabad, 1980/81.

	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed Yield (kg/ha)	Visual score
Annigeri x Giza	3.83	2.40	2.16*	620*	-0.07
x ICCC-1	0.50	-1.98	0.41	-262	0.11
x ICCC-2	-6.75**	2.13	0.50	509	0.06
x JG-62	0.89	-0.54	1.37	178	-0.30
x JM-482	-0.67	2.96	0.48	-301	0.68**
x No.501	-2.95	0.29	-1.48	210	0.06
x P-2591	1.55	3.90*	2.00*	291	-0.22
x P-9800	-5.17**	-0.02	-2.73**	-114	-0.44
x K-850	-2.09	-4.54**	-1.34	304	-0.01
Giza x ICCC-1	-2.42	-2.93	-2.00*	82	-0.03
x ICCC-2	-2.52	2.85	0.94	33	0.08
x JG-62	-1.03	-1.82	-0.36	-404	0.06
x JM-482	-3.92*	-0.98	0.80	315	-0.12
x No.501	-5.86**	-0.65	-0.84	-137	-0.42
x P-2591	-0.70	-3.04	-0.46	-187	-0.36
x P-9800	2.91	1.74	-0.85	295	-0.08
x K-850	1.36	3.52	-1.07	-137	0.02
ICCC-1 x ICCC-2	-3.67	5.79**	0.81	319	-0.40
x JG-62	0.97	-1.21	-0.04	- 66	-0.26
x JM-482	0.81	-2.37	-0.31	-152	0.06
x No.501	-1.86	1.63	-0.86	135	0.27
x P-2591	1.97	2.57	1.68	8	0.32
x P-9800	-0.86	1.02	-1.20	270	-0.23
x K-850	1.36	-2.54	-0.17	303	0.20
ICCC-2 x JG-62	-5.28**	-3.76*	-0.07	- 71	0.02
x JM-482	-5.17**	-3.60	1.32	243	-0.33
x No.501	4.55	-0.26	-2.44**	- 21	0.21
x P-2591	3.05	0.02	-0.19	-468	0.77**
x P-9800	-4.34	-1.87	0.02	12	0.21
x K-850	-1.89	4.24*	0.33	-373	0.31
JG-62 x JM-482	0.47	-1.93	0.89	259	0.31
x No.501	0.19	-0.93	0.14	360	0.18
x P-2591	1.03	2.68	-0.05	115	-0.43
x P-9800	3.64	5.13**	-0.67	413	0.18
x K-850	-0.92	-0.76	-1.18	81	-0.05

Contd....Table 1.18.

	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield (kg/ha)	Visual score
JM-482 x No. 501	5.30**	2.24	-2.76**	-238	0.33
x P-2591	-1.20	1.52	0.87	88	-0.11
x P-9800	0.41	2.63	-1.44	-324	0.17
x K-850	-1.81	3.74*	0.43	-118	0.10
No. 501 x P-2591	-0.81	-1.48	-1.95*	-300	-0.07
x P-9800	0.14	0.96	5.09**	- 3	0.21
x K-850	-1.42	2.40	0.69	55	-0.53
P-2591 x P-9800	-1.70	-2.42	-1.28	-223	-0.07
x K-850	4.08*	5.35**	-1.21	21	0.53*
P-9800 x K-850	0.36	-1.21	1.87	44	-0.03
S.E. (S_{ij})	1.97	1.81	0.97	284	0.23

F_2 trial-3 20 x 5 line x tester

The trial included the 100 F_2s, 20 lines and one tester, and was sown as an 11 x 11 triple lattice at Hyderabad. The plot sizes and spacing and the data recorded were as for the 10 x 10 diallel trial except for visual score. A reduced set (15 x 5) was sown at Gwalior where plant height was also recorded.

Hyderabad. The means, CVs and LSDs of the F_2s and parents are given in Table 1.19. There were significant differences among testers for all characters and among lines for all except seed yield (Table 1.20). Line x tester interactions were significantly greater than the error mean square in the case of days to flowering and seed size. GCA variances were also significantly greater than zero for all characters and very much higher than those for SCA, which were significantly greater than zero only for days to flowering and seed size, indicating the variation to be predominantly additive.

Among lines, IC-7389-20-3-B-BP was a good general combiner for earliness and seed size (Table 1.21). Among testers, Phule G-3, GW-5/7 and Annigeri were good general combiners. None of the parents showed GCA effects significantly greater than zero for seed yield. Estimates of SCA effects were small and rarely significantly different from zero.

Gwalior. The means, LSDs and CVs of the F_2s and parents grown at Gwalior are shown in Table 1.22. There were significant differences among testers for all characters except days to maturity (Table 1.23) and among lines for all but days to maturity and plant height. The line x tester mean square was significantly greater than zero only for seed size. GCA variances were significantly greater than zero for all characters except days to maturity and larger than SCA variances except for plant height. As at Hyderabad, IC-7389-20-3-B-BP showed good general combining ability for earliness and seed size (Table 1.24). Among testers P-127 was good for seed yield and GW-5/7 for seed size and plant height. Estimates of SCA effects were small and usually non significant.

F_2s three-way crosses

Non replicated plots of F_2s of 31 three way crosses (Table 1.25) made in 1977/78 were sown as space planted bulks at Hyderabad. Symptoms of iron chlorosis were noted in some of the plots early in the season and reactions were recorded.

Table 1.19. Characteristics of entries in F_2 20 x 5 line x tester trial, 1980-81.

IC.No/Name	Parentage	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield kg/ha
781	IC-7343-14-3-B-BP x BDN-9-3	50	119	12.3	1179
782	IC-7343-14-3-B-BP x Phule G-3	48	115	15.5	1271
783	IC-7343-14-3-B-BP x K-850	58	120	17.7	1734
784	IC-7343-14-3-B-BP x JG-74	50	113	15.4	1533
785	IC-7343-14-3-B-BP x Chafa	49	117	14.5	1230
786	IC-7343-14-3-B-BP x CPS-1	55	121	14.3	1377
787	IC-7343-14-3-B-BP x NEC-240	67	123	13.4	1172
788	IC-7343-14-3-B-BP x N-59	63	121	13.2	1349
789	IC-7343-14-3-B-BP x P-99	61	117	14.0	1241
7810	IC-7343-14-3-B-BP x GW-5/7	49	118	20.3	1711
7811	IC-7343-14-3-B-BP x SL-972-A	57	119	12.0	1668
7812	IC-7343-14-3-B-BP x T-103	50	114	13.1	2512
7813	IC-7343-14-3-B-BP x P-180-1	62	124	12.9	1340
7814	IC-7343-14-3-B-BP x P-505	65	128	12.4	1267
7815	IC-7343-14-3-B-BP x P-1081-1	60	119	11.4	1623
7816	IC-7343-14-3-B-BP x JM-583	67	126	14.5	1412
7817	IC-7343-14-3-B-BP x P-436	54	114	12.7	1128
7818	IC-7343-14-3-B-BP x P-127	62	116	14.0	1472
7819	IC-7343-14-3-B-BP x ICCC-1	54	117	16.3	1653
7820	IC-7343-14-3-B-BP x Annigeri	50	120	16.5	1661
7821	IC-7362-5-2-1P-BP x BDN-9-3	53	115	13.0	1908
7822	IC-7362-5-2-1P-BP x Phule G-3	51	114	15.0	1519
7823	IC-7362-5-2-1P-BP x K-850	62	124	17.6	1629
7824	IC-7362-5-2-1P-BP x JG-74	50	115	15.1	1327
7825	IC-7362-5-2-1P-BP x Chafa	51	116	14.2	1571
7826	IC-7362-5-2-1P-BP x CPS-1	58	122	15.0	1720
7827	IC-7362-5-2-1P-BP x NEC-240	65	127	14.8	1214
7828	IC-7362-5-2-1P-BP x N-59	54	120	15.6	1425
7829	IC-7362-5-2-1P-BP x P-99	61	119	13.0	1129
7830	IC-7362-5-2-1P-BP x GW-5/7	53	116	19.5	1654
7831	IC-7362-5-2-1P-BP x SL-972-A	54	122	13.8	1315
7832	IC-7362-5-2-1P-BP x T-103	53	114	12.0	1458
7833	IC-7362-5-2-1P-BP x P-180-1	60	121	13.9	1484
7834	IC-7362-5-2-1P-BP x P-505	65	125	18.8	1341
7835	IC-7362-5-2-1P-BP x P-1081-1	63	127	12.1	1321
7836	IC-7362-5-2-1P-BP x JM-583	68	128	12.2	1414
7837	IC-7362-5-2-1P-BP x P-436	55	115	12.9	1324
7838	IC-7362-5-2-1P-BP x P-127	58	118	12.9	1249
7839	IC-7362-5-2-1P-BP x ICCC-1	55	116	15.4	2145
7840	IC-7362-5-2-1P-BP x Annigeri	57	120	16.7	1872

Contd....Table 1.19.

IC.No/Name	Parentage	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield kg/ha
7841	IC-73241-3-1-1P-LB-BP x BDN-9-3	47	113	14.3	1699
7842	IC-73241-3-1-1P-LB-BP x Phule G-3	47	114	17.4	1513
7843	IC-73241-3-1-1P-LB-BP x K-850	54	114	17.8	1610
7844	IC-73241-3-1-1P-LB-BP x JG-74	50	113	13.8	1802
7845	IC-73241-3-1-1P-LB-BP x Chafa	47	115	14.3	2051
7846	IC-73241-3-1-1P-LB-BP x CPS-1	54	115	15.7	1122
7847	IC-73241-3-1-1P-LB-BP x NEC-240	57	123	13.5	1349
7848	IC-73241-3-1-1P-LB-BP x N-59	51	118	14.4	1403
7849	IC-73241-3-1-1P-LB-BP x P-99	53	117	11.4	1033
7850	IC-73241-3-1-1P-LB-BP x GW-5/7	49	114	24.3	1528
7851	IC-73241-3-1-1P-LB-BP x SL-972-A	50	115	12.5	1477
7852	IC-73241-3-1-1P-LB-BP x T-103	51	114	13.9	1483
7853	IC-73241-3-1-1P-LB-BP x P-180-1	53	116	13.2	1309
7854	IC-73241-3-1-1P-LB-BP x P-505	51	124	12.7	1296
7855	IC-73241-3-1-1P-LB-BP x P-1081-1	53	120	13.5	1812
7856	IC-73241-3-1-1P-LB-BP x JM-583	58	125	12.2	1267
7857	IC-73241-3-1-1P-LB-BP x P-436	50	115	13.1	1632
7858	IC-73241-3-1-1P-LB-BP x P-127	49	118	13.0	1411
7859	IC-73241-3-1-1P-LB-BP x ICCC-1	49	117	15.5	1557
7860	IC-73241-3-1-1P-LB-BP x Annigeri	46	110	17.9	1841
7861	IC-7389-20-3-B-BP x BDN-9-3	51	112	15.2	1541
7862	IC-7389-20-3-B-BP x Phule G-3	48	111	19.8	1666
7863	IC-7389-20-3-B-BP x K-850	55	115	23.5	2013
7864	IC-7389-20-3-B-BP x JG-74	50	114	18.6	1421
7865	IC-7389-20-3-B-BP x Chafa	47	109	16.3	1445
7866	IC-7389-20-3-B-BP x CPS-1	53	118	16.1	1316
7867	IC-7389-20-3-B-BP x NEC-240	62	123	15.5	1838
7868	IC-7389-20-3-B-BP x N-59	53	115	23.3	1788
7869	IC-7389-20-3-B-BP x P-99	52	112	18.2	1313
7870	IC-7389-20-3-B-BP x GW-5/7	49	109	20.0	2004
7871	IC-7389-20-3-B-BP x SL-972-A	52	115	15.2	1285
7872	IC-7389-20-3-B-BP x T-103	51	114	16.2	1572
7873	IC-7389-20-3-B-BP x P-180-1	50	114	16.0	1803
7874	IC-7389-20-3-B-BP x P-505	58	120	14.6	1425
7875	IC-7389-20-3-B-BP x P-1081-1	57	116	15.1	1587
7876	IC-7389-20-3-B-BP x JM-583	61	122	14.2	1672
7877	IC-7389-20-3-B-BP x P-436	49	111	15.1	1393
7878	IC-7389-20-3-B-BP x P-127	54	113	17.2	1609
7879	IC-7389-20-3-B-BP x ICCC-1	51	114	19.4	2379
7880	IC-7389-20-3-B-BP x Annigeri	49	111	18.0	1598
7881	IC-73167-5-3-B-BP x BDN-9-3	50	114	12.8	1344
7882	IC-73167-5-3-B-BP x Phule G-3	46	115	15.4	1332

Contd....Table 1.19.

No/N:	Parentage	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield kg/ha
7883	IC-73167-5-3-B-BP x K-850	60	114	17.8	1940
7884	IC-73167-5-3-B-BP x JG-74	51	110	14.2	1319
7885	IC-73167-5-3-B-BP x Chafa	49	115	13.3	1809
7886	IC-73167-5-3-B-BP x CPS-1	56	119	19.3	1542
7887	IC-73167-5-3-B-BP x NEC-240	64	127	11.6	912
7888	IC-73167-5-3-B-BP x N-59	54	114	14.1	1362
7889	IC-73167-5-3-B-BP x P-99	55	113	13.0	1313
7890	IC-73167-5-3-B-BP x GW-5/7	49	116	20.3	1733
7891	IC-73167-5-3-B-BP x SL-972-A	57	116	13.4	1474
7892	IC-73167-5-3-B-BP x T-103	52	109	12.3	1071
7893	IC-73167-5-3-B-BP x P-180-1	58	116	13.4	1385
7894	IC-73167-5-3-B-BP x P-505	64	123	12.7	1425
7895	IC-73167-5-3-B-BP x P-1081-1	60	120	10.3	1143
7896	IC-73167-5-3-B-BP x JM-583	65	125	13.3	1126
7897	IC-73167-5-3-B-BP x P-436	55	110	13.3	1615
7898	IC-73167-5-3-B-BP x P-127	56	115	13.9	1294
7899	IC-73167-5-3-B-BP x ICCC-1	53	115	14.7	1285
78100	IC-73167-5-3-B-BP x Annigeri	54	115	14.5	1851
BDN-9-3		47	111	12.6	1669
Phule G-3		44	113	18.2	1390
K-850		61	116	22.3	1517
JG-74		47	106	15.7	1330
Chafa		48	111	13.2	1007
CPS-1		56	114	14.8	1202
NEC-240		74	128	11.8	1029
N-59		52	119	14.1	1278
P-99		60	114	12.9	1197
GW-5/7		48	110	29.2	1683
SL-972-A		54	116	10.7	1628
T-103		52	107	12.3	1677
P-180-1		56	114	13.3	1620
P-505		80	129	10.2	1174
P-1081-1		62	122	11.6	1817
JM-583		74	128	11.6	1486
P-436		51	109	12.9	1015
P-127		58	116	12.7	1762
ICCC-1		52	114	17.7	1590
Annigeri		52	114	18.6	1806
IC-7343-14-3-B-BP		66	125	14.2	1753
Mean		55	117	15.0	1499
CD(.05)		3.8	5.2	3.27	780.7
CV%		4.4	2.8	13.6	32.6

Table 1.20. Mean squares from the analysis of variance and estimates of general & specific combining ability variances in the F_2 20 x 5 line x tester trial Hyderabad, 1980-81.

Source	d.f.	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield kg/ha
Mean Squares					
Replications	2	98.12**	285.9**	37.71**	4037130**
Crosses	99	90.39**	62.6**	22.15**	285498
Testers	19	317.34**	214.9**	66.06**	481021*
Lines	4	420.75**	293.9**	108.06**	384158
Line x Tester	76	16.27**	12.3	6.65*	231424
Error	198	5.99	10.5	4.69	244192
Variances:					
GCA		9.41**	6.5*	2.18**	5364*
SCA		3.42**	0.6	0.65*	-ve

Table 1.21. Estimates of general combining ability effects of parents and their standard errors from F_2 20 x 5 Line x Tester Trial at Hyderabad, 1980-81.

	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield kg/ha
Lines				
IC-7343-14-3-B-BP	2.18^{**}_{**}	1.83^{**}_{**}	-0.75	-14.70
IC-7362-5-2-1P-BP	2.38^{*}	2.63	-0.35	22.75
IC-73241-3-1-1P-LB-BP	-3.52^{**}_{**}	-0.52^{**}_{**}	-0.34^{*}	-72.95
IC-7389-20-3-B-BP	-2.05^{*}	-2.79	2.36^{*}	125.85
IC-73167-5-3-B-BP	1.01	-1.14	-0.91	-60.96
$SE(g_i)$	0.45	0.59	0.40	90.22
Testers				
BDN-9-3	4.30^{**}_{**}	-2.74^{*}_{**}	-1.51^{*}	64.20
Phule G-3	6.77^{**}_{**}	-3.34	1.55^{**}_{**}	-86.53
K-850	3.03^{**}_{**}	0.26^{**}_{**}	3.82	288.54
JG-74	4.50^{**}_{**}	-3.87^{*}	0.36	9.67
Chafa	5.90	-2.87	-0.55	106.34
CPS-1	0.43^{**}_{**}	1.66^{**}_{**}	1.03	-186.80
NEC-240	8.43	7.33	-1.34	-210.93
N-59	0.56	0.59	1.08	12.80
P-99	1.76^{**}_{**}	-1.74^{*}_{**}	-1.12^{**}_{**}	-327.46
GW-5/7	4.70	-2.61	5.85^{*}_{*}	194.07
SL-972-A	0.64^{**}_{**}	0.33^{**}_{**}	-1.69	-106.80
T-103	2.97^{*}_{*}	-3.54	-1.49	188.47
P-180-1	2.10^{**}_{**}	1.13^{**}_{**}	-1.19	-72.73
P-505	6.10^{**}_{**}	6.59^{**}_{**}	-0.74^{**}_{**}	-165.26
P-1081-1	4.10^{**}_{**}	3.19^{**}_{**}	-2.63^{*}_{*}	-24.86
JM-583	9.36^{*}_{*}	8.46^{**}_{**}	-1.74^{*}_{*}	-44.20
P-436	1.90	-4.07	-1.64	-119.33
P-127	1.30^{*}_{*}	-1.34	-0.86	-103.46
ICCC-1	2.04^{**}_{**}	-1.34	1.17^{*}_{*}	312.80
Annigeri	3.44	-2.07	1.64	271.47
$SE(g_i)$	0.89	1.18	0.79	180.44

Table 1.22. Characteristics of entries in F_2 15 x 5 line x tester trial at Gwalior, 1980-81.

Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield (kg/ha)
781	79.7	129	41.3	15.7	424
782	70.3	134	53.0	17.3	785
783	83.7	136	52.7	18.1	757
784	77.3	131	41.0	15.1	436
785	81.0	130	39.0	13.9	401
787	89.7	130	46.7	14.0	488
788	84.0	133	48.0	16.1	587
7810	85.0	135	51.7	19.7	678
7811	84.3	131	44.7	13.3	412
7814	99.3	141	45.0	14.2	519
7816	93.3	137	48.7	13.6	642
7817	82.7	134	46.7	13.9	753
7818	90.3	133	46.0	15.9	643
7819	80.7	134	45.7	16.4	539
7820	84.3	136	44.7	16.7	714
7821	86.0	135	48.7	15.8	686
7822	69.3	134	47.7	18.4	674
7823	83.7	132	46.0	19.2	563
7824	75.3	131	43.0	14.9	539
7825	83.0	131	41.3	14.2	559
7827	76.7	135	45.0	14.5	460
7828	74.3	131	47.7	15.2	682
7830	73.7	132	51.3	24.7	662
7831	76.0	132	42.0	13.7	511
7834	85.7	132	47.3	15.0	599
7836	96.0	139	49.7	13.7	587
7837	87.7	137	44.0	14.0	618
7838	87.7	134	45.0	15.0	634
7839	87.3	136	48.7	20.4	595
7840	84.0	131	48.7	17.3	626
7841	76.0	135	43.3	16.6	551
7842	73.3	132	40.3	19.1	654
7843	78.7	136	50.7	20.9	829
7844	75.7	132	44.0	16.2	575
7845	69.0	128	48.3	14.4	789
7847	90.3	139	47.0	13.8	515
7848	82.7	134	46.3	16.1	622
7850	75.6	131	55.0	20.9	571
7851	83.0	133	47.7	13.9	591
7854	80.3	134	44.0	15.8	484
7856	83.0	136	47.0	14.7	686
7857	79.7	136	43.0	15.2	583
7858	77.7	135	47.3	16.0	983
7859	78.7	137	49.0	17.9	785

Contd....Table 1.22.

Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield (kg/ha)
7860	76.3	135	44.3	17.5	599
7861	75.3	137	48.3	17.2	666
7862	71.7	128	48.3	18.3	678
7863	87.0	136	52.7	24.1	637
7864	75.3	134	53.7	21.0	690
7865	72.7	134	46.0	14.6	647
7867	78.0	129	44.7	16.9	380
7868	80.3	136	44.3	18.3	630
7870	74.3	133	52.0	26.4	654
7871	69.0	132	47.3	18.0	579
7874	79.7	133	49.3	18.2	745
7876	79.3	131	56.3	18.5	638
7877	70.7	125	43.0	16.9	505
7878	74.3	131	44.7	16.2	769
7879	74.7	131	51.7	20.4	726
7880	69.3	132	42.3	20.1	650
7881	70.3	129	40.0	13.3	523
7882	68.0	125	44.0	15.2	595
7883	78.0	134	48.3	19.0	789
7884	74.3	131	44.3	14.3	614
7885	69.3	132	43.7	13.7	638
7887	89.3	134	48.7	12.7	591
7888	72.7	129	43.3	14.5	599
7890	72.7	136	57.7	21.7	845
7891	79.0	134	49.0	12.9	666
7894	82.7	132	42.7	13.3	666
7896	88.7	137	48.0	12.1	706
7897	72.7	134	46.0	14.0	749
7898	74.7	134	48.3	13.8	991
7899	72.0	131	47.7	15.3	781
78100	74.3	133	45.7	15.7	686
BDN-9-3	71.0	134	49.0	14.9	908
Phule G-3	71.3	135	44.0	18.5	761
K-850	94.0	140	49.3	26.2	714
JG-74	76.3	131	47.7	16.2	626
Chafa	71.7	131	50.7	13.1	746
NEC-240	103.0	140	51.0	11.8	642
N-59	76.7	133	47.7	16.7	595
GW-5/7	72.7	129	48.7	28.8	464
SL-972-A	82.0	131	47.3	13.7	424
P-505	98.0	138	43.3	11.5	635
JM-583	96.7	136	49.0	11.8	674
P-436	75.0	129	41.3	14.1	618
P-127	80.0	132	45.3	14.3	726

Contd....Table 1.22.

Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield (kg/ha)
ICCC-1	79.7	137	47.7	18.1	730
Annigeri	73.0	132	47.0	18.5	741
Mean	79.6	133	46.9	16.5	641
CD(.05)	12.04	6.89	7.90	2.31	252.31
CV%	9.5	3.2	10.5	8.8	24.6

Table 1.23. Mean squares from the analysis of variance and estimates of general and specific combining ability variances in the F_2 15 x 5 Line x Tester Trial at Gwalior, 1980-81.

Source	d.f.	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha
Replications	2	173.56**	34.54*	124.97**	2.01	63184.10**
Crosses	74	143.09**	24.77	43.11**	25.46**	42758.00**
Testers	14	303.59**	27.70	105.16**	88.22**	89604.20**
Lines	4	658.58**	31.87	32.36	114.24**	90249.30**
Line x Tester	56	66.14	23.53	28.36	3.42*	27564.20
Error	148	60.97	20.20	22.15	2.11	26565.80
GCA		13.83**	0.21	1.35*	3.26**	2075.75**
SCA		1.72	1.11	2.07	0.44*	362.81

Table 1.24. Estimates of general combining ability effects from F_2 15 x 5 Line x Tester Trial at Gwalior, 1980-81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha
Lines					
IC-7343-14-3-B-BP	5.15**	0.45	-0.49	-0.88**	-50.60
IC-7362-5-2-1P-BP	2.52	0.30	-0.40	-0.08	-36.17
IC-73241-3-1-1P-LB-BP	-0.46*	0.99	-0.31	0.12**	22.80
IC-7389-20-3-B-BP	-3.79*	-1.04	1.51	2.54**	3.80
IC-73167-5-3-B-BP	-3.32	-0.70	-0.31	-1.70	60.16
SE(g_i)	1.65	0.95	0.99	0.31	34.36
Testers					
BDN-9-3	-1.76	-0.19	-2.47	-0.77*	-65.75
Phule G-3	-8.70	-2.32	-0.13	1.17**	41.32
K-850	2.97	1.54	3.27	3.80	91.72
JG-74	-3.65	-1.32	-1.60	-0.15**	-65.02
Chafa	-4.23	-2.19	-3.13	-2.30**	-29.15*
NEC-240	3.57	0.48	-0.40	-2.09	-149.15
N-59	-0.43	-0.59	-0.87**	-0.43**	-11.88
GW-5/7	-2.96	0.28	6.73	6.22**	46.12
SL-972-A	-0.96*	-0.72	-0.67	-2.12*	-84.02
P-505	6.30**	1.28	-1.13	-1.18**	-33.22
JM-583	8.84	2.88	3.13	-1.98*	16.05
P-436	-0.56	0.14	-2.27	-1.69*	5.98**
P-127	1.70	0.14	-0.53	-1.08*	168.32
ICCC-1	-0.56	0.61	1.73	1.61	49.38
Annigeri	-1.56	0.01	-1.67	0.99	19.32
SE(g_i)	2.85	1.64	1.72	0.53	59.52

Table 1.25. Pedigrees of three-way crosses in non-replicated plots at Hyderabad 1980-81.

ICL Number	Pedigree
78374	Annigeri x (P-436 x H-223)
78375	HMS-10 x (P-436 x H-223)
78376	ICCC-1 x (P-436 x H-223)
78378	Phule G-3 x (Annigeri x Pant G-114)
78379	ICCC-4 x (Annigeri x Pant G-114)
78381	HMS-1 x (JG-62 x Annigeri)
78382	P-127 x (JG-62 x Annigeri)
78383	P-436 x (JG-62 x Annigeri)
78384	K-850 x (Caina x H-208)
78389	P-127 x (ICCC-1 x K-468)
78394	73129-16-2-B-BP x (P-5482 x T-3)
78395	Col-1 x (P-5482 x T-3)
78396	BDN-9-3 x (P-5482 x T-3)
78400	Pant G-114 x (JG-62 x P-345-1)
78402	Pant G-120 x (JG-221 x H-355)
78403	7343-14-3-B-BP x (JG-221 x H-355)
78404	Chafa x (JG-221 x H-355)
78405	ICCC-1 x (CPS-1 x ICCC-3)
78406	73241-3-1-1P-B-BP x (CPS-1 x ICCC-3)
78408	ANM-723 x (P-436 x ICCC-4)
78409	V-138 x (P-436 x ICCC-4)
78410	73114-16-2-LB-B-BP x (P-463 x ICCC-4)
78411	ICCC-4 x (ICCC-1 x ICCC-2)
78413	T-54-A x (ICCC-1 x ICCC-2)
78414	P-2520 x (JG-221 x F-404)
78416	B-110 x (JG-221 x F-404)
78419	ICCC-4 x (SL-972-A x Caina)
78420	P-324 x (SL-972-A x Caina)
78422	GL-645 x (JG-62 x Annigeri)
78425	7362-5-2-B-BP x (P-5482 x T-3)
78426	JM-466 x (Caina x PRR-1)

F_3 GENERATION

All the F_3 populations were sown in replicated yield trials at Hyderabad, Gwalior and Hissar. In addition, Trial 1 was sown at 12 other locations in India, as part of the AICPIP, and at 11 locations in other countries. Trial 1 was a RCB with 4 reps, Trials 2 to 4 were 6 x 6 triple lattices and Trial 5 was a 7 x 7 quadruple lattice. The plot sizes were 4 rows, 4m long and 30 cms apart. Days to 50% flowering

and to maturity, and weights of 100 seed were recorded in all trials and net plots of 2 rows x 3.5m were bulk harvested to estimate seed yield, at Hyderabad and Gwalior. Plant heights were recorded at Gwalior and a rating for appearance carried out at Hyderabad. The trials at Hissar were heavily damaged by *Botrytis* which was aggravated by unusually wet conditions and yield and seed size data were not recorded. Details of Trial 1 (F_3-MLT) are given elsewhere.

The entries in Trials 2 to 5 are listed with their parentages in Tables 1.26 to 1.29. Trials 2 to 4 each included 30 F_3 populations, G-130, Annigeri, K-850 and P-324 and two local checks. Trial 5 included 42 F_3 populations and ICCC-4, in addition to the other checks.

Time to flowering and maturity were longest at Hissar and shortest at Hyderabad with Gwalior intermediate (Table 1.30). Seed yields were considerably higher at Hyderabad than at Gwalior but seed sizes were similar. At Hyderabad, Annigeri was the highest yielder in two trials and in the top six in the others (Tables 1.31 to 1.34). None of the F_3 populations was significantly higher yielding than Annigeri at Hyderabad nor the local checks (Gwalior-2 and strain-76) at Gwalior.

There were consistent positive associations between days to flowering and to maturity (Tables 1.35 to 1.38) and early flowering types tended to be larger seeded. At Hyderabad, the visual rating was positively correlated with days to flowering and maturity and all tended to be negatively correlated with seed yield, indicating the importance of early maturity for high seed yield in peninsular India. Seed yield was also positively correlated with seed size at Hyderabad but this may have resulted from the negative association between seed size and earliness. At Gwalior, later maturing entries tended to be taller but there were no consistent correlations between seed yield and other plant characters.

Seventy F_3 populations (Table 1.39) including high, intermediate and poor yielding types for comparison, will be sown as F_4 space planted bulks at Hyderabad in 1981-82 for single plant selection.

F_4 GENERATION

At Hyderabad, comprised 80 space planted bulks of crosses from F_3 trials in 1979/80. Most of these had appeared among the top yielders, but intermediate and poor yielding bulks were also included for comparison. The plots were a maximum of 50 rows 4m long but in some cases were reduced

Table 1.26. Pedigrees of entries in F_3-MLT-2 in 1980-81.

IC number	Pedigree
770092-BH	F-496 x G-130
771104-BP	JG-62 x H-335
770269-B	BH-203 x K-850
770304-BG	IC-7347-6-4-B-BH x P-1209-1
770427-B	B-110 x T-3
770472-B	GL-629 x H-208
770765-B	Pant G-114 x IC-76861-F1
770766-B	IC-73167-13-3-B-BH x IC-76862-F1
770767-B	P-5482 x IC-76864-F1
770770-BG	H-355 x IC-76885-F1
770775-BP	P-436 x IC-76906-F1
770777-B	ICCC-3 x IC-76914-F1
770876-B	ICCC-1 x IC-76899-F1
770877-BP	IC-73144-6-1-2P-BP x IC-76912-F1
771083-BP	P-436 x G-130
771086-BP	ICCC-5 x P-1863
771087-B	IC-73167-13-3-B-BH x P-36
771090-B	ICCC-3 x P-1353
771093-BG	No.501 x P-1353
771097-B	IC-7385-17-2-B-BH x P-36
771099-B	H-208 x P-1353
771102-BH	F-404 x H-355
771107-BH	P-993 x P-36
771111-B	P-992 x G-130
771113-B	P-992 x NEC-1639
771117-B	IC-7347-6-4-B-BH x GL-629
771121-B	IC-751245-F2-2 x IC-75877-F2-1
771123-BG	IC-75661-F2-2 x IC-75926-F2-1
771125-B	IC-75667-F2-2 x IC-75858-F2-1
771130-BH	IC-75736-F2-1 x IC-75859-F2-1
G-130	
Annigeri	
K-850	
P-324	
Local check-1	
Local check-2	

Table 1.27. Pedigrees of entries in F_3-MLT-3, 1980-81.

IC number	Pedigree
770430-BG	H-355 x F-496
770431-BP	F-378 x SL-972-A
770435-B	F-378 x P-436
770436-BH	F-404 x JG-39
770437-B	F-378 x P-992
770440-BH	H-355 x T-3
770444-BH	F-187 x ICC-2345
770447-BG	NEC-550 x ICC-6371
770449-B	P-1871 x ICC-6527
770450-B	P-992 x ICC-6626
770452-BH	P-4249 x ICC-9037
770475-BG	Rabat x P-538
770476-BP	IC-73144-6-1-2P-BP x P-2591
770477-BP	F-378 x P-9800
770480-B	L-534 x USA-613
770485-B	NEC-2296 x ICC-6481
770488-B	ICC-8209 x C-104
770781-B	JG-221 x IC-76953-F1
770782-B	ICCC-2 x IC-76936-F1
770783-B	BG-203 x IC-76848-F1
770784-B	Pant G-115 x IC-76852-F1
770785-B	IC-73213-9-3-B-BP x IC-76861-F1
770787-B	ICCC-2 x IC-76863-F1
770788-BP	K-468 x IC-76864-F1
770881-B	ICCC-5 x IC-76949-F1
770891-BP	K-850 x IC-76998-F1
771133-B	IC-75782-F2-1 x IC-75899-F2-3
771136-B	IC-75877-F2-2 x IC-75736-F2-6
771143-B	IC-75759-F2-3 x IC-751570-F2-1
771146-B	IC-75787-F2-3 x IC-751040-F2-1
G-130	
Annigeri	
K-850	
P-324	
Local check-1	
Local check-2	

Table 1.28. Pedigrees of entries in F3-MLT-4, 1980-81.

IC number	Pedigree
770126-BH	F-378 x BG-203
770127-BH	F-378 x Pant G-114
770130-BH	F-378 x ICCC-3
770134-BP	USA-613 x ICCC-2
770135-BH	USA-613 x ICCC-3
770136-BH	H-355 x BG-203
770140-B	H-355 x ICCC-3
770142-B	JG-39 x Pant G-114
770147-B	JGC-1 x Pant G-114
770148-B	JGC-1 x ICCC-1
770150-B	JGC-1 x ICCC-3
770152-BH	P-1198-1 x Pant G-114
770153-BP	P-1198-1 x ICCC-1
770155-BP	P-1198-1 x ICCC-3
770159-B	P-790 x ICCC-2
770168-BP	P-840 x ICCC-1
770454-BP	H-208 x P-4301
770457-B	C-214 x P-4301
770459-BH	ICC-2204 x V-165
770462-B	ICC-8209 x NEC-240
770466-B	H-208 x ICC-10490
770467-BH	G-130 x ICC-10495
770488-B	ICC-8209 x C-104
770789-B	ICCC-5 x IC-76870-F1
770793-BG	P-1209-1 x IC-76900-F1
770795-BP	P-436 x IC-76913-F1
770893-B	P-1209-1 x IC-76869-F1
770898-B	F-378 x IC-76979-F1
771119-BG	ICC-4840 x NEC-2296
771150-B	IC-75862-F2-1 x IC-75979-F2-3
771154-B	IC-75952-F2-2 x IC-75504-F2-2
G-130	
Annigeri	
K-850	
P-324	
Local check-1	

Table 1.29. **Pedigrees** of entries in F_3-MLT-5, 1980-81.

IC number	Pedigree
770001-BP	PRR-1 x Annigeri
770004-B	PRR-1 x ICCC-1
770006-BH	PRR-1 x H-208
770008-B	PRR-1 x P-992
770009-B	PRR-1 x P-5462
770010-B	PRR-1 x NEC-802
770016-BP	Annigeri x CPS-1
770017-BP	Annigeri x Caina
770018-BP	Annigeri x ICCC-1
770019-B	Annigeri x K-850
770020-B	Annigeri x H-208
770021-BP	Annigeri x F-496
770024-BH	Annigeri x NEC-802
770026-BH	Annigeri x E-100
770027-B	Annigeri x ICCC-2
770028-BP	Annigeri x IC-73213-9-3-B-BP
770029-B	Annigeri x G-130
770043-BP	Caina x ICCC-1
770044-BH	Caina x K-850
770056-B	ICCC-1 x H-208
770057-B	ICCC-1 x F-496
770058-B	ICCC-1 x P-992
770060-B	ICCC-1 x NEC-802
770063-B	ICCC-1 x ICCC-2
770074-B	K-850 x IC-73213-9-3-B-BP
770076-BP	H-208 x F-496
770079-B	H-208 x NEC-802
770082-BH	H-208 x ICCC-2
770083-B	H-208 x IC-73213-9-3-B-BP
770085-B	F-496 x P-992
770089-BH	F-496 x E-100
770090-BH	F-496 x ICCC-2
770091-B	F-496 x IC-73213-9-3-B-BP
770092-B	F-496 x G-130
770097-BP	P-992 x ICCC-2
770102-B	P-5462 x E-100
770106-B	NEC-802 x NEC-989
770108-B	NEC-802 x ICCC-2
770114-B	NEC-989 x G-130
770117-BH	E-100 x G-130
770118-BH	ICCC-2 x IC-73213-9-3-B-BP
770119-BH	ICCC-2 x G-130
G-130	
Annigeri	
K-850	
P-324	
ICCC-4	
Local check-1	
Local check-2	

Table 1.30. Mean values of characteristics recorded in F_3 multilocational trials 2 to 5 at Hyderabad, Gwalior and Hissar 1980-81.

Trial		Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield (kg/ha)
2	Hyderabad	59.6	120	16.1	1418
	Gwalior	66.3	136	15.2	942
	Hissar	86.0	157	-	-
3	Hyderabad	61.4	121	14.7	1266
	Gwalior	67.7	140	15.4	837
	Hissar	88.0	159	-	-
4	Hyderabad	59.7	119	14.9	1319
	Gwalior	94.4	145	14.3	937
	Hissar	88.6	159	-	-
5	Hyderabad	56.6	119	16.3	1720
	Gwalior	64.9	137	16.2	864
	Hissar	76.5	158	-	-

Table 1.31. Characteristics of entries in F_3-MLT-2 at Hyderabad, Gwalior and Hissar in 1980-81.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar
790092-BH	71.7	85.3	91.7	128	141	156	13.0	12.6		1501 (20)	976 (16)	
771104-BP	56.8	62.0	87.7	121	136	157	13.7	12.0		1889 (4)	1095 (4)	
770269-B	58.7	64.0	85.3	116	135	155	17.3	14.9		1829 (7)	1023 (10)	
770304-BG	52.6	62.3	83.3	119	135	158	19.3	20.6		1691 (8)	1154 (1)	
770427-B	63.7	73.3	85.0	124	140	157	17.6	16.1		1646 (10)	940 (21)	
770472-B	64.3	66.3	85.7	122	135	157	16.1	15.9		1636 (11)	996 (13)	
770765-B	63.4	65.3	84.4	122	138	158	13.6	12.2		1626 (12)	1016 (11)	
770766-B	61.9	64.7	84.7	119	137	158	13.6	13.0		1576 (16)	1079 (6)	
770767-B	53.6	64.0	81.3	122	134	156	17.2	16.3		1359 (23)	706 (33)	
770770-BG	49.4	61.0	83.0	125	136	157	15.1	12.8		1347 (24)	1031 (9)	
770775-BP	55.7	61.0	82.3	112	134	155	13.6	13.1		1398 (22)	960 (18)	
770777-BP	59.9	67.0	85.7	121	134	155	14.0	13.6		1433 (21)	1107 (3)	
770876-B	53.6	61.3	79.0	119	134	156	17.6	16.0		1553 (17)	829 (31)	
770877-BP	55.7	59.7	84.7	115	133	157	15.7	15.2		1529 (19)	888 (25)	
771083-BP	60.4	65.6	83.0	117	135	154	17.4	16.6		1577 (15)	1071 (7)	
771086-BP	58.6	67.3	84.0	119	135	153	13.7	12.0		1619 (13)	877 (27)	
771088-B	51.6	59.3	80.6	110	132	157	19.0	16.7		1843 (5)	897 (24)	
771090-B	56.0	61.3	83.3	118	134	152	15.3	14.4		1974 (2)	1007 (12)	
771093-BG	60.6	63.7	83.4	125	138	157	17.2	18.5		1086 (26)	883 (28)	
771097-B	55.4	60.7	81.4	123	136	157	16.3	14.6		1933 (3)	946 (20)	
771099-B	58.2	61.0	84.7	123	134	155	13.1	13.3		1607 (14)	1095 (4)	
771102-BH	69.5	68.7	88.3	125	139	156	12.2	11.4		759 (33)	869 (28)	
771107-BH	66.6	68.7	88.0	126	140	157	16.0	15.7		1028 (29)	924 (22)	
771111-B	73.6	68.7	95.3	125	141	156	15.7	15.0		697 (35)	686 (35)	
771113-B	70.5	86.3	93.3	129	143	160	14.0	14.1		405 (36)	952 (19)	
771117-B	66.0	70.0	88.0	122	148	160	20.8	20.6		997 (31)	694 (34)	
771121-B	64.3	66.7	88.0	124	138	157	15.4	15.3		945 (32)	1035 (8)	
771123-BG	57.4	63.3	84.0	115	134	156	15.0	15.8		1316 (25)	861 (29)	
771125-B	68.8	75.3	89.6	128	140	157	14.6	15.3		1010 (30)	813 (32)	
771130-BH	66.2	78.3	90.3	126	140	157	16.5	16.9		750 (34)	675 (36)	

Contd....Table 1.31.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar
G-130	65.4	79.3	92.3	126	141	160	15.1	12.5		1202 (27)	917 (23)	
Annigeri	44.5	56.7	84.0	109	134	152	21.3	20.2		1990 (1)	833 (30)	
K-850	54.4	65.0	83.8	110	135	155	26.7	24.3		1836 (6)	964 (17)	
P-324	55.0	64.0	86.3	116	134	159	11.7	12.4		1673 (9)	996 (13)	
Local check-1	43.2	62.7	85.7	109	133	157	20.5	13.9		1544 (18)	988 (15)	
Local check-2	58.7	58.3	95.3	118	133	158	14.6	13.2		1238 (26)	1127 (2)	
Mean	59.6	66.3	86.0	120	136	157	16.1	15.2		1418	942	
CD	6.90	6.64	3.38	5.3	2.8	3.4	1.84	1.81		611.8	353.3	
CV	7.1	6.1	2.4	2.7	1.3	1.4	7.0	7.4		26.7	23.0	

* Adjusted means.

Table 1.32. Characteristics of entries in F_3-MLT-3 at Hyderabad, Gwalior and Hissar in 1980-81.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar
770430-BG	71.4	78.7	91.7	127	140	161	11.2	11.8		1154 (24)	857 (17)	
770431-BP	55.2	60.3	84.7	119	138	161	10.8	13.1		1403 (9)	813 (24)	
770435-B	57.3	64.3	86.3	121	140	161	13.9	15.3		1154 (23)	932 (8)	
770436-BH	68.7	72.7	90.0	122	139	160	11.6	11.7		1338 (14)	825 (23)	
770437-B	69.6	72.7	90.3	123	140	159	11.4	11.0		575 (36)	1071 (1)	
770440-BH	68.8	84.9	89.3	123	142	161	13.0	15.2		1202 (20)	896 (13)	
770444-BH	67.3	71.6	90.0	125	140	160	12.7	12.8		1095 (26)	837 (20)	
770447-BG	69.8	75.8	94.3	125	141	159	14.6	15.5		1172 (22)	710 (31)	
770449-B	64.0	64.9	90.3	127	141	161	13.4	13.6		1387 (11)	992 (16)	
770450-B	61.1	88.0	96.0	127	144	161	12.0	16.5		701 (35)	738 (29)	
770452-BH	59.8	65.4	87.3	120	138	155	10.9	10.6		1255 (17)	900 (12)	
770475-BG	61.3	65.7	89.7	123	141	160	21.6	23.0		1400 (10)	829 (21)	
770476-BP	53.1	58.6	83.3	116	136	160	15.6	15.9		1053 (28)	738 (27)	
770477-BP	62.3	63.9	86.7	124	142	160	19.6	19.9		785 (34)	520 (36)	
770480-B	73.2	78.0	92.0	129	142	160	17.0	18.5		1030 (29)	694 (32)	
770485-B	62.1	67.6	87.0	123	142	161	18.3	16.4		1407 (8)	825 (22)	
770488-B	58.9	73.0	86.0	122	140	159	13.0	12.7		1015 (30)	992 (5)	
770781-B	52.2	62.3	84.0	115	137	159	15.3	16.0		1471 (3)	849 (18)	
770782-B	58.7	64.0	85.0	123	138	160	13.5	12.9		1248 (18)	908 (9)	
770783-B	66.9	69.0	87.3	122	139	160	11.4	11.3		915 (32)	873 (16)	
770784-B	43.5	65.3	86.7	119	139	162	11.8	12.9		1057 (27)	980 (7)	
770785-B	49.4	57.1	84.7	118	137	155	13.2	14.3		1323 (15)	904 (10)	
770787-B	63.3	69.4	88.0	127	141	160	13.0	13.9		1184 (21)	687 (33)	
770788-BP	55.7	65.0	85.3	117	138	157	14.8	14.0		1649 (5)	888 (14)	
770881-B	57.7	64.2	85.7	120	139	162	11.8	12.7		982 (31)	900 (11)	
770891-BP	53.3	61.7	85.0	114	138	155	13.2	20.5		1423 (7)	997 (4)	
771133-B	65.2	69.6	88.3	120	140	160	13.0	15.8		1099 (25)	845 (19)	
[illegible]	65.8	69.9	88.3	124	142	163	14.8	14.4		849 (33)	738 (28)	
771143-B	61.7	69.4	90.0	123	141	161	12.4	18.6		1216 (19)	587 (35)	
771146-B	67.9	65.9	86.3	136	143	161	16.1	20.1		1313 (16)	734 (30)	

Contd....Table 1.32.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar
G-130	72.6	75.0	89.7	124	142	160	12.3	14.2		1345 (13)	777 (26)	
Annigeri	46.1	55.1	-	109	139	-	19.9	21.0		2331 (1)	785 (25)	
K-850	57.0	66.1	84.7	111	139	155	28.0	24.8		1809 (4)	595 (34)	
P-324	58.6	64.4	86.7	114	138	157	11.8	12.6		1396 (12)	1023 (2)	
Local check-1	46.2	58.4	89.3	109	136	159	19.0	14.8		1983 (2)	1000 (3)	
Local check-2	55.4	60.2	91.7	120	137	158	14.6	15.0		1849 (3)	885 (15)	
Mean	61.4	67.7	88.0	121	140	159	14.7	15.4		1266	837	
CD	4.90	6.35	2.88	2.7	2.5	2.1	2.50	1.92		601.7	230.0	
CV	4.9	5.7	2.0	5.4	1.1	0.8	10.5	7.6		23.2	16.9	

Table 1.33. Characteristics of entries in F_3-MLT-4 at Hyderabad, Gwalior and Hissar in 1980-81.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar
770126-BH	67.0	95.4	95.3	121	146	158	11.4	12.1		1217 (21)	1059 (5)	
770127-BH	67.3	95.8	91.4	125	145	161	10.4	12.3		1357 (13)	995 (10)	
770130-BH	65.0	93.8	88.0	127	143	160	13.1	13.4		1076 (28)	957 (18)	
770134-BP	71.0	98.0	87.1	123	147	160	12.0	13.7		1056 (29)	869 (27)	
770135-BH	69.7	96.5	95.0	122	147	158	13.9	15.2		1144 (27)	988 (11)	
770136-BH	68.0	95.7	94.2	123	145	157	11.4	11.8		998 (32)	1096 (2)	
770140-B	65.3	94.4	90.6	125	146	159	12.5	13.1		1373 (12)	959 (17)	
770142-B	68.3	94.4	93.3	123	144	159	10.5	11.3		1182 (25)	951 (19)	
770147-B	44.3	90.7	83.5	111	143	159	18.0	18.0		1547 (9)	828 (32)	
770148-B	44.0	90.4	88.7	110	143	161	24.7	23.9		1954 (2)	918 (22)	
770150-B	42.3	86.5	85.2	112	143	157	21.9	20.6		2001 (1)	939 (20)	
770152-BH	54.3	95.4	83.7	113	145	159	11.8	12.8		1695 (7)	1045 (7)	
770153-BP	49.3	91.6	86.8	110	143	158	14.9	14.8		1270 (19)	983 (12)	
770155-BP	53.0	91.7	86.0	109	144	158	14.6	13.4		1205 (23)	978 (13)	
770159-B	55.7	99.7	95.4	125	147	160	9.3	11.7		673 (36)	867 (28)	
770168-BP	55.3	91.7	85.8	117	144	159	14.8	15.4		1784 (5)	1127 (1)	
770454-BP	52.7	93.3	85.0	121	145	160	13.4	13.6		1202 (24)	753 (34)	
770457-B	57.0	94.3	86.1	125	144	161	13.5	14.1		1302 (17)	884 (25)	
770459-BH	79.0	100.7	92.6	127	147	161	11.7	12.9		824 (35)	858 (29)	
770462-B	77.3	100.3	96.5	126	147	160	12.1	13.3		1027 (31)	891 (24)	
770466-B	66.0	92.0	88.0	125	145	159	12.6	12.5		1041 (30)	1032 (8)	
770467-BH	68.3	91.0	89.1	125	146	160	12.0	12.6		1263 (20)	1009 (9)	
770488-B	75.0	95.7	97.2	121	150	160	15.2	17.1		861 (33)	711 (36)	
770789-B	52.7	91.7	85.0	112	145	161	12.3	13.3		1353 (14)	1083 (3)	
770793-BG	52.7	98.7	84.6	114	145	157	15.5	21.0		1531 (10)	972 (14)	
770795-BP	51.7	95.3	81.7	110	144	155	14.3	14.8		1789 (4)	855 (30)	
770893-B	58.0	95.3	86.7	125	145	158	12.7	13.2		1206 (22)	829 (31)	
770898-B	54.0	99.0	85.5	113	145	159	13.8	14.8		1285 (18)	1047 (6)	
771119-BH	72.3	98.7	95.9	125	148	158	16.4	15.8		1343 (15)	874 (26)	
771150-B	61.7	95.3	84.7	123	149	160	16.8	17.6		1150 (26)	901 (23)	
771154-B	59.3	95.3	90.1	122	148	161	14.7	20.6		834 (34)	749 (35)	

Contd....Table 1.33.

	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar	ICRISAT Center	ICRISAT Gwalior	Hissar
G-130	71.0	99.0	90.9	124	147	159	11.5	12.3		1304 (16)	969 (15)	
Annigeri	46.7	87.7	85.2	109	143	160	17.2	17.7		1761 (6)	800 (33)	
K-850	56.0	92.7	82.7	110	144	157	24.5	22.7		1607 (8)	934 (21)	
P-324	54.7	92.7	85.2	112	145	158	11.1	11.4		1403 (11)	1074 (4)	
Local check-1	44.3	92.3	88.6	109	144	157	18.9	13.1		1876 (3)	965 (16)	
Mean	59.7	94.4	88.6	119	145	159	14.3	14.9		1319	937	
CD	13.61	2.44	4.66	5.3	2.6	3.3	2.87	3.15		627.2	302.7	
CV	14.0	1.6	3.2	2.7	1.1	1.3	12.3	13.0		29.4	19.8	

Table 1.34. Characteristics of entries in F_2-MLT-5 at Hyderabad, Gwalior and Hissar in 1980-81.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar
770001-BP	44.9	52.4	51.0	120	136	154	19.1	23.6		1574 (32)	830 (33)	
770004-B	42.3	52.9	61.8	119	136	158	22.7	21.6		1698 (25)	899 (18)	
770006-BH	63.7	63.0	62.5	121	136	157	14.0	12.4		1597 (31)	897 (20)	
770008-B	49.5	57.8	62.0	123	140	159	22.0	20.0		1399 (38)	869 (23)	
770009-B	41.7	54.0	55.2	116	135	158	19.5	21.5		1905 (17)	704 (46)	
770010-B	56.9	55.0	60.0	120	138	158	28.3	24.9		1541 (33)	750 (40)	
770016-BP	46.4	58.8	61.5	109	136	158	17.9	18.3		1690 (27)	726 (41)	
770017-BP	43.6	52.8	55.8	108	133	157	16.7	17.1		2202 (3)	849 (27)	
770018-BP	45.0	56.5	62.5	111	135	156	19.5	17.5		1993 (13)	837 (28)	
770019-B	47.5	57.0	66.7	111	135	157	22.0	21.1		2180 (4)	954 (11)	
770020-B	46.8	58.0	60.5	119	136	156	15.7	14.8		1820 (21)	951 (12)	
770021-BP	48.6	57.0	83.2	120	134	158	15.4	14.7		1845 (20)	1052 (3)	
770024-BH	43.6	56.7	59.2	112	137	154	17.7	18.3		1969 (14)	836 (29)	
770026-BH	47.6	58.3	61.5	114	135	157	19.4	22.4		2105 (8)	686 (47)	
770027-B	47.8	58.3	64.7	120	134	159	12.9	14.3		1964 (15)	1160 (2)	
770028-BP	44.7	58.0	64.2	110	135	160	16.5	16.6		2223 (2)	893 (19)	
770029-B	46.3	58.8	73.5	122	135	156	15.0	14.8		2156 (5)	977 (8)	
770043-BP	45.3	55.2	59.5	112	135	158	15.6	15.3		1942 (16)	835 (30)	
770044-BH	49.2	60.5	76.7	115	136	155	17.9	18.8		2009 (12)	854 (25)	
770056-B	58.1	66.6	78.2	116	135	157	15.4	13.0		1851 (19)	713 (44)	
770057-B	61.5	64.9	83.0	120	136	158	14.0	14.1		1745 (24)	764 (38)	
770058-B	61.0	64.8	85.0	122	137	160	16.8	16.8		1459 (37)	987 (6)	
770060-B	49.2	59.5	64.7	111	135	159	19.4	18.4		2113 (7)	986 (7)	
770063-B	60.2	64.7	84.5	122	136	159	14.4	14.5		1761 (23)	773 (36)	
770074-B	51.6	62.0	82.0	117	137	157	16.6	18.8		1628 (29)	908 (16)	
770076-BP	69.4	73.2	88.0	123	140	159	10.9	11.8		1326 (42)	864 (24)	
770079-B	61.2	65.1	84.0	119	137	157	15.0	14.1		1693 (26)	1007 (4)	
770082-BH	71.7	73.0	91.0	123	140	160	11.3	12.5		1030 (49)	831 (32)	
770083-B	49.9	57.4	72.0	123	137	158	13.4	11.7		1625 (30)	878 (22)	
770085-B	81.3	89.5	93.5	124	141	158	13.9	14.4		1255 (45)	717 (42)	
770089-BH	66.5	73.9	81.0	128	142	159	17.4	17.3		1235 (46)	678 (48)	

Contd....Table 1.34.

IC number	Days to 50% flowering			Days to maturity			Weight of 100 seeds(g)			Seed yield (kg/ha)		
	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar	ICRISAT* Center	ICRISAT Gwalior	Hissar	ICRISAT* Center	ICRISAT* Gwalior	Hissar
770090-BH	82.3	85.2	92.0	125	142	159	12.0	12.4		1336 (41)	714 (43)	
770091-B	70.1	73.7	87.5	124	139	158	12.6	13.2		1196 (47)	892 (21)	
770092-B	73.2	85.3	91.0	123	140	159	12.7	12.6		1056 (48)	763 (39)	
770097-BP	78.6	87.9	95.0	127	142	158	13.3	13.4		1321 (43)	766 (37)	
770102-B	55.5	64.6	74.5	122	139	160	17.2	18.3		1480 (36)	709 (45)	
770106-B	60.0	69.1	85.2	121	137	157	15.2	15.1		1862 (18)	852 (26)	
770108-B	63.6	67.7	86.5	121	138	159	15.1	15.8		2101 (9)	906 (17)	
770114-B	68.4	74.4	88.5	121	138	158	12.6	12.0		1510 (34)	931 (14)	
770117-BH	72.2	85.3	89.5	124	142	160	18.1	17.4		1377 (40)	671 (49)	
770118-BH	53.9	63.9	90.5	121	138	160	12.6	13.4		1271 (44)	1004 (5)	
770119-BH	67.7	69.4	96.0	123	140	161	13.3	12.9		1483 (35)	821 (34)	
G-130	72.5	80.5	90.0	123	140	159	12.6	11.9		1393 (39)	832 (31)	
Annigeri	45.9	55.2	59.5	109	137	157	20.4	21.1		2614 (1)	811 (35)	
K-850	58.2	69.2	83.5	115	138	155	26.4	24.2		2139 (6)	918 (15)	
P-324	54.7	67.0	86.0	116	136	158	12.2	11.1		2075 (11)	964 (9)	
ICCC-4	56.4	64.8	88.0	116	137	159	13.6	13.2		1769 (22)	956 (10)	
Local check-1	43.2	62.4	79.5	107	134	158	19.3	13.6		2101 (10)	943 (13)	
Local check-2	56.2	58.6	96.2	118	134	158	14.2	14.9		1655 (28)	1197 (1)	
Mean	56.6	64.9	76.5	119	137	158	16.3	16.2		1720	864	
CD	4.79	4.77	7.15	4.6	2.6	4.0	2.96	2.02		489.8	247.7	
CV	6.1	5.3	6.8	2.8	1.4	1.8	13.0	8.9		20.5	20.6	

Table 1.35. Correlations among characters in F_3-MLT-2 (upper diagonal) and F_3-MLT-3 (lower diagonal) - ICRISAT Center, 1980-81.

	Days to 50% flowering	Days to maturity	Seed yield (kg/ha)	Weight of 100 seeds (g)	Appearance score[1]
Days to 50% flowering	-	0.23	-0.43**	-0.29	0.64**
Days to maturity	0.65**	-	-0.01	-0.04	0.12
Seed yield (kg/ha)	-.49**	-0.43**	-	0.39*	-0.60**
Weight of 100 seeds(g)	-0.35	-0.44**	0.21	-	-0.26
Appearance score	0.56**	0.62**	-0.65**	-0.19	-

[1] On a scale of 1 to 6 where 1 indicates best and 6 poorest.

Table 1.36. Correlations among characters in F_3-MLT-4 (upper diagonal) and F_3-MLT-5 (lower diagonal) - ICRISAT Center, 1980-81.

	Days to 50% flowering	Days to maturity	Seed yield (kg/ha)	Weight of 100 seeds (g)	Appearance score
Days to 50% flowering	-	0.75**	-0.28	-0.38*	0.57**
Days to maturity	0.58**	-	0.04	-0.08	0.18
Seed yield (kg/ha)	-0.52**	-0.45**	-	0.49**	-0.60**
Weight of 100 seeds(g)	-0.40**	-0.34*	0.29	-	-0.42*
Appearance Score	0.69**	0.72**	-0.66**	-0.36*	-

Table 1.37. Correlations among characters in F_3-MLT-2 (upper diagonal) and F_3-MLT-3 (lower) at Gwalior, 1980-81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Seed yield (kg/ha)	Weight of 100 seeds (g)
Days to 50% flowering	-	0.73**	0.18	-0.27	-0.13
Days to Maturity	0.65**	-	0.40*	-0.24	-0.08
Plant height(cm)	0.46**	0.46**	-	0.26	-0.05
Seed yield(kg/ha)	-0.12	-0.27	-0.16	-	-0.24
Weight of 100 seeds(g)	-0.12	0.17	-0.01	-0.43**	-

Table 1.38. Correlations among characters in F_3-MLT-4 (upper diagonal) and F_3-MLT-5 (lower) at Gwalior in 1980-81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Seed yield (kg/ha)	Weight of 100 seeds (g)
Days to 50% flowering	-	0.62**	0.20	-0.15	-0.35*
Days to maturity	0.68**	-	0.32	0.07	-0.06
Plant height(cm)	0.37*	0.50**	-	0.20	-0.04
Seed yield (kg/ha)	-0.27	-0.25	-0.08	-	-0.18
Weight of 100 seeds (g)	-0.43**	-0.15	-0.18	-0.16	-

Table 1.39. Populations selected from F_3-MLT-2 to 5 to be grown as F_4 space planted bulks at Hyderabad during 1981-82.

Cross no.	Reasons for Selection[a]	
	Hyderabad	Gwalior
770104-BP	HY	HY
770304-BP	HY	
771090-BP	HY	
771097-BP	HY	
770269-BP	HY	
770766-BP		HY
770770-BP		HY
770777-BP		HY
771083-BP		HY
771099-BP		HY
771121-BP		HY
770877-BP	IY	
770876-BP	IY	
770775-BP		IY
771113-BP	PY	IY
770450-BP	PY	
770891-BP	HY	HY
770449-BP	HY	HY
770788-BP	HY	
770781-BP	HY	
770485-BP	HY	
770431-BP	HY	
770475-BP	HY	
770437-BP		HY
770435-BP		HY
770488-BP		HY
770784-BP		HY
770782-BP	IY	HY
771143-BP	IY	
771133-BP		IY
770152-BP	HY	HY
770168-BP	HY	HY
770147-BP	HY	
770148-BP	HY	
770795-BP	HY	
770150-BP	HY	
770793-BP	HY	
770126-BP		HY
770127-BP		HY
770136-BP		HY
770466-BP		HY
770467-BP		HY
770789-BP		HY
770898-BP	IY	HY

Contd....**Table 1.39.**

Cross no.	Reasons for Selection[a]	
	Hyderabad	Gwalior
770153-BP	IY	
770130-BP		IY
770142-BP		IY
770159-BP	PY	
770019-BP	HY	HY
770027-BP	HY	HY
770060-BP	HY	HY
770029-BP	HY	HY
770017-BP	HY	
770018-BP	HY	
770024-BP	HY	
770026-BP	HY	
770028-BP	HY	
770044-BP	HY	IY
770118-BP		HY
770020-BP		
770021-BP		HY
770058-BP		HY
770079-BP		HY
770114-BP		HY
770118-BP		HY
770057-BP	IY	
770004-BP	IY	
770706-BP		IY
770001-BP	Diverse parents	
770016-BP	High yielding parents	

HY, IY and PY indicate high, intermediate and poor yield, respectively.

due to insufficient seed. Early in the season marked symptoms of iron chlorosis were observed and the numbers of plants showing symptoms were recorded and rogued. Large numbers with distinct symptoms occurred particularly in crosses involving NEC-426, No-22, P-6099, H-208 and P-127.

Visual scores were assigned for appearance and maturity and single plant selections were made when the earliest plants were maturing. Many of the populations were classified as late or very late and few plants were selected in these. There appeared to be little correlation between performance in 1979/80 and appearance, maturity or numbers of single plants selected this year (Table 1.40). Selected single plants (over 3000) will be sown as F_5 progeny rows at Hyderabad in 1981/82.

PROGENY ROWS

The numbers of F_5 and more advanced progenies sown at Hyderabad and Hissar are shown in Table 1.41. Where seed was available two sowings were done, in separate fields. At Hyderabad, the second sowing of F_7 and F_8 progenies was in an insecticide-free area. Progenies of late and medium maturity plants selected at Hyderabad were also grown at Hissar and those of early maturity plants selected at Hissar were grown also in Hyderabad. F_5 to F_7 progenies of single plants selected in the wilt sick plot in 1979/80 were also grown.

Table 1.41. Numbers of progeny rows grown at Hyderabad and Hissar 1981/82.

	Hyderabad		Hissar		Total
	I	II	I	II	
F_5	1765	1249	279	240	3533
F_6	428	94	437	408	1367
F_7	202	57	183	160	602
F_8	325	50	210	67	652
Total	2720	1450	1109	875	6154

The plot sizes were 2 rows, 60 cm apart and 4 and 3 m long at Hyderabad and Hissar, respectively and the two checks, G-130 and Annigeri were sown after every twenty progenies. Records taken at Hyderabad included visual scores for maturity and appearance and, in the second sowing of the F_7 and F_8 progenies, for iron chlorosis. The latter were also rated for pod borer damage by the entomologists. Single plants were selected in segregating rows. Uniform rows rated 3 or better for appearance

Table 1.40. The names, pedigrees and characteristics of F_4 spaced planted bulks, 1980-81.

IC Number	Pedigree	1979/80		1980/81		
		Trial/ site	Yield	Maturity	Visual score	No. of S.P.S.
76164	JM-466 x JG-221	PA-1	I	E/M	3	101
76178	SL-972-A x Caina	PA-1	H	E/M	3	49
76185	NEC-1196 x JG-221	PA-1	H	E/L	4	65
76203	T-103 x P-619-1	PA-1	H	E	1	83
76207	P-45 x JG-71	PA-1	H	E/M	3	60
76218	P-45 x P-9668	PA-1	H	E/L	3	83
76232	P-6099 x JG-71	PA-1	H	ML	4	38
76233	P-6099 x NEC-426	PA-1	P	ML	4	15
76239	P-6099 x P-1208	PA-1	H	L	5	17
76250	P-1387 x NEC-136	PA-2	P	VL	5	-
76292	G-543 x 7369-5-5-B	PA-2	H	E/M	2	61
76302	No-22 x 7369-5-5-B	PA-2	H	ML	3	30
76311	NEC-970 x 7341-8-1-B	PA-2	H	M/L	4	16
76315	P-6 x 7369-5-5-B	PA-2	H	E/M	2	76
76438	JG-62 x 7330-10-4-B	PA-2	H	L	4	12
76445	JG-62 x 7367-15-2-B	PA-2	H	M/L	3	60
76459	NEC-426 x 7332-7-2-B	PA-2	H	L	4	5
76463	NEC-426 x 7347-6-4-B	PA-2	I	ML	3	32
76550	NEC-123 x NEC-847	PA-3	H	VL	5	6
76600	NEC-249 x GL-630	PA-3	P	E/L	4	15
76639	F-378 x NEC-802	PA-3	H	L	5	12
76657	JG-62 x H-355	PA-3	H	ML	3	28
76686	H-208 x BDN-9-3	PA-3	H	E/L	4	45
76693	C-214 x JG-74	PA-3	H	E/ML	4	32
76694	C-214 x JG-897	PA-3	H	M/L	3	15
76698	K-468 x P-1208	PA-3	I	E/L	3	14
76706	K-468 x BDN-9-3	PA-3	H	E/L	2/3	56
76713	G-130 x JG-74	PA-4	H	M/L	3	55
76723	F-378 x JG-897	PA-4	I	L	4/5	9
76775	NEC-249 x P-271	PA-4	P	E/M	2	45
76789	P-6099 x P-9668	PA-4	H	ML	3	78
76792	P-1181-A x 73114-15-3-B	PA-4	H	M/L	4	51
76800	P-1181-A x NEC-970	PA-4	H	M/L	4/5	31
76840	NEC-249 x NEC-197	PA-4	H	ML	3	45
761051	H-208 x (Giza x CPI-36071)	PA-4	H	L	4	10
761069	P-2215-1 x (JG-71 x P-1613)	PA-4	H	L	4	21
761103	7358-7-2-B x (P-1363 x P-458)	PA-5	H	ML	3	64
761159	Chafa x (NEC-249 x Giza)	PA-5	H	E/M	3	50
761175	Chafa x (P-1222 x P-1231)	PA-5	H	E	2	100
761184	JM-466 x (P-30 x Giza)	PA-5	H	L	4	37
761191	NEC-495 x (P-200 x P-1100)	PA-5	H	M	3	93
761193	NEC-556 x (PRR-1 x P-1100)	PA-5	I	E/M	3	101
761203	T-103 x (P-1231 x CPI-36071)	PA-5	H	M/L	3/4	80
761204	WP-2654-A x (P-1214 x P-12	PA-5	P	ML	3	89

Contd....Table 1.40.

IC number	Pedigree	1979/80		1980/81		
		Trial/ site	Yield	Maturity	Visual score	No. of S.P.S.
761340	P-2559 x F_5(BN-10 x NP-34)	PA-5	H	E/M	3	49
761361	P-127 x F_5(JG-62 x F-378)	PA-6	H	E/M	4	27
761368	Radhey x F_5(H-208 x BEG-482)	PA-6	H	E/L	4	40
761375	P-70 x F_5(JG-62 x P-2252)	PA-6	H	E	1	46
761429	F_2(Radhey x NEC-123)-2 x F_2(P-436 x P-861)-2	PA-6	H	L	4	11
761437	F_2(P-654 x P-1296)-2 x F_2(F-61 x Chafa)-2	PA-6	H	ML	4	45
761600	F_2(P-458 x NP-34)-2 x F_2(P-1363-1 x NEC-240)-2	PA-6	P	ML	4	70
761687	F_5(JG-62 x F-100) x F_5(L-550 x B-110)	PA-6	H	E/M	1	99
761945	P-9669 x F_2(10-2-3 x P-472)-1 X F_2(P-2591 x NEC-249)-1	PA-6	H	-	2	85
761961	F-61 x F_2(T-103 x JM-530) x F_2(NEC-249 x NEC-143)-1	PA-6	I	VL	-	4
76162	JM-466 x B-110	PA	H	L	4	21
76379	C-214 x P-2718-1	GW	H	VL	-	3
76421	73143-5-1-B x 73126-6-2-B	PA	H	M/L	4	27
76431	7389-15-1-B x 73126-6-2-B	PA	H	M/L	4	47
76449	K-850 x 7332-7-2-B	GW	H	L	5	11
76451	K-850 x 73126-6-2-B	PA	H	M	4	20
76628	C-214 x K-850	PA	H	L	5	16
76629	C-214 x NEC-802	PA	H	M/L	4	27
76633	H-208 x K-850	GW	H	L	4	26
76634	H-208 x NEC-802	PA	H	M/L	4	22
76635	H-208 x Annigeri	PA	H	E/L	4	62
76640	F-378 x Annigeri	PA	H	E/L	4	52
76654	JG-62 x NEC-802	GW	H	M/L	4	44
76679	H-208 x P-436	GW	H	M/L	3	39
76683	H-208 x L-550	GW	H	L	4	30
76695	C-214 x BDN-9-3	PA	H	E/L	4	52
76716	G-130 x Annigeri	PA	H	E/L	4	21
76816	NP-34 x P-45	PA	H	M/L	4	30
76870	JG-71 x NEC-426	PA	H	M/L	4	6
761131	Chafa x (WR-315 x CPI-36071)	GW	H	E/L	4	42
761365	P-514 x F_5(K-850 x F-378)	GW	H	M/L	4	47
761423	F_2(NEC-143 x C-214)-2 X F_2(B-108 x WR-315)-2	GW	H	L	5	42
76343	73126-6-2-B x GL-651	PA	P	L	5	14
76368	H-208 x P-2571	PA	P	VL	5	15

Contd....Table 1.40.

IC number	Pedigree	1979/80 Trial/ site	1979/80 Yield	1980/81 Maturity	1980/81 Visual score	No. of S.P.S.
76878	P-1363-1 x 7347-6-4-B	GW	P	M/L	3	16
761229	(P-30 x P-458) x (C-214 x P-183)	GW	P	M/L	4	21
	Total					3214

Site (1979/80)
PA = Patancheru
GW = Gwalior

Yield (1979/80)
H = High
I = Intermediate
P = Poor

Maturity (1980/81)
E = Early
M = Medium
ML = Mid-late
L = Late
VL = Very late

Visual score for appearance on scale of 1 to 5 where 1 is excellent.

were harvested for yield estimates. The numbers of single plants and rows harvested are shown in Table 1.42.

Table 1.42. Numbers of rows and single plants harvested in progeny rows at Hyderabad and Hissar 1980/81.

	Hyderabad		Hissar	
	Rows	Single plants	Rows	Single plants
F_5	1234	1777	168	271
F_6	193	225	206	125
F_7	105	-	120	68
F_8	203	-	139	59

Many of the progenies were later than Annigeri, the standard check for south India. G-130 showed consistently severe symptoms of iron chlorosis which did, however, appear to be confined mainly to later maturing progenies. Final selection of entries for ICSN-DS was based on seed yield expressed as a percentage of the nearest local check, Annigeri; and seed characteristics.

At Hissar, most progenies were killed by *Botrytis* at the pod formation stage. However, a few were free from disease and single plants were selected (Table 1.42). The progenies where most plants survived and were uniform were bulk harvested, and 65 were included in the ICSN-DL.

Details of the entries included in the ICSNs are given in Progress Report No.11, Report of the Sixth International Chickpea Trials and Nurseries 1980/81.

PRELIMINARY YIELD TRIALS

Three Preliminary Yield Trials were conducted including ICCC entries which had not been adequately tested previously and bulked progenies from 1979/80 with insufficient seed for entry in ICSN. ICCC-4, ICCC-13 and Annigeri were included as checks at Hyderabad and Annigeri was replaced by G-130 at Gwalior (Tables 1.43 and 1.44). Trials 1 and 2, of early and medium duration material were sown as 7 x 7 quadruple lattices with four replicates at Hyderabad and Gwalior and Trial 3 of mid-late duration lines was an eight entry randomized block design with 4 replicates sown at Gwalior only. The plot size was 4

Table 1.43 Entries in Preliminary Yield Trial at Hyderabad and Gwalior in 1980-81.

E no	IC number/Name	Pedigree
1	75674-2P-BP-BP	JG-71 x P-388
2	75674-11P-BP-BP	JG-71 x P-388
3	75674-12P-BP-BP	JG-71 x P-388
4	75674-28P-BP-BP	JG-71 x P-388
5	75685-47P-BH-BP	NEC-248 x L-30
6	75701-25P-BH-BP	P-30 x P-388
7	75701-35P-BH-BP	P-30 x P-388
8	75701-38P-BH-BP	P-30 x P-388
9	75701-40P-BH-BP	P-30 x P-388
10	75701-48P-BP-BP	P-30 x P-388
11	75756-3H-BP-BP	P-1013 x C-214
12	75756-5H-BP-BP	P-1013 x C-214
13	75756-18H-BP-BP	P-1013 x C-214
14	75788-39H-BH-BP	H-208 x NP-34
15	75816-7H-BP-BP	C-214 x P-183
16	75816-14H-BP-BP	C-214 x P-183
17	75816-17H-BP-BP	C-214 x P-183
18	75841-15P-BH-BP	P-1231 x P-1265
19	75841-16P-BP-BP	P-1231 x P-1265
20	75841-23P-BP-BP	P-1231 x P-1265
21	75841-25P-BH-BP	P-1231 x P-1265
22	75841-43P-BH-BP	P-1231 x P-1265
23	75841-44P-BH-BP	P-1231 x P-1265
24	75841-49P-BH-BP	P-1231 x P-1265
25	75847-20P-BH-BP	P-1214 x P-1231
26	75885-1H-BP-BP	WR-315 x RS-11
27	75898-19P-BH-BP	P-1661 x P-1214
28	752097-28P-BH-BP	F_2(P-99 x WFWG-III) x F_2(C-235 x NEC-249)-2
29	752098-40P-BH-BP	F_2(P-99 x WFWG-III) x F_2(C-235 x NEC-249)-3
30	752100-12P-BH-BP	F_2(P-99 x WFWG-III) x F_2(C-235 x NEC-249)-5
31	752194-42P-BH-BP	F_2(P-502 x P-436) x F_2(F-240 x P-3090)-2
32	752194-43P-BH-BP	F_2(P-502 x P-436) x F_2(F-240 x P-3090)-2
33	752194-44P-BH-BP	F_2(P-502 x P-436) x F_2(F-240 x P-3090)-2
34	741338-5P-1P-BP-BP	P-861 x P-436
35	741481-3P-1P-BP-BP	10-2-3 x P-272
36	75381-19H-1P-BP-BP	(NEC-1639 x L-550) x JG-62
37	751660-2H-1H-BH-BP	L-550 x NEC-584
38	751677-7H-1H-BH-BP	P-1245-1 x (P-648 x BG-1)
39	751767-3H-1P-BP-BP	C-235 x (NEC-143 x P-388)
40	751783-1P-1P-BP-BP	NEC-1572 x (T-3 x P-272)
41	751783-3P-1P-BP-BP	NEC-1572 x (T-3 x P-272)
42	751945-4P-1P-BH-BP	(JG-62 x NEC-139) x (P-3090 x Pant G-104)
43	751966-1H-1P-BP-BP	(P-861 x P-1243) x (NEC-123 x P-149)
44	751987-1P-1P-BP-BP	(P-1179 x P-919-1) x (P-4282 x K-1184)
45	751991-3P-1P-BP-BP	(NEC-141 x T-103) x (Chafa x P-3090)
46	752201-4H-1H-BH-BP	F_2(Ceylon-2 x P-1243) x F_2(F-61 x NEC-759)-4
47	ICCC-4	
48	ICCC-13	
49	Annigeri/G-130	

Table 1.44. Entries in Preliminary Yield Trial-2 at Hyderabad and Gwalior in 1980-81.

E. No.	IC number/name	Pedigree
1	7434-2P-1P-1H-2P-BP	Lebanese Local x P-654
2	74349-4H-1H-2P-1P-BP	F_2(P-1786 x C-214) x F_2(F-496 x L-550)
3	74401-1H-1H-1H-1P-BP	F_2(NP-34 x P-3896) x F_2(Pant G-102 x Ceylon-2)
4	74408-3H-1P-2P-BH-BP	F_2(K-850 x JG-221) x F_2(H-208 x JG-24)
5	74500-1H-1P-1P-BH-BP	F_2(Pant G-104 x Ceylon-2) x F_2(SP-405 x L-550)
6	74502-1H-2P-1P-1P-BP	F_2(K-850 x Chafa) x F_2(JG-62 x T-3)
7	74540-10H-1P-1H-BH-BP	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)
8	74603-12H-1P-1H-BH-BP	(E-100 x P-436) x (L-550 x F-378)
9	7472-BH-14-1P-1P-2P-BP	-272 x (F-61 x L-550)
10	7499-B-8H-BH-1H-1P-BP	-3111 x G-130
11	74100-B-1P-2H-3P-2P-BP	-3111 x H-208
12	74103-B-5P-1H-1P-1P-BP	-502 x BG-1
13	74105-B-5P-1H-3P-1P-BP	-502 x H-208
14	74119-B-1P-1H-2P-1P-BP	-1387 x G-130
15	74140-B-1H-BH-1H-1P-BP	G-130 x Radhey
16	74140-B-4P-BH-1P-2P-BP	G-130 x Radhey
17	74141-B-1P-1H-2P-1P-BP	G-130 x JG-221
18	74141-B-2P-1H-2P-1P-BP	G-130 x JG-221
19	74156-1-1P-BH-1P-1P-BP	C-235 x JG-221
20	74243-1-2H-1H-1P-1P-BP	H-208 x P-4804
21	74255-B-BP-1P-1P-1P-BP	(K-850 x GW-5/7) x (JG-62 x No.56)
22	74267-B-3H-1H-1P-1P-BP	P-1387 x (L-550 x E-100)
23	74274-B-1H-1H-1P-1P-BP	JG-62 x (K-850 x Chafa)
24	74277-BH-4-1P-1P-1P-BP	L-532 x (K-850 x GW-5/7)
25	74282-B-4P-1H-1H-1P-BP	P-3111 x (K-850 x L-345)
26	74282-B-4P-1H-1P-1P-BP	P-3111 x (K-850 x L-345)
27	74282-B-4P-1H-2P-1P-BP	P-3111 x (K-850 x L-345)
28	74310-B-4P-1H-1P-1P-BP	JG-62 x (GW-5/7 x Pant G-104)
29	74311-B-18H-BH-1P-1P-BP	G-543 x (Ceylon-2 x CP-66)
30	74324-BH-3-1P-1P-2P-BP	(JG-62 x F-378) x L-550
31	74324-BH-10-1P-1P-1P-BP	(JG-62 x F-378) x L-550
32	74640-2P-LB-1P-1P-1P-BP	(JG-62 x Chafa) x (E-100 x P-436)
33	74684-1P-LB-1P-1P-2P-BP	-3172 x (USA-613 x BEG-482)
34	74684-1P-LB-BH-2P-2P-BP	-3172 x (USA-613 x BEG-482)
35	74685-9P-LB-1H-1P-1P-BP	-436 x (P-1387 x F-378)
36	74685-10P-LB-1P-2P-1P-BP	-436 x (P-1387 x F-378)
37	74697-1P-LB-1H-1H-BH-BP	-214 x (BG-1 x P-99)
38	74702-2P-LB-2P-1P-2P-BP	-272 x (L-345 x Pant G-102)
39	74754-2P-LB-1P-2P-2P-BP	-481 x (JG-62 x P-1630)
40	74787-1P-LB-1P-1P-1P-BP	No.296 x (F-378 x E-100)
41	741148-2P-LB-1P-1P-1P-BP	P-502 x No.501
42	ICCC-14	
43	ICCC-15	
44	ICCC-16	
45	ICCC-17	
46	ICCC-18	
47	ICCC-4	
48	ICCC-13	
49	Annigeri/G-130	

rows, 4 m long and 60 cm apart. Days to 50% flowering and days to maturity were recorded. A visual score was made for appearance. Seed size was determined from samples of 100 seeds. At Hyderabad stands were not good and seed yield was estimated from up to 3.5 m length of one row per plot. At Gwalior, 3.5m lengths of the two middle rows were harvested for seed yield.

At Hyderabad, the trials were situated in an area where the water table was high and, together with the sampling to obtain yield estimates, probably contributed to the unexpectedly high seed yields obtained. Days to flowering and maturity were less at Hyderabad than at Gwalior and the seeds produced were larger.

In Trial 1, at Hyderabad five entries yielded significantly higher than Annigeri (Table 1.45). The highest yielders were IC-75788-38H-BH-BP (3414 kg/ha) and IC-75841-49P-BH-BP (3238 kg/ha). At Gwalior, there were also five entries giving significantly higher yields than the check (G-130) but did not correspond with those at Hyderabad. The highest yielders at Gwalior were IC-75674-28P-BP-BP (1324 kg/ha) and IC-75885-IH-BP-BP (1286 kg/ha).

In Trial 2, at Hyderabad none of the entries yielded significantly higher than Annigeri (Table 1.46). The heaviest seed yields were produced by IC-74697-1P-LB-1H-1H-BH-BP (3003 kg/ha) and IC-74685-9P-LB-1H-1P-1P-BP (2976 kg). At Gwalior, eight entries were significantly higher yielding than G-130 but again did not correspond with the highest yielding entries from Hyderabad. The highest yielders were IC-74345-4H-1H-2P-1P-BP (1314 kg/ha) and ICCC-15 (1274 kg).

In Trial 3, at Gwalior only, there were no significant differences among entries for seed yield (Table 1.47).

As in the F_2 trials, there were consistent positive associations between days to flowering and to maturity (Tables 1.48 and 1.49). At Hyderabad, the earlier cultivars were visually rated better than the later maturing entries but this was not reflected in better yields. Seed size tended to be negatively correlated with earliness, the correlations being significant in Trial 1 at Hyderabad. At Gwalior, plant height showed positive correlations with maturity.

Table 1.45. Characteristics of entries in Preliminary Yield Trial-1 at Hyderabad and Gwalior in 1980-81.

IC number/name	Days to 50% flowering		Days to maturity		Plant height (cm)	Weight of 100 seeds (g)		Seed yield (kg/ha)	
	Hyderabad	Gwalior	Hyderabad	Gwalior	Gwalior	Hyderabad	Gwalior	Hyderabad	Gwalior
75674-2P-BP-BP	58	66	114	136	41	15.7	13.3	2804	1093
75674-11P-BP-BP	56	64	110	134	38	15.8	13.4	2434	951
75674-12P-BP-BP	51	60	117	134	40	14.1	11.9	2409	1105
75674-28P-BP-BP	55	62	111	137	42	15.3	13.2	2648	1324
75685-47P-BH-BP	50	62	121	138	54	16.3	14.4	2195	1083
75701-25P-BH-BP	54	59	115	134	41	17.6	13.6	2157	1198
75701-35P-BH-BP	61	64	121	136	40	14.6	12.7	2485	1017
75701-38P-BH-BP	60	62	122	137	43	15.1	12.8	2047	1058
75701-40P-BH-BP	50	62	112	135	40	16.9	13.7	2406	1006
75701-48P-BP-BP	49	60	118	136	39	16.9	15.1	2196	1002
75756-3H-BP-BP	71	84	130	144	49	13.8	12.3	1247	947
75756-5H-BP-BP	69	77	125	140	45	13.7	12.4	1479	881
75756-18H-BP-BP	61	70	127	140	48	13.5	11.6	1823	1093
75788-39H-BH-BP	51	58	114	134	39	23.7	18.4	3414	613
75816-7H-BP-BP	71	84	127	142	50	14.6	12.5	2041	736
75816-14H-BP-BP	72	89	128	142	48	15.2	12.7	2224	893
75816-17H-BP-BP	71	86	128	142	46	15.2	12.5	1945	872
75841-15P-BH-BP	56	65	117	138	43	26.5	21.2	2795	893
75841-16P-BP-BP	54	62	119	138	47	20.2	15.6	1953	1147
75841-23P-BP-BP	50	62	110	137	46	26.8	20.7	2136	956
75841-25P-BH-BP	55	67	116	141	44	26.7	20.4	2858	928
75841-43P-BH-BP	55	62	118	139	46	25.3	19.8	2355	932
75841-44P-BH-BP	54	62	112	138	48	26.7	21.5	2570	985
75841-49P-BH-BP	56	63	114	136	45	26.4	21.0	3238	976
75847-20P-BH-BP	53	62	117	138	44	24.3	18.5	2637	970
75885-1H-BP-BP	58	65	123	137	50	15.5	13.0	2237	1286
75898-12P-BH-BP	56	61	113	137	49	21.4	18.5	2350	1181
752097-28P-BH-BP	56	62	114	134	43	13.9	12.0	1837	1012
752098-40P-BH-BP	47	58	115	135	47	13.1	12.9	2218	1010
752108-12P-BH-BP	44	58	108	139	50	13.4	12.3	1703	1161
752194-42P-BH-BP	58	65	122	138	42	15.9	13.9	2485	823
752194-43P-BH-BP	53	64	113	133	52	18.5	14.6	1723	911
752194-44P-BH-BP	50	62	112	139	48	16.4	14.0	2000	1057
741338-5P-1P-BP-BP	58	62	110	133	41	14.4	12.0	2152	1203
741481-3P-1P-BP-BP	41	53	103	124	39	16.0	13.2	1727	1118

Contd....Table 1.45.

IC number/name	Days to 50% flowering		Days to maturity		Plant height (cm)	Weight of 100 seeds (g)		Seed yield (kg/ha)	
	Hyderabad	Gwalior	Hyderabad	Gwalior	Gwalior	Hyderabad	Gwalior	Hyderabad	Gwalior
75381-19H-1P-BP-BP	53	60	112	134	42	15.7	13.5	2575	913
751660-2H-1H-BH-BP	59	69	120	136	48	20.9	17.2	2353	967
751677-7H-1H-BH-BP	64	71	125	138	47	12.1	10.0	1668	791
751767-3H-1P-BP-BP	65	71	122	139	48	13.7	11.6	1824	938
751783-1P-1P-BP-BP	57	64	120	138	43	13.1	11.1	2441	937
751783-3P-1P-BP-BP	59	64	127	140	46	11.6	10.4	1617	850
751945-4P-1P-BH-BP	63	75	119	138	47	13.7	12.7	2039	917
751966-1H-1P-BP-BP	63	67	127	139	54	18.1	15.9	2056	1183
751987-1P-1P-BP-BP	61	62	116	135	57	17.5	17.2	1627	988
751991-3P-1P-BP-BP	60	63	118	134	42	17.5	13.2	2239	884
752201-4H-1H-BH-BP	61	65	122	140	50	17.2	14.3	2513	1169
ICCC-4	58	63	123	137	44	15.4	13.6	1847	984
ICCC-13	59	63	112	135	46	14.9	12.7	1853	969
Annigeri /G-130[a]	44	78	107	140	50	22.4	11.7	1938	965
Mean	57	66	118	137	45	17.4	14.4	2194	997
Range		53-89		132-144	38-571	11.6-26.8	10.2-21.5		613-1324
CV%	3.7	4.6	2.7	2.5	6.2	4.6	9.4	24.2	22.9
CD(.05)	3.0	4.2	4.5	4.7	3.9	1.10	1.88	734.4	318

[a] Annigeri at Hyderabad and G-130 at Gwalior.

Table 1.46. Characteristics of entries in Preliminary Yield Trial-2 at Hyderabad and Gwalior in 1980-81.

IC number/name	Days to 50% flowering		Days to maturity		Plant height (cm)	Weight of 100 seeds (g)		Seed yield (kg/ha)	
	Hyderabad	Gwalior	Hyderabad	Gwalior	Gwalior	Hyderabad	Gwalior	Hyderabad	Gwalior
7434-2P-1P-1H-2P-BP	60	64	121	137	41	14.0	12.7	1937	902
74349-4H-1H-2P-1P-BP	62	69	121	137	44	12.1	10.6	1938	1314
74401-1H-1H-1H-1P-BP	65	77	121	138	49	13.7	11.2	1939	737
74408-3H-1P-2P-BH-BP	61	66	116	137	50	21.2	16.8	1624	906
74500-1H-1P-1P-BH-BP	61	62	114	134	41	16.9	15.6	1836	896
74502-1H-2P-1P-1P-BP	46	50	109	122	38	15.9	15.5	1236	974
74540-10H-1P-1H-BH-BP	56	59	112	135	42	18.8	16.2	2141	1167
74603-12H-1P-1H-BH-BP	55	61	114	134	42	16.4	14.7	2011	1033
7472-BH-14-1P-1P-2P-BP	53	57	117	136	43	20.8	18.3	2365	995
7499-B-8H-BH-1H-1P-BP	62	66	121	136	47	15.9	13.0	2381	968
74100-B-1P-2H-3P-2P-BP	54	63	109	135	43	15.6	13.2	2570	1017
74103-B-5P-1H-1P-1P-BP	54	59	111	137	46	21.2	17.5	2283	1077
74105-B-5P-1H-3P-1P-BP	53	59	110	136	46	19.7	17.4	2126	1037
74119-B-1P-1H-2P-1P-BP	61	63	120	140	53	18.2	17.4	2583	1145
74140-B-1H-BH-1H-1P-BP	57	63	110	136	47	15.7	13.3	2005	1014
74140-B-4P-BH-1P-2P-BP	55	62	115	135	50	16.9	14.6	1874	1071
74141-B-1P-1H-2P-1P-BP	59	61	113	135	48	16.5	13.1	2247	1199
74141-B-2P-1H-2P-1P-BP	54	62	109	136	50	16.0	14.1	2164	1032
74156-1-1P-BH-1P-1P-BP	57	62	114	135	46	14.7	12.1	1305	1032
74243-1-2H-1H-1P-1P-BP	55	63	116	137	45	16.6	14.7	2142	927
74255-B-BP-1P-1P-1P-BP	51	59	113	134	37	27.3	23.3	2411	1017
74267-B-3H-1H-1P-1P-BP	61	63	113	136	43	15.0	12.8	1532	791
74274-B-1H-1H-1P-1P-BP	58	62	114	135	43	14.1	11.8	2007	1018
74277-BH-4-1P-1P-1P-BP	52	61	111	137	55	34.1	33.0	1547	934
74282-B-4P-1H-1H-1P-BP	58	63	111	135	46	14.5	13.3	2045	1171
74282-B-4P-1H-1P-1P-BP	48	55	107	132	44	15.4	12.9	2597	947
74282-B-4P-1H-2P-1P-BP	55	61	109	135	44	14.9	[illegible]	2442	1029
74310-B-4P-1H-1P-1P-BP	52	60	110	136	42	15.2	13.7	1897	1051
74311-B-18H-BH-1P-1P-BP	64	74	122	138	48	13.0	11.7	1525	1087
74324-BH-3-1P-1P-2P-BP	47	53	107	130	44	19.7	18.0	2226	1100
74324-BH-10-1P-1P-1P-BP	50	55	109	134	43	18.3	15.6	2144	1093
74640-2P-LB-1P-1P-1P-BP	47	51	110	132	45	14.0	13.2	1738	894
74684-1P-LB-1P-1P-2P-BP	46	50	106	133	48	17.4	15.9	2193	852
74684-1P-LB-BH-2P-2P-BP	46	50	109	127	41	15.1	13.0	1833	972

Contd....Table 1.46.

IC number/name	Days to 50% flowering		Days to maturity		Plant height (cm)	Weight of 100 seeds (g)		Seed yield (kg/ha	
	Hyderabad	Gwalior	Hyderabad	Gwalior	Gwalior	Hyderabad	Gwalior	Hyderabad	Gwalior
74685-9P-LB-1H-1P-1P-BP	47	52	110	132	40	16.4	14.8	2976	1140
74685-10P-LB-1P-2P-1P-BP	55	58	115	136	47	15.1	16.0	1375	1220
74697-1P-LB-1H-1H-BH-BP	68	71	121	137	48	16.0	13.4	3003	983
74702-2P-LB-2P-1P-2P-BP	59	62	118	139	46	13.7	11.5	2106	1043
74754-2P-LB-1P-2P-2P-BP	46	50	109	129	46	14.4	12.2	2107	1187
74787-1P-LB-1P-1P-1P-BP	63	65	122	137	51	19.5	16.2	1826	797
741148-2P-LB-1P-1P-1P-BP	52	57	112	135	59	15.3	13.0	2467	919
ICCC-14	57	63	112	135	52	17.7	16.7	1689	1151
ICCC-15	66	68	121	135	49	14.8	12.8	1987	1274
ICCC-16	60	66	120	136	47	14.7	13.7	1872	926
ICCC-17	64	73	122	139	49	21.2	17.6	1585	1146
ICCC-18	51	58	113	134	48	19.4	16.4	2290	1182
ICCC-4	60	63	120	137	48	14.4	12.9	1870	1063
ICCC-13	57	61	117	134	48	14.2	13.3	2469	960
Annigeri/G-130[a]	46	75	108	140	49	21.5	13.0	2372	937
Mean	56	61	114	135	46	17.0	14.8	2058	1027
Range	46-68	50-77	106-122	127-140	37-59	12.1-34.2	10.6-33.0	1236-3003	737-1314
CV%	4.8	5.0	3.1	1.9	5.8	7.1	6.1	30.1	16.0
CD(.05)	3.7	4.2	4.9	3.5	3.7	1.68	1.24	857.3	228

[a] Annigeri at Hyderabad and G-130 at Hissar.

Table 1.47. Characteristics of entries in Preliminary Yield Trial-3 at Gwalior in 1980-81.

Entry	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield (kg/ha)
ICCC-20	64.3	136	48.0	12.03	1204
K-850	62.8	137	50.3	22.89	1187
H-208	71.3	135	48.8	11.60	1172
G-130	78.5	139	51.3	12.35	1154
ICCC-17	68.0	138	48.5	18.91	1145
ICCC-18	60.8	133	46.5	16.27	1115
ICCC-21	62.0	137	48.3	19.78	1080
ICCC-19	70.5	138	52.0	21.45	1065
Mean	67.3	136.3	49.2	16.91	1140
L.S.D.	1.35	1.4	2.94	1.69	206.5
CV(%)	4.4	0.7	4.1	6.8	12.3

Table 1.48. Correlations among characters in Preliminary Yield Trial-1 at Hyderabad (upper diagonal) and Gwalior (lower diagonal), 1980-81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Seed yield (kg/ha)	Weight of 100 seeds (g)	Visual score
Days to 50% flowering	-	0.74**	-	-0.12	-0.29*	0.57*
Days to maturity	0.50**	-	-	-0.11	-0.30*	0.56**
Plant height(cm)	0.22	0.32*	-	-	-	-
Seed yield(kg/ha)	-0.29*	0.02	0.14	-	0.36*	-0.49**
Weight of 100 seeds(g)	-0.25	-0.01	0.06	-0.04	-	-0.28
Visual score	0.04	-0.16	-0.13	-0.21	-0.19	-

Table 1.49. Correlations among characters in Preliminary Yield Trial-2 at Hyderabad (upper diagonal) and Gwalior (lower diagonal), 1980-81.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Seed yield (kg/ha)	Weight of 100 seeds (g)	Visual score
Days to 50% flowering	-	0.71**	-	-0.13	-0.24	0.53**
Days to maturity	0.59**	-	-	-0.06	-0.16	0.47**
Plant height(cm)	0.18	0.35*	-	-	-	-
Seed yield (kg/ha)	-0.10	-0.01	0.06	-	0.12	-0.26
Weight of 100 seeds(g)	-0.15	-0.01	0.10	-0.00	-	-0.22
Visual score	0.12	0.01	0.02	-0.19	0.01	-

Appendix 1.1. Parentage of crosses in F_1/F_2 10 x 10 diallel trial at Hissar in 1980-81.

IC number	Parentage	IC number	Parentage
79352	H-208 x K-850	79375[a]	L-550 x Pant G-114
79353	H-208 x L-550	79376	P-636 x NEC-177
79354	H-208 x P-636	79377	P-636 x HMS-8
79355[a]	H-208 x NEC-177	79378	P-636 x P-324
79356	H-208 x HMS-8	79379	P-636 x P-2161
79357	H-208 x P-324	79380	P-636 x P-4351
79358	H-208 x P-2161	79381	P-636 x Pant G-114
79359[a]	H-208 x P-4351-1	79382	NEC-177 x HMS-8
79360[a]	H-208 x Pant G-114	79383	NEC-177 x P-324
79361[a]	K-850 x L-550	79384[a]	NEC-177 x P-2161
79362	K-850 x P-636	79385	NEC-177 x P-4351-1
79363	K-850 x NEC-177	79386[a]	NEC-177 x Pant G-114
79364	K-850 x HMS-8	79387	HMS-8 x P-324
79365	K-850 x P-324	79388	HMS-8 x P-2161
79366[a]	K-850 x P-2161	79389	HMS-8 x P-4353-1
79367[a]	K-850 x P-4351-1	79390	HMS-8 x Pant G-114
79368[a]	K-850 x Pant G-114	79391	P-324 x P-2161
79369[a]	L-550 x P-636	79392[a]	P-324 x P-4353-1
79370[a]	L-550 x NEC-177	79393	P-324 x Pant G-114
79371	L-550 x HMS-8	79394	P-2161 x P-4353-1
79372[a]	L-550 x P-324	79395	P-2161 x Pant G-114
79373[a]	L-550 x 2161	79396	P-4353-1 x Pant G-114
79374[a]	L-550 x P-4351-1		

a = selected for further testing.

Appendix 1.2. Parentage of crosses in F_1/F_2 10 x 5 line x tester trial at Hissar in 1980-81.

IC number	Parentage	IC number	Parentage
79397	G-130 x ICCC-10	79422	H-208 x ICCC-20
79398	G-130 x ICCC-11	79423	H-208 x ICCC-21
79399	G-130 x ICCC-17	79424	H-208 x IC-73167-5-3-B
79400	G-130 x ICCC-18	79425	H-208 x IC-737-18-1-B
79401	G-130 x ICCC-19	79426	H-208 x IC-7357-22-3-B
79402	G-130 x ICCC-20	79427	ICCC-13 x ICCC-10
79403	G-130 x ICCC-21	79428	ICCC-13 x ICCC-11
79404	G-130 x IC-73167-5-3-B	79429	ICCC-13 x ICCC-17
79405	G-130 x IC-737-18-1-B	79430	ICCC-13 x ICCC-18
79406	G-130 x IC-7357-22-3-B	79431	ICCC-13 x ICCC-19
79407	Pant G-114 x ICCC-10	79432	ICCC-13 x ICCC-20
79408	Pant G-114 x ICCC-11	79433	ICCC-13 x ICCC-21
79409	Pant G-114 x ICCC-17	79434	ICCC-13 x IC-73167-5-3-B
79410	Pant G-114 x ICCC-18	79435	ICCC-13 x IC-737-18-1-B
79411	Pant G-114 x ICCC-19	79436	ICCC-13 x IC-7357-22-3-B
79412	Pant G-114 x ICCC-20	79437	F-496 x ICCC-10
79413	Pant G-114 x ICCC-21	79438	F-496 x ICCC-11
79414	Pant G-114 x IC-73167-5-3-B	79439	F-496 x ICCC-17
79415	Pant G-114 x IC-737-18-1-B	79440	F-496 x ICCC-18
79416	Pant G-114 x IC-7357-22-3-B	79441	F-496 x ICCC-19
79417	H-208 x ICCC-10	79442	F-496 x ICCC-20
79418	H-208 x ICCC-11	79443	F-496 x ICCC-21
79419	H-208 x ICCC-17	79444	F-496 x IC-73167-5-3-B
79420	H-208 x ICCC-18	79445	F-496 x IC-737-18-1-B
79421	H-208 x ICCC-19	79446	F-496 x IC-7357-22-3-B

Appendix 1.3. Parentage of crosses in F_2 10 x 10 diallel trial at Hissar in 1980-81 are the same as for the F_2 10 x 10 diallel trial at Hyderabad. The parentage of the crosses in the F_2 19 x 5 line x tester trial at Hissar are given in R.O.W. 1979-80 table 1.14. Combinations involving G-543 omitted due to shortage of seed.

Appendix 1.4. Parentage of crosses in trials of miscellaneous F_2 populations at Hissar in 1980-81.

IC Number	Parentage
78697	BG-203 x ICCC-1
78698	BG-203 x H-208
78699	BG-203 x K-850
78633	Annigeri x ICCC-2
78700	Annigeri x H-208
78701	P-436 x ICCC-2
78702	ICCC-1 x H-208
78497	K-468 x G-543
78517	Pant G-114 x G-545
78537	BG-203 x G-543
78557	ICCC-1 x G-543

PROJECT 2 : DEVELOPMENT OF KABULI CULTIVARS AND SUPERIOR BREEDING MATERIALS

OBJECTIVES : a. To breed high yielding, disease resistant kabuli cultivars with good consumer acceptance

b. To contribute advanced breeding lines and segregating populations to the programs of kabuli producing countries.

INTRODUCTION

The majority of the kabuli breeding work has now been transferred to Hissar, with the aim of developing improved kabuli genotypes for north India. As in the desi project the bulk/pedigree method is being utilised, involving replicated tests of F_1, F_2 and F_3 populations followed by single plant selection in F_4s of promising crosses. The products of the program feed into the trials of ICARDA and of the AICPIP.

The trials were affected by termite damage and wilt in the early part of the season followed by *Ascochyta* and *Botrytis* in the later stages of development but useful data were obtained.

HYBRIDISATION

Eighty two strains were included in the crossing block. Their origins and main characteristics are given in Table 2.1, which illustrates the considerable range for days to flower, plant height, branch and pod numbers and seed size. Most of the lines originated in India, Iran and U.S.S.R. (Table 2.2).

Twentysix new entries in the crossing block this year included kabuli wilt resistant lines, high yielding strains developed at ICRISAT and promising strains from the germplasm. Some of these were also included for further evaluation and possible future use. Eighteen lines were discontinued on account of lack of promise.

We made a 15 x 6 line x tester set (Table 2.3) involving 15 high yielding or wilt resistant kabuli lines and three desi and three kabuli high yielding testers. Two wilt resistant kabuli lines, ICCL-80002 and -80004, developed at ICRISAT, were used in crosses to incorporate wilt resistance. Six other crosses were made for high yield (Table 2.4). Material involving K x K and D x K crosses from other projects will also be included in this project.

Table 2.1. Origins and characteristics[a] of the kabuli entries in the crossing block grown at ICRISAT Center, 1980/81.

Number	Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant width (cm)	Growth habit	Number of primary branches	Number of secondary branches	Number of pods/plant	Days to maturity	Number of seeds/pod	Seed color	Weight of 100 seeds(g)
ICC-4928*	C-104	India	81	48	37	SE	3.7	5.7	91	125	1.03	SW	23.6
ICC-10761-EB3	CRIC-35380	Turkey	70	37	35	SS	3.3	3.3	38	129	1.08	SW	28.7
ICC-7773*	Giza	Egypt	62	42	27	SE	2.3	2.3	47	130	1.09	SW	13.2
ICC-5244*	GL-622	India	79	49	31	SS	2.7	3.7	35	129	1.03	SW	27.3
ICC-5250*	GL-629	India	71	51	45	SS	2.7	6.0	109	124	1.16	SW	18.9
ICC-5253*	GL-633	India	60	48	24	SE	2.0	4.3	60	111	1.00	SW	21.5
ICC-5255*	GL-635	India	58	46	24	SE	2.3	4.3	44	110	1.34	SW	18.2
ICC-5256	GL-637	India	58	48	30	SE	2.3	3.7	35	110	1.11	SW	17.5
ICC-5264	GL-645	India	81	35	39	SS	2.3	4.3	51	135	1.06	SW	16.6
ICC-5264-EB4	GL-645	India	86	39	38	SS	3.0	4.0	43	135	1.23	SW	13.8
ICC-5270	GL-651	India	90	36	37	SS	2.7	5.3	56	135	1.05	SW	16.5
ICC-8284*	HYB-16-3	India	80	40	35	SS	2.0	4.7	47	131	1.19	SW	17.8
ICC-12317*	ICCC-24	ICRISAT	81	39	28	SS	2.0	3.0	56	130	1.00	SW	16.5
ICC-12318*	ICCC-25	ICRISAT	73	43	40	SS	2.7	6.3	104	126	1.15	SW	16.5
ICC-12319	ICCC-26	ICRISAT	75	41	25	SS	2.3	4.0	55	128	1.31	SW	12.7
ICC-7510	JAM	Iran	81	44	44	SS	2.7	5.0	52	134	1.15	SW	22.9
ICC-8446	JM-466	Ethiopia	55	31	32	SS	2.3	2.0	67	124	1.18	SW	9.8
ICC-8465	JM-482	Pakistan	80	36	31	SS	2.7	6.0	60	129	1.08	SW	15.4
ICC-8468*	JM-485	Pakistan	81	48	36	SS	2.7	6.0	63	126	1.11	SW	19.4
ICC-4962	K-4	India	81	40	72	SS	2.7	4.0	68	130	1.22	SW	17.7
ICC-8920	K-1170	USSR	81	66	44	ER	2.3	2.7	60	134	1.02	SW	16.7
ICC-8921*	K-1174	USSR	77	68	32	ER	2.3	2.3	39	134	1.08	SW	18.2
ICC-8922*	K-1184	USSR	86	65	35	ER	2.3	2.3	23	134	1.26	SW	18.4
ICC-8923*	K-1189	USSR	73	70	38	ER	2.0	2.7	41	129	1.02	SW	17.9
ICC-8926	K-1480	USSR	73	80	54	ER	2.3	7.0	78	120	1.00	SW	23.4
ICC-8927	K-1481	USSR	88	80	34	ER	2.3	2.7	31	137	1.00	SW	24.5

Contd...,Table 2.1.

Number	Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant width (cm)	Growth habit	Number of primary branches	Number of secondary branches	Number of pods/plant	Days to maturity	Number of seeds/pod	Seed color	Weight of 100 seeds(g)
ICC-8929*	K-56567	USSR	77	68	28	ER	2.3	1.3	46	134	1.02	SW	17.8
ICC-7521	Kourosh	Iran	71	46	29	SS	3.3	2.7	47	130	1.02	SW	26.0
ICC-4971*	L-532	India	83	42	39	SS	3.0	6.7	74	131	1.01	SW	19.3
ICC-4972	L-534	India	86	45	39	SS	2.7	3.3	23	131	1.00	SW	28.6
ICC-4973	L-550	India	73	40	40	SS	2.3	5.3	68	128	1.03	SW	20.1
	Leb.Local PM	ICRISAT	67	39	31	SS	2.3	2.7	50	126	1.04	SW	17.5
ICC-5654*	Ludhiana-23	India	81	39	33	SS	2.0	4.0	54	133	1.00	SW	15.2
ICC-7709	NEC-10	Jordan	81	37	46	SS	2.7	6.0	83	131	1.01	SW	23.5
ICC-7710*	NEC-34	Jordan	67	41	45	SS	2.7	2.7	49	128	1.00	SW	23.9
ICC-7717	NEC-130	USSR	88	36	29	SS	2.3	4.3	-	135	-	SW	28.3
ICC-7723*	NEC-143	Sudan	55	43	32	SS	2.0	0.3	58	124	1.09	SW	10.0
ICC-6283	NEC-175	Peru	73	52	32	SS	2.0	2.0	26	128	1.04	SW	23.1
ICC-6375*	NEC-329	Iran	81	37	30	SS	2.0	1.3	21	132	1.05	SW	21.6
ICC-7267	NEC-1640	Algeria	69	45	29	SS	2.0	2.7	23	128	1.00	SW	32.0
ICC-7290	NEC-1663	Tunisia	69	51	36	SS	2.0	3.7	43	131	1.00	SW	27.9
ICC-7848	NEC-1831	Iran	86	50	35	SS	2.7	3.3	30	134	1.63	SW	12.9
ICC-7966-EB 4	NEC-2059	Iran	86	45	37	SS	2.0	4.7	61	134	1.33	SW	14.5
ICC-8149	NEC-2296	Iran	86	37	28	SS	2.7	3.7	32	129	1.09	SW	21.0
ICC-8265	NEC-2438	Turkey	88	43	31	SS	3.0	3.0	31	134	1.03	SW	20.7
ICC-8748*	NEC-2594	Afghanistan	86	33	26	SS	2.3	3.7	40	134	1.65	SW	15.1
ICC-4983	No.501	India	77	45	37	SS	2.7	2.7	42	129	1.07	SW	25.8
ICC-8638	Ofra	Israel	86	46	36	SS	4.0	6.7	43	134	1.00	SW	29.1
ICC-537*	P-422	India	65	34	31	SS	2.7	3.3	84	120	1.19	SW	10.2
ICC-2407	P-2178-1	Iran	53	36	26	SS	2.0	2.7	39	121	1.00	SW	17.0
ICC-2451	P-2236	Iran	67	38	32	SS	2.0	3.0	48	126	1.02	SW	17.0
ICC-2473	P-2265	Iran	71	32	35	SS	2.3	4.7	59	131	1.02	SW	16.3
ICC-2584	P-2591	Iran	65	39	39	SS	2.3	3.3	62	127	1.26	SW	15.2

Contd....Table 2.1.

Number	Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant width (cm)	Growth habit	Number of primary branches	Number of secondary branches	Number of pods/plant	Days to maturity	Number of seeds/pod	Seed color	Weight of 100 seeds(g)
ICC-2692	P-2759	Iran	69	42	39	SS	2.6	4.0	70	127	1.20	SW	16.4
ICC-3010	P-3482	Iran	67	53	38	SS	2.0	4.0	74	127	1.36	SW	14.6
ICC-3589	P-4262-1	USSR	69	53	48	SS	3.0	6.0	96	134	1.06	SW	23.5
ICC-4840*	P-6613	Iran	77	40	38	SS	2.7	4.0	43	127	1.00	SW	18.7
ICC-4854*	P-9623	USA	61	48	41	SS	2.7	7.3	39	128	1.00	SW	17.6
ICC-7559-EB4	P-9625	USA	76	34	26	SS	3.0	4.3	37	130	1.05	SW	22.8
ICC-7564	P-9635	USA	69	31	30	SS	2.3	3.3	39	126	1.03	SW	19.5
ICC-4907*	P-9800	Turkey	71	47	28	SS	2.3	4.0	32	127	1.50	SW	20.6
ICC-11142*	P-9847	India	71	72	33	ER	2.3	2.3	36	127	1.00	SW	20.2
ICC-12322	P-10168	India	97	46	38	ER	2.0	4.0	35	134	1.00	SW	17.2
ICC-12324	P-10186	India	77	36	43	ER	3.3	5.0	66	134	1.00	SW	23.6
ICC-12325	P-10187	India	81	52	32	ER	3.0	4.0	38	134	1.00	SW	26.7
ICC-12326	P-10188	India	81	67	35	ER	2.3	3.3	18	134	1.00	SW	31.6
ICC-12327	P-10189	India	71	32	32	SS	3.7	6.0	80	129	1.00	SW	20.9
ICC-2446-EB3	P-2224-2	Iran	62	44	51	SS	3.3	6.3	141	121	1.01	SW	20.2
ICC-2696-EB3	P-2774-1	Iran	52	41	30	SS	3.3	3.0	54	115	1.26	SW	15.8
ICC-10035*	PM-L-550	Iran	70	35	39	SS	2.7	2.7	60	131	1.12	SW	16.9
ICC-4993*	Rabat	Morocco	81	42	38	SS	2.3	4.7	44	131	1.07	SW	22.0
IC-7375-15-1-B-BP-EB	L-550 x CP-66	ICRISAT	67	35	38	SS	3.3	4.7	89	125	1.03	SW	17.0
IC-7375-15-1-B-BP-EB2	L-550 x CP-66	ICRISAT	71	43	39	SS	3.0	4.0	73	125	1.03	SW	15.6
IC-74765-9H-IH-1P-BH*	L-550 x (L-2 x BEG-482)	ICRISAT	66	43	42	SS	3.3	2.0	71	114	1.06	SW	14.6
ICCL-80002*	K-4 x WR-315	ICRISAT	57	42	37	SS	2.3	3.3	65	117	1.29	SW	15.1
ICCL-80004*	L-550 x USA-613	ICRISAT	55	39	39	SS	2.0	3.7	113	115	1.31	SW	15.6

Contd....Table 2.1.

Number	Pedigree	Origin	Days to 50% flowering	Plant height (cm)	Plant width (cm)	Growth habit	Number of primary branches	Number of secondary branches	Number of pods/plant	Days to maturity	Number of seeds/pod	Seed color	Weight of 100 seeds(g)
ICCL-80007*	L-550 x L-2	ICRISAT	68	41	33	SS	2.3	3.3	64	117	1.00	SW	20.3
ICCL-80010*	L-550 x L-2	ICRISAT	55	41	42	SS	3.7	5.7	143	126	1.06	SW	17.2
ICCL-80011*	L-550 x E-100	ICRISAT	71	43	38	SS	3.0	4.3	74	126	1.53	SW	12.5
ICCL-80015*	L-550 x Ceylon-2	ICRISAT	61	45	43	SS	2.7	2.7	51	127	1.14	SW	17.9
ICCL-80019	P-388 x (T-3 x P-836)	ICRISAT	73	40	34	SS	2.3	4.0	73	129	1.00	SW	19.4
ICC-7510-EB4	12-071-10025JAM	Iran	70	43	45	SS	3.0	3.3	58	129	1.33	SW	25.6
Range			52-97	31-80	24-72		2.0-4.0	0.3-7.3	18-143	110-137	1.00-1.65		9.8-32.0

[a] Means of three plants.

* Entries used in crosses.

Table 2.2 Origin by countries of kabuli strains included in the crossing block in 1980/81.

Country	Number
Afghanistan	1
Algeria	1
Egypt	1
Ethiopia	1
ICRISAT	14
India	19
Iran	16
Israel	1
Jordan	2
Morocco	1
Pakistan	2
Peru	1
Sudan	1
Tunisia	1
Turkey	3
USA	3
USSR	9
Unknown	5
Total	82

Table 2.3. Details of parents used in 15 x 6 line x tester study.

Entries	Characteristics
Lines	
ICCL-80002	Kabuli wilt resistant
ICCL-80004	Kabuli wilt resistant
ICCL-80007	Kabuli High yield
ICCL-80010	Kabuli High yield
ICCL-80011	Kabuli High yield
ICCL-80015	Kabuli High yield
ICCL-80019	Kabuli High yield
ICCC-24	Kabuli High yield
ICCC-25	Kabuli High yield
ICCC-26	Kabuli High yield
GL-633	Kabuli High yield
GL-635	Kabuli High yield
GL-637	Kabuli High yield
P-9623	Kabuli large seed
IC-740765-9H-1H-1P-BH	Kabuli High yield

Contd....Table 2.3.

Entries	Characteristics
Testers	
BG-209	Desi high yield
JG-74	Desi high yield and wilt resistant
Pant G-114	Desi high yield
GL-629	Kabuli high yield
L-550	Kabuli high yield
C-104	Kabuli high yield and large seed

Table 2.4. Crosses made among high yielding kabuli types, 1980/81.

IC number	Cross
800339	ICCC-26 x H-76-49
800340	750705-BP-BP-48P x P-9623
800341	750705-BP-BP-14P x P-9623
800343	750705-57P-4P-BP x P-9623
800342	L-550 x P-422
800344	L-550 x NEC-249

F_1 GENERATION

F_1s of crosses made in 1979/80 were advanced off-season in Kashmir.

F_1 10 x 4 line x tester trial. Thirty-nine F_1s, the 14 parents (See KOW, 1979/80), Table 2.5) and 11 checks were sown in an 8 x 8 triple lattice design with plots of 1 row, 4m in length and 60 cms apart. The numbers of days to first and 50% flowering and seed yields were recorded on a plot basis and the entries rated for disease incidence.

Plant stands were variable resulting in a very high coefficient of variation for seed yield (Table 2.5). The desi cultivar H-208 gave the highest seed yield of 2961 kg/ha, significantly higher than all other entries. Among the kabuli materials, IC-7358-8-2-B-BH gave the

Table 2.5. Characteristics of F_1 generations, parents and checks in 10 x 4 L x T experiment at Hissar, 1980/81.

Pedigree	Days to 1st flower	Days to 50% flowering	Disease score	Seed yield kg/ha	Rank
F_1 generation					
C-104 x 7358-8-2-B-BH	88	96	4.7	1712	9
x 7347-6-4-B-BH	89	95	5.7	1331	19
x 7385-17-2-B-BH	85	90	4.0	991	32
x 7369-5-3-1P-BP	85	91	6.0	1199	24
L-532 x 7358-8-2-B-BH	89	94	4.0	1754	7
x 7347-6-4-B-BH	89	94	4.7	1512	12
x 7385-17-2-B-BH	88	94	6.7	832	43
x 7369-5-3-1P-BP	88	93	4.7	1421	15
GL-622 x 7358-8-2-B-BH	81	93	4.0	1789	4
x 7347-6-4-B-BH	89	94	4.3	1914	3
x 7385-17-2-B-BH	77	86	8.0	860	42
x 7369-5-3-1P-BH	86	93	4.7	1394	16
NEC-139 x 7358-8-2-B-BH	82	90	8.0	666	52
x 7347-6-4-B-BH	73	79	6.3	784	47
x 7385-17-2-B-BH	82	89	7.7	624	53
x 7369-5-3-1P-BP	80	87	6.3	600	57
P-9800 x 7358-8-2-B-BH	84	92	5.3	1366	17
x 7347-6-4-B-BH	87	93	5.0	915	37
x 7385-17-2-B-BH	80	88	7.3	832	43
x 7369-5-3-1P-BP	78	86	8.0	569	59
NEC-329 x 7358-8-2-B-BH	81	89	7.7	752	49
x 7347-6-4-B-BH	80	88	5.7	939	36
x 7385-17-2-B-BH	79	90	9.0	821	45
x 7369-5-3-1P-BP	68	77	6.3	940	35
GL-629 x 7358-8-2-B-BH	88	94	4.7	1297	21
x 7347-6-4-B-BH	88	93	5.3	1456	13
x 7385-17-2-B-BH	85	91	5.0	1449	14
x 7369-5-3-1P-BP	85	91	5.3	1761	6
No.501 x 7358-8-2-B-BH	85	91	3.7	1789	4
x 7347-6-4-B-BH	87	93	7.3	1032	31
x 7385-17-2-B-BH	86	93	5.7	1574	10
x 7369-5-3-1P-BP	82	91	5.3	1359	18
K-4 x 7358-8-2-B-BH	91	97	4.5	950	34
x 7347-6-4-B-BH	89	93	7.3	680	51
x 7385-17-2-B-BH	87	93	6.0	1109	28
x 7369-5-3-1P-BP	84	91	5.3	971	33
ICCC-14 x 7358-8-2-B-BH	85	92	6.3	617	54
x 7347-6-4-B-BH	82	92	7.7	617	54
x 7385-17-2-B-BH	84	90	6.0	1220	22
x 7369-5-3-1P-BP	81	89	4.0	1089	30

Contd....Table 2 5.

Pedigree	Days to 1st flower	Days to 50% flowering	Disease score	Seed yield kg/ha	Rank
Lines					
C-104	91	96	6.3	444	62
L-532	91	96	4.3	1167	26
GL-622	88	93	5.7	1172	25
NEC-139	42	52	8.3	616	56
P-9800	42	52	8.3	256	63
NEC-329	74	82	8.3	576	58
GL-629	84	92	7.0	894	39
No.501	86	91	4.0	1331	19
K-4	85	92	3.7	915	37
ICCC-14	79	87	8.7	894	39
Testers					
7358-8-2-B-BH	88	93	6.3	2217	2
7347-6-4-B-BH	80	88	8.3	478	61
7385-17-2-B-BH	77	86	8.3	886	41
7369-5-3-1P-BP	85	91	6.5	1220	22
Checks					
L-550	79	88	6.0	1116	27
Rabat	90	95	5.0	1096	29
K-1480	93	99	5.0	732	50
L-144	82	89	8.3	509	60
GL-645	69	77	5.0	818	46
JM-482	92	99	7.0	784	47
JM-485	91	97	4.3	1739	8
H-208	78	87	3.0	2961	1
G-130	88	93	5.0	1546	11
Mean	83	90	5.89	1109	
CD(.05)	10.7	10.0	3.2	739.3	
CV%	8.1	7.0	33.0	41.7	

highest yield and this was reflected in the higher mean yield of the F_1s of which it was a parent. L-550, the standard kabuli check cultivar ranked 27th with 1116 kg seed/ha. The lines, NEC-139 and P-9800 initiated flowering before temperatures dropped and much earlier than other genotypes. Flowering also started early in one rep of four other entries contributing to a higher than normal C.V. for days to flowering.

There were significant differences due to lines for all characters except disease rating which was highly variable (Table 2.6). Differences due to testers and the line x tester interactions were non significant. Estimates of GCA variances were positive, usually significant and much greater than SCA variances, except in the case of disease ratings and seed yield.

Among lines, GL-629, GL-622 and No.501 were the best general combiners for seed yield and NEC-139 and -329 the poorest, the latter associated with good general combining ability for early flowering and high disease scores (Table 2.7). Among the testers, none of the GCA effects were significant. SCA effects were all non significant except for a significant value for days to 50% flowering in the case of NEC-139 x IC-7347-6-4-B-BH (Table 2.8).

F_2 AND MORE ADVANCED GENERATIONS

The F_2 and more advanced generations were grown in replicated trials or as non replicated progeny rows or bulks.

Replicated Trials

F_2 10 x 4 line x tester trial. The same crosses which were included in the F_1 10 x 4 line tester were also evaluated in a replicated trial in the F_2 generation , after advancing the F_1s in the off-season nursery in Kashmir, compared with the parents and the same check cultivars.

The trial was sown as an 8 x 8 triple lattice with 3 replications and plots of 4 rows, 4m long and 60 cm apart. The number of days to first and 50% flowering and maturity; plant height; the numbers of primary and secondary branches and yield per plant; the number of seeds per pod; seed size; and seed yield were recorded on a plot basis.

Due to variable stands and growth and disease problems the data were very variable. Yields were lower than in the F_1 trial and the highest yielder was GL-629 with 1761 kg per ha but differences among entries were not significant (Table 2.9).

Table 2.6. Mean squares from the analysis of variance and estimates of GCA and SCA variances in F_1 10 x 4 line x tester trial at Hissar in 1980-81.

Source	DF	Days to first flower	Days to 50% flowering	Disease score	Seed yield kg/ha
Mean squares					
Lines	9	176.77**	97.91**	7.87	1225120**
Testers	3	98.82*	86.69*	8.59	291827
Lines x Testers	27	32.65	26.79	4.61	260551
Error	78	41.23	34.20	4.20	197470
Variance estimates					
GCA		5.01**	3.12**	0.17	23711**
SCA		-2.86	-2.47	0.14	21027
GCA/SCA		-1.75	-1.26	1.21	1.13

Table 2.7. Estimates of GCA effects and their standard errors from F_1 10 x 4 line x tester trial at Hissar, 1980/81

	Days to 1st flower	Days to 50% flowering	Disease score	Seed yield kg/ha
Lines				
C-104	2.91**	2.22	-0.77	168.84
L-532	4.72**	2.88	-0.82	250.61**
GL-622	-0.42**	0.72**	-0.57	360.07**
NEC-139	-4.86**	-4.62**	1.23*	-463.15**
P-9800	-1.95**	-1.28**	0.56	-220.88**
NEC-329	-7.11**	-5.12**	1.31*	-313.42**
GL-629	2.56	1.30	-0.77	361.81**
No.501	1.24	1.22	-0.36	314.65**
K-4	3.84*	2.72	-0.03	-203.39
ICCC-14	-0.92	-0.03	0.22	-255.12*
$SE(g_i)$	1.66	1.51	0.53	114.74
Testers				
7358-8-2-B-BH	1.56	2.00	-0.54	127.11
7347-6-4-B-BH	1.38	0.53	0.08	-13.99
7385-17-2-BH	-0.69	-0.50	0.71	-113.27
7369-5-3-1P-BP	-2.25	-2.03	-0.24	0.14
$SE(g_i)$	2.6	2.39	0.84	181.42

Table 2.8. SCA effects in F_1 10 x 4 L x T trial at Hissar, 1980/81.

Crosses	Days to 1st flower	Days to 50% flowering	Disease	Seed yield kg/ha
C-104 x 7358-8-2-B-BH	-0.16	0.92	0.13	288.26
x 7347-6-4-B-BH	1.43	1.38	0.51	47.11
x 7385-17-2-BH	-1.58	-2.25	-1.79	-236.30
x 7369-5-3-1P-BP	0.32	-0.05	1.16	- 99.07
L-532 x 7358-8-2-B-BH	-0.56	-1.42	-0.35	248.19
x 7347-6-4-B-BH	-0.88	0.05	-0.45	146.04
x 7385-17-2-BH	0.27	0.42	0.92	-435.78
x 7369-5-3-1P-BP	1.17	0.95	-0.13	41.56
GL-622 x 7358-8-2-B-BH	-3.41	-0.58	-0.74	173.47
x 7347-6-4-B-BH	4.76	2.22	-1.03	439.67
x 7385-17-2-BH	-6.25	-5.42	2.15	-517.45
x 7369-5-3-1P-BP	4.90	3.78	-0.38	-95.70
NEC-139 x7358-8-2-B-BH	1.28	1.75	1.46	-129.21
x 7347-6-4-B-BH	-7.88	-7.78	-0.83	130.04
x 7385-17-2-BH	3.85	3.58	-0.12	69.47
x 7369-5-3-1P-BP	2.75	2.45	-0.51	-70.31
P-9800 x 7358-8-2-B-BH	0.69	0.08	-0.54	288.34
x 7347-6-4-B-BH	3.20	2.55	-1.49	19.82
x 7385-17-2-BH	-1.73	-1.42	0.21	35.70
x 7369-5-3-1P-BP	-2.16	-1.22	1.82	-343.85
NEC-329 x 7358-8-2-B-BH	2.53	0.92	1.04	-234.20
x 7347-6-4-B-BH	1.70	1.72	-1.58	94.55
x 7385-17-2-BH	2.77	4.42	1.13	15.65
x 7369-5-3-1P-BP	-7.00	-7.05	-0.59	123.99
GL-629 x 7358-8-2-B-BH	0.19	-0.17	0.13	-321.71
x 7347-6-4-B-BH	0.03	-0.03	0.17	-20.77
x 7385-17-2-BH	-0.90	-0.33	-0.79	71.57
x 7369-5-3-1P-BP	0.67	0.53	0.49	270.91
No.501 x 7358-8-2-B-BH	-1.83	-2.75	-1.29	218.90
x 7347-6-4-B-BH	0.34	0.38	1.76	-377.70
x 7385-17-2-BH	1.75	1.08	-0.54	243.83
x 7369-5-3-1P-BP	-0.27	1.28	0.07	-85.03
K-4 x 7358-8-2-B-BH	1.25	1.75	-0.64	-104.01
x 7347-6-4-B-BH	-0.54	-0.78	1.43	-233.97
x 7385-17-2-BH	0.57	-0.08	-0.53	294.17
x 7369-5-3-1P-BP	-1.28	-0.88	-0.25	43.81
ICCC-14 x 7358-8-2-B-BH	-0.01	-0.50	0.81	-428.03
x 7347-6-4-B-BH	-2.16	0.30	1.52	244.80
x 7385-17-2-BH	1.25	0.00	-0.64	459.14
x 7369-5-3-1P-BP	0.9	0.20	-1.69	213.68
$SE(S_{ij}-S_{ii})$	4.97	4.53	1.59	344.21
$SE(S_{ij}-S_{jj})$	4.54	4.14	1.45	314.22
$SE(S_{ij})$	4.23	3.85	1.35	292.52

Table 2.9. Characteristics of parents, F_2s and checks in F_2 10 x 4 line x tester trial at Hissar in 1980/81.

Entries	Days to 1st flower	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
F_2 generation													
C-104 x 7358-8-2-B-BH	90	95	167	56	2.53	11.70	90.47	110.07	21.31	3.33	5.67	19.9	516
x 7347-6-4-B-BH	89	93	168	63	4.00	12.63	112.87	137.10	27.04	3.00	5.00	21.8	690
x 7385-17-2-B-BH	87	93	165	54	2.80	10.27	102.30	129.40	28.11	2.67	5.67	22.1	647
x 7369-5-3-1P-BP	89	93	166	70	2.27	9.60	95.33	141.87	28.94	3.67	5.67	21.5	480
L-532 x 7358-8-2-B-BH	89	94	165	54	2.37	11.23	73.67	103.20	15.91	3.67	7.67	22.8	738
x 7347-6-4-B-BH	90	94	164	55	2.33	11.07	90.37	108.30	20.45	1.67	8.33	20.6	904
x 7385-17-2-B-BH	88	93	167	57	2.50	12.00	126.07	174.57	29.48	2.67	3.33	19.7	912
x 7369-5-3-1P-BP	88	93	167	57	2.23	10.13	93.07	115.20	27.05	3.00	5.00	24.4	762
GL-622 x 7358-8-2-B-BH	91	96	166	59	2.93	15.73	151.97	224.57	41.94	3.00	6.33	19.6	882
x 7347-6-4-B-BH	87	92	167	63	2.53	11.60	122.23	176.80	31.16	3.67	3.67	18.8	1412
x 7385-17-2-B-BH	90	94	167	59	2.47	10.50	87.60	114.47	22.30	2.67	5.00	21.4	1087
x 7369-5-3-1P-BP	90	94	166	59	2.83	12.30	105.63	129.07	24.92	3.00	4.33	22.6	1492
NEC-139 x 7358-8-2-B-BH	88	93	166	59	2.73	11.73	104.37	146.13	29.61	3.00	6.33	20.9	567
x 7347-6-4-B-BH	87	93	167	46	2.50	14.03	104.77	147.30	23.67	3.00	9.00	20.5	405
x 7385-17-2-B-BH	92	94	165	50	2.47	9.87	92.87	124.47	23.76	3.00	6.33	21.1	601
x 7369-5-3-1P-BP	88	93	168	50	2.43	10.80	85.57	123.53	21.32	3.33	8.67	20.0	820
P-9800 x 7358-8-2-B-BH	89	93	168	60	2.90	12.70	93.17	132.10	23.50	3.67	5.33	18.2	1071
x 7347-6-4-B-BH	89	93	167	66	2.67	9.80	90.23	109.33	24.60	2.67	5.33	23.8	940
x 7385-17-2-B-BH	90	94	166	52	2.57	9.00	89.43	138.03	24.20	3.33	5.00	19.0	912
x 7369-5-3-1P-BP	85	90	167	60	2.77	11.47	105.83	143.17	25.28	3.67	3.33	19.4	1269
NEC-329 x 7358-8-2-B-BH	88	93	165	60	2.43	10.50	90.17	113.67	23.29	3.67	7.67	21.9	631
x 7347-6-4-B-BH	90	94	166	60	2.93	15.37	128.80	165.17	33.93	2.67	5.00	23.3	821
x 7385-17-2-B-BH	89	93	167	57	2.67	11.87	99.83	133.20	27.29	3.00	6.33	23.9	636
x 7369-5-3-1P-BP	87	92	166	56	2.53	11.50	109.67	146.43	25.12	3.00	8.67	21.1	752
GL-629 x 7358-8-2-B-BH	78	92	165	66	2.43	11.43	104.17	152.77	28.69	2.33	5.00	23.3	978
x 7347-6-4-B-BH	89	94	166	59	2.47	13.07	101.73	135.17	26.74	2.00	7.67	18.7	547

Contd....Table 2.9.

Entries	Days to 1st flower	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
GL-629 x 7385-17-2-B-BH	87	92	167	53	2.70	13.03	120.30	158.20	27.34	3.00	6.67	19.0	897
x 7369-5-3-1P-BP	76	89	166	57	2.20	10.47	67.67	118.50	23.50	2.33	4.00	20.9	686
No.501 x 7358-8-2-B-BH	89	93	166	52	2.57	10.13	86.23	128.23	23.10	3.00	7.67	19.9	924
x 7347-6-4-B-BH	83	88	166	53	2.37	13.83	147.63	210.57	32.30	3.33	7.00	19.4	788
x 7385-17-2-B-BH	87	93	169	57	2.80	12.13	113.70	139.40	26.79	3.33	6.67	21.8	858
x 7369-5-3-1P-BP	89	93	168	58	2.67	13.43	105.07	131.43	24.19	3.00	6.33	20.9	968
K-4 x 7358-8-2-B-BH	85	89	168	58	2.87	15.20	104.63	131.27	27.69	2.33	6.67	21.4	833
x 7347-6-4-B-BH	90	94	166	61	2.63	13.10	125.83	166.40	25.97	3.33	8.67	19.5	460
x 7385-17-2-B-BH	88	93	167	63	2.33	13.83	122.33	65.32	28.74	4.00	7.67	22.4	804
x 7369-5-3-1P-BP	78	91	166	56	2.60	13.73	163.60	208.90	36.76	3.00	4.67	18.5	912
ICCC-14 x 7358-8-2-B-BH	84	87	168	58	2.47	12.13	99.97	138.97	25.54	3.67	6.33	18.2	862
x 7347-6-4-B-BH	85	91	166	58	2.50	12.87	129.70	150.70	29.94	2.67	5.33	21.0	758
x 7385-17-2-B-BH	87	92	167	55	2.57	12.27	115.10	149.27	24.80	3.00	4.33	20.2	1309
x 7369-5-3-1P-BP	85	89	166	55	2.63	13.37	166.53	228.77	39.22	3.33	4.00	15.8	684
Lines													
C-104	93	98	167	55	2.00	11.00	83	100	19.6	1.00		21.6	428
L-532	90	94	168	62	2.33	11.33	77	94	19.3	1.67		23.8	921
GL-622	118	93	166	50	2.33	10.00	89	115	30.2	1.00		27.7	476
NEC-139	41	53	168	54	2.00	15.00	152	218	30.0	1.00		-	-
P-9800	84	89	161	56	2.00	11.00	57	76	13.3	1.00		-	-
NEC-329	89	96	167	56	2.50	14.50	116	147	30.5	1.00		12.8	1761
GL-629	87	92	168	55	2.67	15.33	113	169	29.1	1.67		17.5	666
No.501	85	92	168	56	2.33	10.33	86	108	27.2	1.00		25.7	493
K-4	92	97	167	55	2.63	12.33	102	164	27.9	1.00		18.8	850
ICCC-14	82	88	167	49	2.33	14.00	103	207	29.9	1.00		16.7	857

Contd....Table 2.9.

Entries	Days to 1st flower	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
Testers													
7358-8-2-B-BH	90	94	165	58	3.00	11.00	102	132	25.5	1.00		20.9	1035
7347-6-4-B-BH	86	92	167	38	2.67	13.00	95	124	23.4	1.33		21.9	614
7385-17-2-B-BH	84	90	167	56	2.33	11.33	92	154	27.5	2.00		22.4	864
7369-5-3-1P-BP	87	92	168	59	3.00	15.00	172	216	36.0	2.00		9.1	1173
Checks													
L-550	87	91	169	51	2.33	12.67	134	161	36.1	1.00		22.6	785
Rabat	89	93	167	62	2.33	9.33	80	107	26.0	1.00		24.4	745
K-1480													
L-144	84	90	167	69	2.50	12.00	58	97	30.7	1.00		31.8	202
GL-645	69	76	168	51	2.33	15.00	130	172	26.2	2.00		16.6	388
JM-482	91	96	166	54	3.00	14.00	167	256	34.7	2.00		17.5	357
JM-485	90	95	166	61	2.33	10.33	91	127	20.0	1.67		18.0	459
H-208	82	88	166	56	2.00	12.00	154	237	27.7	1.00		15.3	1052
G-130	91	94	169	58	2.33	12.33	161	241	29.9	1.00		13.8	1142
Mean	87.27	92.56	166.47	57	2.61	12.04	108.01	142.52	26.89	3.04	6.03	20.73	830
CD(.05)	8.01	3.29	4.07	12.83	0.72	3.56	43.51	64.47	11.56	1.34	2.70	3.03	577.1
CV%	5.6	2.2	1.5	13.8	17.1	18.2	24.8	27.8	26.5	27.0	27.6	9.0	48.8

There were significant differences due to lines for days to 50% flowering, disease score, seed size and seed yield as in the F_1 trial and also for primary branches and pods per plant (Table 2.10). Differences among testers were significant for days to first and 50% flowering, numbers of secondary branches and pods per plant. The lines x testers mean squares was significant only for the disease score.

As with the F_1 trial there were no significant general combining ability effects among the testers (Table 2.11). Among lines, K-4 was a good general combiner for seed yield and for earliness, in contrast with the F_1 trial where K-4 was later. NEC-139 was again the poorest combiner for seed yield. Estimates of SCA effects were small and usually non-significant (Table 2.12).

F_2 10 x 5 line x tester trial. The 49 F_2 populations of the F_1 line x tester set tested in 1979-80 (ROW 1979/80, Tables 2.7 to 2.10) were included in an 8 x 8 triple lattice trial with the 15 parents. The plot sizes and data recorded were the same as for the F_2 10 x 4 trial.

Many plots were damaged by disease so that accurate yield and seed size data could not be obtained from some entries which were omitted from the analysis. This also prevented valid estimates of combining ability but the characteristics of those entries from which meaningful data were recorded are shown in Table 2.13.

There were significant differences among these entries for all characters except numbers of primary and secondary branches and seed yield per plant. The highest yield (1639 kg seed/ha) was obtained from the parent, ICCC-2, while the F_2 of the cross ICCC-2 and GL-629 ranked second, seed yields being closely associated with disease scores. The best combinations have been advanced for F_3 trials in 1981-82.

F_2s for high yield. 27 ^{K} x ^{K} and 8 ^{K} x ^{D} F_2s which had been tested as F_1s in 1979-80 (ROW, 1979/80, tables 2.11 and 2.12) were included in an 8 x 8 triple lattice trial together with 27 F_1s of crosses made in 1979-80 and multiplied in Kashmir (ROW, 1979/80, Table 2.4) and the checks L-550 and H-208. The plot size was 4 rows, 4m apart with 60 cm between rows and data recorded were days to flowering, disease incidence, seed yield and seed size (Table 2.14).

As in the other trials, plots of a number of entries were severely damaged by *Ascochyta* and *Botrytis* and were omitted from the analysis. There were significant differences among the 43 remaining entries for all characters except the disease rating. The highest seed yield (2173 kg/ha) was obtained from the F_2 of JM-482 x K-850 followed by 1855 kg/ha from

Table 2.10. Mean squares and estimates of GCA and SCA variances from the analysis of variance of F_2 10 x 4 line x tester trial at Hissar in 1980/81.

Source	DF	Days to first flower	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Number of days to pod set	Number of seeds/pod	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
Mean squares														
Lines	9	33.40	22.13**	4.00	39.37	0.54**	6.56	1661.00*	6141.32**	68.56	1.23	14.43**	29.79**	51995*
Testers	3	102.78*	35.38*	8.67	17.44	0.09	22.36*	1527.53	2245.63	110.53	0.68	4.73*	8.86	13070
Lines x Testers	27	28.96	5.41	2.66	74.26	0.19	6.83	1091.90	2139.30	71.38	0.58	5.25	5.50	14106*
Error	78	24.35	4.19	6.28	62.38	0.20	4.80	717.30	1575.02	50.[illegible]	0.38	2.[illegible]	3.[illegible]	126[illegible]
Variance estimates														
GCA		1.86	1.11	0.17	1.47	0.006	0.36	90.59	53.67	0.85	0.02	0.21*	[illegible]	4[illegible]2.05
SCA		1.54	0.44	1.21	5.96	0.005	0.68	124.87	287.14	7.06	0.05	0.83*	[illegible]	4961.40
GCA/SCA		1.21	2.52	0.14	0.37	2.000	0.53	0.73	0.29	0.12	0.67	0.25	18.75	0.81

Table 2.11. Estimates of GCA effects and their standard errors from F_2 10 x 4 line x tester trial at Hissar in 1980/81.

	Days to first flower	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Number of days to pod set	Number of seeds/pod	Single plant yield	Visual score	Disease score	Weight of 100 seeds(g)	Seed yield (Kg/ha)
Lines													
C-104	1.73	1.19*	0.37	0.52	-0.05**	-0.83*	-12.53	-23.13*	-3.47	0.21	0.22*	0.52**	-57.48
L-532	1.98	0.86	0.45	2.51	0.50	1.40	5.08	-1.83	0.63	-0.13	-0.87	1.42**	162.28
GL-622	-0.18	-0.39	0.20	-0.41	0.16	0.23	-5.23	-7.52	1.29	-0.29	0.22**	1.34	-159.62*
NEC-139	0.90	0.53	-0.47	0.56	-0.12	0.02	0.89	7.98**	-0.96	0.21	1.97	-0.10**	-306.19
P-9800	-0.35	0.86	-0.97	0.73	-0.21	-0.44	-9.75	-31.09*	-2.61	0.21*	0.63*	1.71*	-50.14
NEC-329	-0.85	0.69*	-0.47	-2.60	-0.15	0.13	2.31	1.45	-0.57	-0.54*	1.30*	-1.26**	-34.47
GL-629	-0.27*	-1.31*	1.03	-0.16	0.04	0.43*	1.86	8.43	-0.42	0.21	-0.62*	-1.95**	105.16
No.501	-2.77*	-1.06**	-0.13	2.13	-0.21	-1.22	-12.85	-19.09	-0.61	-0.38	-1.12	1.77*	-43.99
K-4	1.98	1.44**	-0.30	-3.26	0.05	-0.25	2.67**	17.50**	1.62**	0.42*	-0.20**	-1.08**	176.56*
ICCC-14	-2.18	-2.81	0.28	-0.01	-0.03	0.53	27.56	47.30	5.10	0.46	-1.53	-2.37	207.89
SE (g_i)	1.27	0.52	0.65	2.04	0.12	0.57	6.92	10.25	1.84	0.21	0.43	0.48	91.72
Testers													
7358-8-2-B-BH	1.63	1.14	-0.30	1.41	0.05	-0.44	-2.18	-0.42	0.25	-0.01	-0.40	0.39	-36.10
7347-6-4-B-BH	1.57	0.64	0.23	-1.59	0.03	-0.82	-12.07	-11.76	-2.57	-0.92	-0.17	-0.05	86.08
7385-17-2-B-BH	-1.73	-0.56	-0.57	-0.24	-0.08	0.08	-2.39	3.67	0.24	-0.21	0.53	0.41	-64.42
7369-5-3-1P-BP	-1.47	-1.23	0.63	0.42	0.00	1.17	16.64	8.52	2.08	0.13	-0.03	-0.75	14.44
SE (g_i)	2.01	0.83	1.02	3.22	0.18	0.89	10.93	16.20	2.90	0.34	0.68	0.76	145.02

Table 2.12. Estimates of SCA effects and their standard errors from F_2 10 x 4 line x tester trial at Hissar in 1980/81.

Entries	Days to 1st flower	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
C-104 x 7358-8-2-B-BH	-0.30	-0.23	0.13	-2.98	-0.07	0.93	-2.84	-8.92	-2.36	0.09	-0.18	-1.74	-221.14
x 7347-6-4-B-BH	-0.57	-0.39	-0.40	2.22	-0.12	0.11	4.18	6.83	1.45	-0.68	-1.08	0.16	227.89
x 7385-17-2-B-BH	1.07	-0.19	-1.27	2.03	-0.05	-0.79	-2.93	-9.40	-0.38	0.63	0.88	0.28	-77.79
x 7369-5-3-1P-BP	-0.20	0.81	1.53	-1.27	0.24**	-0.25	1.58	11.48	1.29	-0.04	0.38	1.30	71.04
L-532 x 7358-8-2-B-BH	-1.88	-1.56	1.38	1.42	0.85	-0.36	1.95	-3.17	-0.73	0.09	0.23	-0.74	-266.36
x 7347-6-4-B-BH	-1.15	-0.06	-0.82	0.48	-0.30	-0.32	4.61	0.14	-0.03	-0.01	-0.67	0.53	412.73
x 7385-17-2-B-BH	2.15	0.81	-0.68	0.27	-0.10	1.85	18.10	20.81	6.17	-0.04	-0.70	0.71	-107.14
x 7369-5-3-1P-BP	0.88	0.81	0.12	-2.17	-0.44	-1.17	-24.66	-17.78	-5.41	-0.04	1.13	-0.50	-39.23
GL-622 x 7358-8-2-B-BH	-2.05	0.03	-1.03	-4.20	-0.01	-1.56	1.70	-5.18	-0.32	-0.08	-0.18	-0.33	11.90
x 7347-6-4-B-BH	-0.32	0.53	-0.57	3.60	-0.01	0.28	13.65	22.90	4.01	0.16	0.25	-1.66	-180.61
x 7385-17-2-B-BH	3.32	1.73	1.23	0.22	-0.03	-0.48	-0.56	-5.47	-1.12	0.46	-0.45	1.39	29.98
x 7369-5-3-1P-BP	-0.95	-2.28	-0.37	-0.39	-0.10	1.76	-14.79	-12.25	-2.57	-0.54	0.38	0.11	147.30
NEC-139 x 7358-8-2-B-BH	-0.83	-0.89	0.30	10.14*	-0.26	-2.02	-11.39	-8.23	2.77	0.43	-1.98	0.45	-8.13
x 7347-6-4-B-BH	-2.73	-0.73	0.43	-10.67*	-0.01	2.79	7.93	8.56	0.32	-0.54	1.17	-0.11	-205.67
x 7385-17-2-B-BH	0.23	-0.53	0.23	-2.09	0.13	-0.64	3.16	-7.73	-1.05	-0.04	0.13	0.04	292.30
x 7369-5-3-1P-BP	3.30	2.14	-0.97	2.62	0.15	-0.01	0.30	7.38	-2.06	-0.04	-1.65	-0.37	-78.50
P-9800 x 7358-8-2-B-BH	0.78	-0.56	0.13	-5.33	-0.08	0.81	-22.41	-7.82	-8.62	0.43	1.40	0.01	-6.35
x 7347-6-4-B-BH	3.85*	0.28	-1.07	-7.04	0.04	-0.91	6.67	24.79	2.06	-0.54	-0.17	-1.25	-264.97
x 7385-17-2-B-BH	-6.85*	-0.53	0.07	7.95	0.11	-0.24	8.30	37.66*	4.17	-0.71	-2.20	0.49	262.36
x 7369-5-3-1P-BP	2.22	0.81	0.87	4.42	-0.07	1.07	7.44	-54.01*	-2.59	0.63	0.97	0.75	8.96
NEC-329 x 7358-8-2-B-BH	2.28	-0.06	-1.70	-1.01	-0.17	-0.66	-17.77	-35.21*	-6.12	-0.83	1.40	0.17	144.59
x 7347-6-4-B-BH	0.35	-0.56	1.77	-3.61	-0.05	-0.55	-12.68	-8.68	-2.43	0.74	1.50	0.57	-61.68
x 7385-17-2-B-BH	4.32*	1.31	0.23	4.21	0.08	0.82	-6.19	-12.47*	-0.18	-0.29	-0.20	-1.16	-184.89
x 7369-5-3-1P-BP	-6.95*	-0.69	-0.30	0.41	0.14	0.40	36.65	56.41*	8.37	0.38	-2.17	-0.73	101.98
GL-629 x 7358-8-2-B-BH	-0.97	0.61	-0.53	-1.21	-0.19	-0.03	18.37	24.03	2.78	-0.58	1.03	0.13	12.89
x 7347-6-4-B-BH	0.77	1.44	0.60	4.26	0.23	1.05	-4.64	-7.09	-0.39	0.33	0.78	-0.53	49.39
x 7385-17-2-B-BH	1.40	0.98	0.40	-3.69	0.13	0.48	12.82	3.58	0.63	-0.04	0.72	-0.15	25.33
x 7369-5-3-1P-BP	-1.20	-3.03*	-0.47	0.64	-0.18	-1.5	-26.54	-20.51	-3.00	0.29	0.88	0.18	-87.62

Contd....Table 2.12.

Entries	Days to 1st flower	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
No.501 x 7358-8-2-B-BH	2.20	0.36	0.63	-3.57	-0.21	-0.24	0.08	-7.82	0.53	0.34	0.48	1.48	11.31
x 7347-6-4-B-BH	2.60	0.86	0.10	7.97	0.24	-0.20	7.13	-2.34	0.90	-0.09	0.58	1.31	67.63
x 7385-17-2-B-BH	-6.77*	-2.28	-0.10	-2.32	-0.13	-0.43	-25.11	-8.60	-3.02	-0.13	-1.45	-2.04	-35.74
x 7369-5-3-1P-BH	1.97	1.06	-0.63	-2.08	0.10	0.89	17.90	18.75	1.59	-0.13	0.38	-0.75	-43.20
K-4 x 7358-8-2-B-BH	0.45	1.19	-0.20	3.06	0.23	4.39**	43.46*	64.96*	13.18*	-0.08	0.90	-0.47	-88.66
x 7347-6-4-B-BH	-1.15	-0.64	-0.40	-0.94	-0.12	-1.97	-9.19	-10.23	-1.74	0.16	-0.67	-0.64	-180.68
x 7385-17-2-B-BH	1.15	-0.11	0.07	-2.33	-0.02	-1.73	-22.06	-35.46	-5.65	0.13	1.30	-0.19	-18.29
x 7369-5-3-1P-BH	-0.45	-0.44	0.53	0.21	-0.10	-0.69	-12.22	-19.28	-5.78	-0.21	-1.53	1.30	287.62
ICCC-14 x 7358-8-2-B-BH	0.28	1.11	0.88	3.68	-0.10	-0.53	-11.15	-12.61	-1.08	0.18	-0.43	0.08	409.96
x 7347-6-4-B-BH	-1.65	-0.73	0.35	3.74	0.16	-0.28	-17.66	-34.89	-4.14	0.08	-1.00	1.12	144.98
x 7385-17-2-B-BH	-0.02	-1.19	-0.18	-4.24	-0.13	1.18	14.47	17.08	0.07	0.04	1.97	0.64	-186.08
x 7369-5-3-1P-BH	1.38	0.81	-1.05	-3.17	0.06	-0.37	14.34	30.42	5.15	-0.29	-0.53	-1.84	-368.86
$SE(S_{ij}-S_{ii})$	3.82	1.57	1.94	6.12	0.34	1.70	20.75	30.74	5.51	0.64	1.29	1.45	275.15
$SE(S_{ij}-S_{jj})$	3.49	1.43	1.77	5.58	0.31	1.55	18.94	28.06	5.03	0.58	1.18	1.32	251.18
$SE(S_{ij})$	3.25	1.33	1.65	5.20	0.29	1.44	17.63	26.13	4.68	0.54	1.1	1.23	233.84

Table 2.13. Characteristics of entries in F_2 10 x 5 L x T trial at Hissar in 1980/81.

Entries	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Rank
F_2 generation													
Pant G-114 x GL-629	91	167	60	2.50	10.43	130.43	197.23	26.25	3.00	5.00	14.7	1222	6
Pant G-114 x L-550	88	167	57	2.53	11.67	122.47	190.20	27.37	3.00	5.00	17.1	1269	4
Pant G-114 x P-422	90	167	54	2.43	11.97	173.70	259.17	29.81	3.33	7.33	13.5	766	40
Pant G-114 x Giza	66	167	62	2.57	12.47	138.80	202.90	25.58	3.67	4.27	14.0	1206	9
Pant G-114 x K-56567	92	167	70	2.70	16.33	149.33	229.43	33.06	3.67	4.33	16.3	1055	14
Pant G-114 x Rabat	92	166	51	2.53	10.67	114.87	185.37	27.24	3.67	6.67	17.4	944	23
Pant G-114 x Kourosh	87	166	54	2.63	13.63	140.20	211.97	26.29	4.00	5.00	17.9	808	35
Pant G-114 x P-9623	52	167	55	2.60	9.73	99.37	154.17	28.24	4.00	8.33	20.2	970	19
Pant G-114 x No.501	90	167	57	2.90	10.60	121.93	190.10	29.62	3.33	3.67	17.3	1158	10
Pant G-114 x JM-482	92	166	65	3.27	10.23	157.83	255.00	33.23	2.67	4.44	14.6	1214	8
ICCC-2 x GL-629	92	168	67	3.90	16.27	154.93	239.70	28.49	3.33	4.00	13.5	1404	2
ICCC-2 x L-550	93	167	66	3.20	12.47	149.03	235.23	28.04	3.33	6.00	13.8	1051	15
ICCC-2 x P-422	90	167	59	3.30	14.13	183.73	289.07	30.84	2.40	6.33	12.2	793	37
ICCC-2 x Giza	75	166	68	3.37	14.23	139.50	204.67	25.33	3.67	5.67	13.2	532	48
ICCC-2 x K-56567	92	166	60	3.33	11.13	151.27	221.50	28.63	4.00	5.33	16.5	1080	12
ICCC-2 x Rabat	92	168	78	4.17	14.10	109.63	156.03	23.11	3.00	4.67	15.8	774	39
ICCC-2 x Kourosh	88	166	61	2.80	13.03	163.67	233.37	35.15	2.67	7.00	17.8	801	36
ICCC-2 x P-9623	78	166	68	2.80	14.23	136.90	201.70	29.34	5.00	6.94	17.2	718	43
ICCC-2 x No.501	92	166	59	2.53	11.23	109.33	166.17	28.15	2.67	5.33	18.6	845	30
ICCC-2 x JM-482	93	167	65	3.03	12.93	132.23	213.20	23.05	3.00	5.33	13.4	829	32
ICCC-4 x GL-629	89	166	62	2.90	13.80	151.03	206.83	29.20	3.67	7.00	15.2	1087	11
ICCC-4 x L-550	65	167	66	2.53	11.27	139.53	213.60	32.48	3.00	6.67	17.2	877	25
ICCC-4 x P-422	66	166	62	2.30	10.93	128.30	178.90	21.32	3.00	7.67	13.8	682	44
ICCC-4 x Giza	61	166	57	2.57	15.00	155.87	243.33	28.98	3.33	8.00	16.3	813	34
ICCC-4 x K-56567	54	167	65	2.83	13.30	122.80	162.27	22.33	3.67	7.00	16.6	829	32
ICCC-4 x Rabat	87	166	68	2.63	11.90	109.53	150.30	24.05	4.00	6.79	17.1	841	31

Contd....Table 2.13.

Entries	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
ICCC-4 x P-9623	48	165	66	3.13	10.93	97.50	122.90	23.40	3.33	6.00	21.1	730	42
ICCC-4 x No.501	88	167	68	3.03	12.57	120.90	171.53	27.06	3.67	4.77	18.0	1019	17
ICCC-4 x JM-482	88	165	60	2.70	11.10	101.43	166.63	21.64	3.69	6.94	14.6	868	28
BG-203 x GL-629	78	166	69	3.20	13.20	124.20	196.43	24.23	3.33	5.67	14.5	1250	5
BG-203 x L-550	89	168	73	3.10	14.00	98.70	165.17	22.40	3.33	5.67	14.5	1039	16
BG-203 x P-422	63	168	71	3.03	12.67	114.93	191.30	17.78	3.67	7.00	11.5	488	30
BG-203 x Giza	94	168	71	2.53	12.67	149.03	234.60	33.01	3.67	3.67	16.5	1071	13
BG-203 x K-56567	78	167	61	2.87	15.20	155.60	232.87	22.79	3.67	6.44	12.3	639	45
BG-203 x Rabat	90	167	71	3.03	12.97	120.07	176.00	28.91	3.67	5.00	17.1	972	18
BG-203 x Kourosh	76	167	72	2.60	13.60	133.77	198.17	27.12	3.67	6.67	14.8	623	47
BG-203 x P-9623	63	168	70	2.90	12.83	106.50	168.17	24.00	3.67	8.33	19.3	635	46
BG-203 x No.501	90	166	66	2.63	11.10	83.30	127.67	17.47	3.00	5.33	15.6	948	21
BG-203 x JM-482	91	167	66	2.33	8.70	87.77	152.33	16.86	2.67	7.67	13.4	869	26
BDN-9-3 x GL-629	52	165	51	2.37	11.97	114.67	162.57	22.46	3.33	8.00	16.5	468	51
BDN-9-3 x L-550	51	167	65	3.20	12.13	108.80	141.40	24.26	3.33	8.29	17.2	785	35
BDN-9-3 x P-422	53	165	54	2.47	13.33	115.63	163.93	21.18	3.67	6.67	13.6	500	49
BDN-9-3 x Rabat	52	164	51	2.40	10.33	72.60	102.40	17.71	3.67	9.00	18.6	304	55
BDN-9-3 x No.501	53	165	61	2.50	10.93	99.47	142.83	24.60	4.33	8.33	19.3	356	52
BDN-9-3 x JM-482	65	165	58	3.10	14.73	170.53	238.40	32.04	3.00	8.00	17.6	305	54
Lines													
GL-629	92	167	68	2.87	13.30	136.33	203.37	27.74	2.33	3.67	15.0	889	24
L-550	88	167	64	2.67	14.07	81.07	114.33	20.32	3.00	8.67	21.2	932	23
P-422	93	165	62	3.81	17.01	87.10	115.45	9.45	2.40	7.77	11.5	310	53
Rabat	93	166	64	3.63	14.33	79.37	106.10	20.31	2.69	8.33	25.9	294	56
Kourosh	92	167	64	3.17	13.80	104.07	158.17	22.83	2.00	5.67	19.2	861	29
No.501	90	165	59	3.00	11.73	95.43	121.37	29.82	1.00	5.67	22.4	1218	7

Contd....Table 2.13.

Entries	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of primary branches	Number of secondary branches	Days to pod set	Number of pods/plant	Single plant yield	Visual score	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Rank
Testers													
Pant G-114	92	169	57	2.73	13.60	186.00	313.73	35.80	1.33	3.67	13.1	1365	3
ICCC-2	93	168	70	2.47	12.03	110.03	177.03	18.73	1.33	3.67	11.8	1639	1
ICCC-4	89	169	68	2.63	13.50	126.47	197.57	19.87	1.67	7.00	13.7	952	20
BG-203	90	165	63	2.50	10.60	121.10	197.73	18.44	2.00	8.33	10.1	869	26
BDN-9-3	50	165	49	2.51	12.26	174.60	238.00	29.76	2.40	8.77	13.6	762	41
Mean	80	167	63	2.86	12.66	126.13	189.00	25.49	3.15	6.31	16.0	867	
CD(.05)	16.2	2.4	11.3	1.00	4.90	61.10	96.51	12.65	1.27	3.20	3.34	536.9	
CV%	12.5	0.9	11.1	21.7	23.9	29.9	31.6	30.7	24.8	31.3	12.9	38.3	

Table 2.14. Characteristics of K x K and D x K F_2 populations made for high yield.

Entries	Days to 50% flowering	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Rank
No.501 x Annigeri	52.00	8.00	26.17	580	34
No.501 x ICCC-1	78.00	6.33	24.30	1346	5
7357-12-3-BH x 7385-17-2-BH	87.33	6.00	20.00	1086	13
7357-12-3-BH x JM-482	94.00	7.00	15.77	906	18
7357-12-3-BH x Annigeri	52.00	7.33	17.77	733	23
7357-12-3-BH x ICCC-1	66.33	8.33	16.48	1023	14
Giza x ICCC-2	51.00	6.33	15.05	1351	4
JM-482 x H-208	91.33	5.33	13.30	1855	2
JM-482 x K-850	91.00	6.00	20.55	2172	1
No.501 x P-9800	61.33	8.67	25.37	454	37
No.501 x P-2591	52.33	8.33	24.00	552	35
No.501 x JM-482	91.33	4.67	19.03	1268	7
No.501 x GL-629	91.67	6.00	23.00	1387	3
No.501 x P-9623	47.67	7.33	25.70	662	29
No.501 x K-1480	79.67	7.33	27.75	543	36
No.501 x Jam	77.67	8.00	25.68	182	43
(L-550 x L-2) x P-9800	49.33	6.33	25.77	818	20
No.501 x NEC-141	93.00	8.67	27.40	335	39
No.501 x L-532	92.00	4.33	24.83	1154	10
No.501 x GL-645	78.33	8.33	21.65	293	41
No.501 x P-422	92.00	6.67	20.30	618	32
L-532 x P-2265	92.33	8.00	20.00	429	38
L-532 x GL-645	52.00	6.00	15.33	682	25
L-532 x NEC-2594	94.33	7.33	22.70	231	42
L-550 x K-56567	47.33	7.33	20.65	1008	15
L-550 x Kourosh	89.33	7.00	25.23	656	30
L-550 x L-534	90.33	7.33	27.13	296	40
L-550 x NEC-30	78.00	7.33	26.45	605	33
L-550 x NEC-139	91.67	8.33	25.10	662	28
L-550 x NEC-329	92.00	5.33	22.93	1216	9
7378-18-5-2H-BH x NEC-1640	94.82	6.00	25.90	851	19
7378-18-5-2H-BH x NEC-1663	90.33	8.33	24.55	927	17
7378-18-5-2H-BH x C-104	93.00	6.00	22.45	977	16
7378-18-5-2H-BH x GL-622	92.00	5.67	23.42	1226	8
7378-18-5-2H-BH x GL-629	90.67	5.33	19.00	1132	12
7378-18-5-2H-BH x GL-645	90.33	7.67	18.73	1140	11
7378-18-5-2H-BH x GL-651	91.33	5.33	20.07	1312	6
7378-18-5-2H-BH x Giza	52.00	7.67	22.15	675	26
K-4 x Hyb-16-3	94.33	7.67	18.40	798	21
K-4 x KM-466	90.67	8.33	17.95	631	31
K-4 x K-1189	53.00	7.67	20.65	707	24
K-4 x K-1481	94.67	5.67	19.55	668	27
L-550	90.33	7.33	24.60	758	22
Grand mean	79.40	6.94	21.92	858.79	
CD(.05)	14.12	2.62	4.19	600.06	
CV(%)	11.0	23.2	11.8	43.1	

JM-482 x H-208. The kabuli check, L-550, ranked 22nd with 759 kg/ha.

F_3 trial. Thirty four F_3 populations derived from crosses involving kabuli parents, the F_2 populations of which had been tested in F_2-trials-A and B at Hissar in 1979-80 (ROW 1979/80, Tables 2.13, 2.14 and 2.15) were evaluated together with the controls L-550 and H-208 in a 6 x 6 triple lattice trial, this season. Plot sizes were as for the F_2 trials. The numbers of days to flowering and to maturity, disease scores, seed yields and seed sizes were recorded.

Plots of 5 entries were severely damaged by disease and were omitted from the analysis. There were significant differences among the remaining 34 entries, for all characters but days to maturity (Table 2.15). The CV for seed yield (30.9%) was rather lower than the F_2 trials. H-208 gave a significantly higher seed yield (3011 kg/ha) than other entries. L-550 ranked second and was also significantly higher yielding than most of the F_3s. There was again a close association between the disease rating and seed yield. The best F_3s will be sown as bulks for single plant selection in 1981/82.

Non-replicated bulks and progeny rows

The numbers of non-replicated bulks and progeny rows sown and the single plants and lines selected are summarised in Table 2.16.

Table 2.16. The numbers of bulks and progeny rows sown and single plants and lines selected at Hissar in 1980/81.

Generation	Type	Number sown	Number selected	
			Single plants	Lines
F_2	Population	25	80	-
F_3	Population	126	305	-
F_4	Population	4	68	-
F_4	Progeny	1076	-	84
F_5	Population	64	46	-
F_5	Progeny	658	143	135
F_5	Progeny bulk	118		
F_6	Progeny	44	11	3
F_6	Progeny bulk	134	-	28
F_7	Progeny	121	-	12
F_7	Progeny bulk	51		
Total		2421	653	262

Table 2.15. Characteristics of populations in F_3 trial at Hissar, 1980/81.

Pedigree	Var.	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
K-4 x No.501	3.00	93	167	5.67	23.2	1111
K-4 x 7385-17-2-BH	3.33	88	166	6.00	24.9	979
K-4 x 7357-12-3-B-BH	3.00	94	165	5.67	16.9	1092
K-4 x Giza	2.67	87	163	8.67	18.2	446
K-4 x P-9800	3.33	88	162	8.00	22.5	792
K-4 x P-2591	3.33	88	165	6.67	19.7	778
K-4 x JM-482	3.67	95	166	5.00	20.0	1063
No.501 x Giza	3.01	83	163	8.67	20.6	228
No.501 x P-9800	3.33	78	165	7.39	35.7	602
No.501 x JM-482	2.67	92	166	5.00	24.8	1212
7385-17-2-BH x Giza	3.51	50	166	8.00	21.7	478
7385-17-2-BH x JM-482	3.67	87	163	7.67	22.6	704
7357-12-3-B-BH x Giza	3.33	74	166	6.00	18.3	959
7357-12-3-B-BH x P-9800	3.33	87	164	7.67	20.6	584
7357-12-3-B-BH x P-2591	3.33	89	166	6.67	18.0	712
7357-12-3-B-BH x JM-482	3.00	93	167	4.33	17.0	1388
Giza x P-9800	3.01	61	165	8.00	27.7	400
Giza x P-2591	3.67	86	165	7.33	16.6	673
P-9800 x JM-482	3.33	93	167	4.67	19.7	1527
P-2591 x JM-482	3.67	83	163	8.00	18.3	544
No.501 x GL-629	3.54	89	167	8.33	31.1	504
No.501 x K-1480	3.33	92	164	7.00	26.6	571
No.501 x L-532	4.00	93	165	7.00	26.2	988
L-532 x P-2544	3.67	99	167	6.33	27.4	915
L-532 x NEC-694	3.51	95	167	8.67	30.6	538
No.501 x ICCC-1	3.67	75	165	5.67	23.2	1130
7385-17-2-BH x 7357-12-3-B-BH	3.33	89	166	6.33	20.5	1165
7357-12-3-B-BH x JM-482	3.00	93	167	6.00	17.2	1333

Contd....Table 2.15.

Pedigree	Var.	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha
7357-12-3-B-BH x Annigeri	3.00	87	167	6.33	18.3	1333
L-550	1.00	89	166	4.67	23.3	1626
H-208	1.00	86	166	3.67	12.8	3011
Mean	3.17	86.3	165.4	6.61	22.08	947.8
CD(.05)	0.87	12.13	3.51	2.45	3.11	478.0
CV%	16.8	8.6	1.3	22.7	8.6	30.9

Populations. Non replicated bulks of 10 to 50 rows of 4m length and 60 cm apart (200 to 1000 plants per population) were sown space-planted for single plant selection.

The F_2s were 25 of the combinations which had also been included in the F_2 trial of high yielding types. The F_3s were D x K combinations which had been in F_2 Trials C to F (ROW 1979/80, Tables 2.15 to 2.18) and F_4s, K x K combinations from F_3 Trial A (ROW 1979/80, Table 2.21) at Hissar in 1979/80. The F_5 populations comprised the 64 best entries from F_4 Trial C at Hissar in 1979/80 (ROW 1979/80, Table 2.23).

Single plants were selected based on appearance and on seed type for evaluation in progeny rows in 1981/82.

Progeny rows and bulks. Progeny rows and bulks were sown in 2 row plots 4 m long and 60cm apart with L-550 every tenth plot for comparison.

Single plants were selected for progeny rows in 1981/82. Bulked lines exceeding the yield of the nearest check by 200% were selected for replicated tests and by 150% for non-replicated rows in 1981/82. In addition, 101 advanced generation lines were sent to ICARDA for replicated tests under winter-sown conditions.

PRELIMINARY AND ADVANCED TRIALS

One hundred and seventy-five F_5 and more advanced progeny bulks were evaluated in two preliminary and two advanced trials. The trials were all triple lattices and included H-208 and/or L-550 as checks. The preliminary trials were 8 x 8 and 6 x 6 lattices with 4 row plots and the advanced trials 7 x 7 and 6 x 6 lattices with 8 row plots. The rows were 30 cm apart and there was 10cm between plants within the rows. Days to flowering and maturity, seed size and seed yield were recorded and the entries rated for disease level.

There were significant differences among entries for all characters in all four trials (Tables 2.17 to 2.20). In all trials there were advanced breeding lines giving over 2 tonnes seed/ha and significantly better than the kabuli check L-550. Following elimination of those with unsatisfactory seed type 14 entries from the preliminary trials and 31 from the advanced trials (indicated in the tables) were selected for further testing. In addition three entries from Advanced Trial 2 were contributed for kabuli coordinated trials. The identities of the ICCL entries are given in Table 2.21.

Table 2.17. Characteristics of entries in Preliminary Trial-1 at Hissar in 1980/81.

ICCL/ICC No.	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
74454-38-1P-1P-BP-BH	F_2(K-850 x JG-221) x L-550	93	166	2	17.9	1779	15
74454-38-1P-2P-BP-BH	F_2(K-850 x JG-221) x L-550	94	162	6	16.1	1372	42
74508-4H-1H-1P-BP-BH	F_2(Ahmedabad-52 x Ceylon-2) x F_2(K-4 x L-550)	89	167	3	17.2	1622	24
74508-4H-1H-2P-BP-BH	F_2(Ahmedabad-52 x Ceylon-2) x F_2(K-4 x L-550)	87	164	4	18.7	1628	23
74630-5H-1H-1P-BP-BH	(Annigeri x B-108) x (L-550 x K-4)	91	163	4	17.3	1750	16
74698-1H-1H-1P-BP-BH	C-104 x (JG-221 x BEG-482)	92	162	7	19.1	1381	40
74765-1H-1H-2P-BP-BH	L-550 x (L-2 x BEG-482)	89	163	4	16.6	1846	12
74765-1H-1H-3P-BP-BH	L-550 x (L-2 x BEG-482)	88	162	4	14.4	1439	35
74765-8H-1H-1P-BP-BH	L-550 x (L-2 x BEG-482)	89	162	6	20.1	1426	36
74765-9H-1H-1P-BP-BH	L-550 x (L-2 x BEG-482)	88	163	4	20.0	2049	5
74593-4H-1H-1H-1H-BH	(K-850 x RS-11) x (L-550 x F-378)	88	167	4	23.1	1421	37
74593-4H-1H-1H-2H-BH	(K-850 x RS-11) x (L-550 x F-378)	86	166	4	22.1	1077	58
74670-9H-1H-1H-1H-BH	(Radhey x L-550) x (K-850 x H-208)	89	163	3	19.6	1966	9
74508-4H-1H-1H-2H-BH	F_2(Ahmedabad-52 x Ceylon-2) x (K-4 x L-550)	92	165	3	17.9	999	59
74670-9H-1H-1H-2H-BH	(Radhey x L-550) x (K-850 x H-208)	88	165	3	22.0	2228	1[a]
74698-1H-1H-1H-1H-BH	C-104 x (JG-221 x BEG-482)	93	163	5	17.2	1358	44
74649-14P-1P-1H-1H-BH	(P-505 x F-378) x (B-108 x C-235)	92	166	4	24.7	1646	21
74397-4H-1H-1H-1H-BH	F_2(L-550 x H-208) x (K-4 x L-550)	92	165	5	16.6	1109	54
74440-17P-1P-1H-2H-BH	(L-550 x GW-5/7) x (K-4 x L-550)	90	162	6	21.1	1262	49
74357-6H-2H-1H-1H-BH	F_2(L-550 x H-208) x F_2(B-108 x JG-24)	91	165	6	19.3	1450	33
74433-12P-1P-2P-1H-BH	F_2(T-3 x Annigeri) x F_2(L-550 x B-108)	91	167	2	15.0	1463	32
74440-14P-1P-1P-1H-BH	F_2(GW-5/7 x L-550) x F_2(K-4 x L-550)	50	162	6	23.6	1393	38
74440-14P-1P-1P-2H-BH	F_2(GW-5/7 x L-550) x F_2(K-4 x L-550)	61	163	7	24.1	1230	50
74440-14P-1P-3P-1H-BH	F_2(GW-5/7 x L-550) x F_2(K-4 x L-550)	60	163	7	25.6	976	60
74440-22P-1P-2P-1H-BH	F_2(GW-5/7 x L-550) x F_2(K-4 x L-550)	46	166	4	21.4	951	61
74440-22P-1P-3P-1H-BH	F_2(GW-5/7 x L-550) x F_2(K-4 x L-550)	49	163	5	22.7	1468	31

Contd....Table 2.17.

ICCL/ICC No.	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
74807-1P-1P-1P-1H-BH	NEC-1077 x (K-850 x C-235)	90	165	3	13.5	1824	14
74440-22P-1P-4P-1H-BH	F_2(GW-5/7 x L-550) x F_2(K-4 x L-550)	49	164	7	18.9	946	62
74764-4P-1P-2P-1H-BH	P-2614 x (H-208 x K-4)	88	164	5	17.4	1371	43
74764-4P-1P-3P-1H-BH	P-2614 x (H-208 x K-4)	89	165	6	17.2	1449	34
74808-5P-1P-1P-1H-BH	L-550 x (P-2940 x L.Local)	92	165	2	13.5	1941	10
74349-7H-1P-3P-1H-BH	F_2(P-1786 x C-214) x F_2(F-496 x L-550)	84	166	5	26.2	1549	28
74646-4H-2P-1P-1H-BH	(C-235 x L-550) x (CP-66 x F-370)	91	168	2	17.7	1917	11
74454-10H-1H-3P-1H-BH	L-550 x (K-850 x JG-221)	74	164	3	23.7	2190	3
74670-9H-1H-3P-1H-BH	(Radhey x L-550) x (K-850 x H-208)	88	164	4	23.1	1476	30
74765-9H-1H-5P-1H-BH	L-550 x (L-2 x BEG-482)	86	164	3	16.6	1832	13
74807-1H-1H-4P-1H-BH	NEC-1077 x (K-850 x C-235)	87	161	7	24.8	1657	20[a]
74347-1H-1H-1P-1H-BH	F_2(L-1 x NP-34) x F_2(Ceylon-2 x L-550)	88	163	4	23.2	1561	27
74347-1H-1H-2P-1H-BH	F_2(L-1 x NP-34) x F_2(Ceylon-2 x L-550)	45	164	3	23.3	1989	8[a]
74716-3P-1P-1P-1H-BH	P-4357 x (Ceylon-2 x L-550)	46	163	7	20.4	1087	56
74433-12P-1H-1P-1H-BH	(T-3 x Annigeri) x (L-550 x B-108)	93	166	4	15.6	1111	53
74440-14P-1P-1H-1H-BH	(L-550 x GW-5/7) x (K-4 x L-550)	92	162	5	22.4	1096	55
75862-3P-1P-2H-BH	12-071-0593 x GL-629	91	165	1	13.7	2017	6
75862-3P-1P-3H-BH	12-071-0593 x GL-629	92	166	3	13.1	1713	18
74884-5H-1H-2H-BH	K-4 x L-550	91	163	4	20.2	1323	46
75485-11H-1H-1H-BH	P-388 x (T-3 x P-836)	89	164	5	28.3	1390	39
75269-6P-3P-1H-BH	(BR-70 x P-502)x(P-514 x P-502)	89	167	6	13.7	1337	45
752601-2H-3P-2H-BH	F_4(P-1786 x C-214) x F_4(L-550 x E-100)	98	168	3	16.8	1591	25
752601-2H-4P-1H-BH	F_4(P-1786 x C-214) x F_4(L-550 x E-100)	92	168	3	17.0	2006	7
74884-5H-1P-1H-BH	K-4 x L-550	94	166	5	21.4	1287	48
75495-2H-3P-2H-BH	L-532 x (NEC-249 x NEC-34)	89	163	8	15.9	564	64
752559-3H-1H-1H-BH	F_3(L-345 x K-468) x F_3[K-4 x (L-550 x H-355)]	94	169	2	14.7	1215	51
7562-1H-1H-1H-BH	L-550 x PM from L-550	90	161	5	23.8	1744	17[a]
7599-1P-1H-1H-BH	CPI-36071 x L-550	88	163	4	22.0	1306	47
75485-11H-2H-1H-BH	P-388 x (T-3 x P-836)	87	163	4	32.3	2197	2[a]
75485-11H-2H-2H-BH	P-388 x (T-3 x P-836)	73	161	5	29.8	1684	19[a]

Contd....Table 2.17.

ICCL/ICC No.	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
75102-10H-1H-2H-BH	L-532 x K-1286	98	164	5	28.5	1074	57
7561-4P-4P-1H-BH	CPI-36071 x L-550	89	163	5	22.8	1637	22[a]
75219-7P-3P-1H-BH	(NEC-1372 x L-550)x (V-4 x P-3090)	90	163	6	22.7	1569	26
75334-3H-1P-1H-BH	(C-214 x NEC-10) x (T-3 x P-10)	103	168	4	17.8	1147	52
75495-6H-5P-1H-BH	L-532 x (NEC-249 x NEC-34)	48	162	7	21.0	793	63
	L-550	87	163	5	22.4	1377	41
	L-550	87	161	5	23.7	1493	29
	H-208	86	162	3	13.3	2103	4
Mean		84	164	5	20.1	1497	
CD (.05)		8.6	3.4	3	2.53	761.7	
CV%		6.3	1.3	42.3	7.9	31.8	

[a] Selected for further trials in 1982-83.

Table 2.18. Characteristics of entries in Preliminary Trial-2 at Hissar in 1980/81.

Selection number	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Rank
74433-7P-1P-2P-BP-BP	F_2(T-3 x Annigeri) x F_2(L-550 x B-108)	85	165	7	17.9	1359	22
74433-7P-1P-3P-BP-BP	F_2(T-3 x Annigeri) x F_2(L-550 x B-108)	84	167	5	18.0	2152	3[a]
74433-7P-1P-4P-BP-BP	F_2(T-3 x Annigeri) x F_2(L-550 x B-108)	86	166	3	17.5	1910	9[a]
74433-12P-1P-3P-BP-BP	F_2(T-3 x Annigeri) x F_2(L-550 x B-108)	91	160	3	13.5	1776	13[a]
74434-2P-1P-2P-BP-BP	F_2(P-1786 x L-550) x F_2(T-3 x G-24)	93	164	4	14.4	1711	14
74440-22P-1P-1P-BP-BP	F_2(L-550 x GW-5/7) x F_2(K-4 x L-555)	74	162	4	21.3	1172	30
74440-22P-1P-2P-BP-BP	F_2(L-550 x GW-5/7) x F_2(K-4 x L-555)	51	168	5	21.4	1038	34
74440-22P-1P-3P-BP-BP	F_2(L-550 x GW-5/7) x F_2(K-4 x L-555)	73	161	5	21.5	1055	33
74440-22P-1P-4P-BP-BP	F_2(L-550 x GW-5/7) x F_2(K-4 x L-555)	51	162	8	21.0	1287	26
74450-3P-1P-2P-BP-BP	P-9800 x F_2(K-850 x JG-24)	91	166	5	26.8	1252	28
74454-11P-1P-1P-BP-BP	L-550 x F_2(K-850 x JG-221)	85	167	7	22.6	1149	31
74536-4P-1P-3P-BP-BP	(G-130 x P-5409) x (L-550 x BG-1)	84	168	6	13.1	742	36
74630-6P-1P-1P-BP-BP	(Annigeri x B-108) x (L-550 x K-4)	88	166	5	16.8	1739	14
74764-4P-1P-1P-BP-BP	(H-208 x K-4) x P-2614	85	165	7	14.2	1311	25
74349-7H-1P-1P-BP-BP	F_2(P-1786 x C-214) x F_2(F-496 x L-550)	87	169	4	26.1	1480	19
74716-3H-1P-3P-BP-BP	P-4351 x (Ceylon-2 x L-550)	83	165	7	17.7	1372	21
74765-5H-1P-2P-BP-BP	L-550 x (L-2 x BEG-482)	72	166	6	20.2	1146	32
74765-1H-2P-BP-BP	L-550 x (L-2 x BEG-482)	86	168	6	14.9	986	35
74765-1H-3P-BP-BP	L-550 x (L-2 x BEG-482)	87	167	5	13.7	1458	20
74765-9H-1H-1P-BP-BP	L-550 x (L-2 x BEG-482)	89	167	2	20.4	1842	11
74765-1H-1H-3P-BP-BP	L-550 x (L-2 x BEG-482)	89	166	3	17.0	2107	6
74765-1H-1H-4P-BP-BP	L-550 x (L-2 x BEG-482)	87	167	3	15.9	2334	1[a]
74765-1H-1H-5P-BP-BP	L-550 x (L-2 x NEG-482)	89	167	4	13.9	2050	8
74867-1H-1H-1P-BP-BP	Kaka x P-99	89	163	4	21.2	1219	29
74867-1H-1H-2P-BP-BP	Kaka x P-99	87	165	4	22.5	1783	12[a]
7338-1-1-1H-1P-1P-BP	H-208 x C-104	94	168	2	14.2	2106	7
7369-2-1-1P-1P-1P-BP	L-550 x USA-613	85	167	4	20.7	2112	5[a]
7384-3-2-2H-LB-BH	L-550 x Pant G-104	88	164	6	21.2	1616	18
73235-5-1-1P-LB-1P-BP	F-378 x Rabat	91	164	3	21.9	1635	17
7379-BH-2-1P-1H-1H-BH	F-378 x L-550	92	169	3	22.6	2167	2[a]

Contd....Table 2.1g.

Selection number	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Rank
7461-B-1H-B-1H-1H-BH	(K-850 x K-468) x (Chafa x K-4)	88	167	4	19.3	1704	16
74264-12-1H-2H-1H-1H-BH	K-4 x (L-550 x H-355)	92	165	4	14.2	1324	23
7380-B-3H-1H-1H-1H-BH	F-404 x L-550	91	166	3	15.7	1317	24
7380-B-3H-1H-2H-1H-BH	F-404 x L-550	91	167	3	14.6	1880	10
	L-550	87	166	5	23.0	1279	27
	H-208	84	167	3	12.3	2146	4
Mean		85	166	4	18.4	1575	
CD(.05)		9.1	2.8	3	2.2	706.7	
CV%		6.6	1.0	37.6	7.1	27.7	

[a] Selected for trials in 1981/82.

Table 2.19. Characteristics of entries in Advanced Trial-1 at Hissar in 1980/81.

Selection number	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
7385-15-1-1H-1P-BP-BP-BP	L-550 x L-2	90	167	1	18.3	2626	1[b]
7344-19-3-1H-1P-BP-BP-BP	L-550 x F-61	91	170	2	20.8	1716	39
73242-17-2-1P-1P-BP-BP-BP	K-4 x L-144	91	165	4	23.8	1612	44
7385-8-2-1P-1P-BP-BP-BP	L-550 x L-2	90	168	3	21.6	2097	16[a]
7369-4-1-1P-1P-BP-BP-BP	L-550 x USA-613	88	168	4	19.0	2057	19
7370-8-3-1P-2P-BP-BP-BP	L-550 x GW-5/7	45	164	4	35.0	1435	45
7358-4-3-B-BH-6P-BP-BP	L-550 x K-4	98	168	4	23.2	1901	30
7358-4-3-B-BH-2P-BP-BP	L-550 x K-4	92	163	4	21.8	2096	17[a]
7344-19-2-BH-BP-4P-BP-BP	L-550 x F-61	92	169	4	18.2	2033	21[a]
7358-4-3-BH-3P-BP-BP	L-550 x K-4	94	166	2	23.5	1941	28
7387-3-3-6H-BP-3P-BP-BP	L-550 x E-100	94	169	3	14.5	2222	12
ICCL-80029	L-550 x K-4	92	168	4	20.2	2415	7
7358-7-3-B-BH-BH-3P-BP-BP	L-550 x K-4	89	168	5	18.0	1992	23
7358-7-3-B-BH-BH-1P-BP-BP	L-550 x K-4	89	162	4	18.4	2389	9
7358-3-2-BP-BP-1P-BP-BP	L-550 x K-4	88	166	4	21.5	2484	5[a]
7358-3-2-BP-BP-3P-BP-BP	L-550 x K-4	88	168	5	22.1	2037	20[a]
7358-3-2-BP-BP-4P-BP-BP	L-550 x K-4	88	163	5	21.8	1986	25
7358-11-3-B-BP-1P-BP-BP	L-550 x K-4	90	165	3	34.5	2088	18[a]
7356-15-2-1H-BP-1P-BP-BP	L-550 x SP-405	91	168	3	18.9	1870	33
7358-4-3-B-BH-7P-BP-BP	L-550 x K-4	96	167	3	24.2	1958	26[a]
7376-15-2-1H-BP-4P-BP-BP	L-550 x SP-405	89	167	3	18.2	2250	10[a]
7376-15-2-1H-BP-5P-BP-BP	L-550 x SP-405	92	168	2	18.0	2227	11[a]

Contd....Table 2.19.

Selection number	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
ICCL-80023	H-208 x C-104	91	167	4	19.0	2100	15
ICCL-80024	L-550 x L-2	86	167	5	24.5	1946	27[a]
ICCL-80025	L-550 x L-2	88	166	5	21.6	1922	29[a]
ICCL-80026	F-378 x Rabat	88	167	4	21.4	1626	43[a]
73843-2-2H-LB-BH	L-550 x Pant G-104	87	163	4	20.7	1990	24[a]
7353-6-1-1P-1P-1H-BH	L-550 x BEG-482	90	169	2	17.1	2439	6[b]
ICCL-80006	L-550 x L-2	88	168	2	18.2	2524	3[a]
ICCL-80006	L-550 x L-2	86	167	2	18.3	2327	4
ICCL-80007	L-550 x L-2	88	167	4	21.4	1659	40
73235-5-2-1P-1P-1H-BH	F-378 x Rabat	84	165	5	22.2	1654	41
ICCL-80008	L-550 x K-468	90	167	4	22.1	2101	14[a]
7358-16-5-2H-1P-1H-BH	L-550 x H-223	85	167	5	21.6	1769	36[a]
7371-1-1-1H-1P-1H-BH	L-550 x No.42	95	167	2	15.7	1718	38
ICCL-80009	ICCL-80009	92	165	4	17.4	1881	32[a]
ICCL-80010	ICCL-80010	88	167	4	20.7	1899	31[a]
ICCL-80011	ICCL-80011	90	168	2	17.3	2391	8
ICCL-24	C-104 x (JG-221 x BEG-482)	93	166	4	19.6	2030	22
ICCL-80013	L-550 x (L-2 x BEG-482)	89	169	3	14.5	1643	42
ICCL-80014	(L-550 x GW-5/7) x (K-4 x L-550)	47	166	6	21.1	1023	48
741106-4H-1H-1H-BH	Ceylon-2 x L-550	92	168	4	18.2	2103	13
ICCL-80015	Ceylon-2 x L-550	92	167	3	20.6	1805	35
ICCL-80016	(L-550 x GW-5/7) x (K-4 x L-550)	92	165	4	16.4	1867	34
74765-9H-1H-1P-BH	L-550 x (L-2 x BEG-482)	94	170	4	19.3	1754	37
	L-550	86	167	6	20.7	727	49[a]
	L-550	84	166	5	22.1	1172	46
	L-550	85	167	6	23.5	1053	47
	H-208	90	164	2	12.8	2592	2
Mean		88	167	4	20.3	1942	
CD(.05)		3.2	3.3	2.6	2.85	654.1	
CV%		2.2	1.2	45.9	8.7	20.8	

[a] **Selected for trials in 1981-82.**
[b] **Selected for coordinated trials.**

Table 2.20. Characteristics of entries in Advanced Trial-2 at Hissar in 1980/81.

Selection number	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
7358-4-3-1P-1P-1P-BP	L-550 x K-4	92	169	4	24.9	2116	3[a]
7369-2-1-1P-1P-1P-BP	L-550 x USA-613	90	170	5	20.0	1339	25
7385-1-1-1H-1P-1P-BP	L-550 x L-2	87	162	6	21.2	1584	17
7385-6-2-1P-1P-1P-BP	L-550 x L-2	87	164	7	20.9	1089	32
7370-8-3-1P-1P-BP-BP	L-550 x GW-5/7	47	168	6	28.4	1711	13[a]
73235-5-1-1P-LB-1P-BP-BP-BP	F-378 x Rabat	90	167	5	19.8	1633	15
751233-BP-BH	JG-62 x NEC-141	90	167	7	20.5	571	35
751244-BP-BH	C-214 x NEC-108	87	170	3	15.2	1721	12
752690-BP-BP	(K-850 x WFWG-III) x (P-4206 x K-286)	92	169	6	22.6	1172	29
75812-BP-BH	(NP-34 x P-9623)	47	167	7	21.4	1157	30
75849-BP-BH	P-1231 x GL-629	90	169	4	19.8	1763	9[a]
7626-BP-BH	JG-62 x K-56567	86	167	3	23.3	2082	4[a]
7348-18H-1H-BH	C-235 x L-550	86	169	3	15.6	1734	11[b]
75485-11H-1H-BH	P-388 x (T-3 x P-836)	89	167	5	25.5	2144	2[b]
751661-11H-1P-BH	L-550 x NEC-1108	89	169	3	20.1	1984	6[a]
752601-2H-1P-BH	F-4(P-1786 x C-214) x F_4(L-550 x E-100)	92	168	4	15.2	1546	18
752601-2H-2P-BH	F-4(P-1786 x C-214) x F_4(L-550 x E-100)	96	170	2	15.7	2012	5[a]
73360-1H-4P-BH	(K-4 x WFWG-III) x (L-532 x P-42)	88	169	6	19.6	1345	24
7379-BH-2-1P-1H-1H-BH	F-370 x L-550	93	170	5	23.1	1436	21
7461-B-1H-B-1H-2H-BH	(K-850 x K-468) x (Chafa x K-4)	90	168	5	19.5	1530	19
7380-B-3H-1H-BH	F-404 x L-550	93	169	3	13.6	1822	7
GL-629		89	167	6	18.2	1294	27
L-532		98	162	7	17.0	934	34
752281-1P-1H-BH	F_3(JGC-1 x L-144)-3 x F_3(GW-5/7 x L-550)-3	88	169	6	18.5	1119	31
75439-1H-BP-BH	NEC-143 x (F-317 x NEC-240)	90	169	3	10.1	1368	23
75360-8H-2P-BH	(K-4 x WFWG-III) x (L-532 x P-472)	83	166	6	14.4	1040	33

Contd....Table 2.20

Selection number	Pedigree	Days to 50% flowering	Days to maturity	Disease score	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
75406-6P-1H-BH	L-550 x (C-214 x NEC-108)	87	167	2	20.7	2501	1
7348-18H-1H-BH	C-235 x L-550	82	166	8	23.0	1610	16[a]
75393-3P-1H-BH	K-4 x (NEC-143 x C-214)	86	165	5	21.2	1708	14[a]
7358-8-2-B-BH	L-550 x K-4	84	166	4	22.9	1739	10
7347-6-4-B-BH	L-550 x G-130	88	167	5	21.3	1289	26
7385-17-2-B-BH	L-550 x L-2	89	165	8	17.7	1227	28
7369-5-3-1P-BP	L-550 x USA-613	90	167	9	20.3	485	36
	H-208	85	167	7	11.7	1403	22
	L-550	88	164	7	20.6	1768	8
	L-550	87	164	5	23.0	1498	20
Mean		86	167	5	19.6	1512	
CD		3.0	3.4	2	2.50	583.6	
CV%		2.1	1.2	26.1	7.5	23.9	

[a] Selected for trials in 1981-82.

[b] Selected for coordinated trials.

Table 2.21. Selection numbers and parentage of kabuli ICCL entries

ICCL number	IC number	Pedigree
80006	7385-15-1-1H-1P-1H-BH	L-550 x L-2
80007	7385-2-2-2P-1P-1H-BH	L-550 x L-2
80008	7357-12-3-2H-1P-1H-BH	L-550 x K-468
80009	7338-2-4-1H-1P-1P-BH	H-208 x C-104
80010	7385-15-1-1H-1P-2P-BH	L-550 x L-2
80011	7387-3-3-2H-BH-1P-BH	L-550 x E-100
80012	74698-1H-1H-1H-BH	C-104 x (JG-221 x BEG-482)
80013	74765-1H-1H-1H-BH	L-550 x (L-2 x BEG-482)
80014	74440-5P-1P-1H-BH	(L-550 x GW-5/7) x (K-4 x L-550)
80015	741106-4H-1H-2H-BH	Ceylon-2 x L-550
80016	74440-13P-1P-1H-BH	(L-550 x GW-5/7) x (K-4 x L-550)
80023	7338-1-1-1H-1P-1P-BH	H-208 x C-104
80024	7385-8-2-1P-2P-BH	L-550 x L-2
80025	7385-1-2-1H-1P-BH	L-550 x L-2
80026	73235-5-1-1P-LB-1-BP	F-378 x Rabat
80029	7358-7-3-BH-BH-2P-BP	L-550 x K-4
80030	7358-7-3-BH-BH-1P-BP-BP	L-550 x K-4

PROJECT 5 : BREEDING FOR ADAPTATION TO LATE SOWING

OBJECTIVES:

(a) To identify strains/cultivars which perform well under late sown conditions.

(b) To use these strains for the development of high yielding genotypes adapted to late planting.

INTRODUCTION

We continued screening germplasm and breeding materials for adaptation to late-sowing in north India, to tailor materials for double cropping systems in rotation with rice, cotton and maize. Late sowing may have advantages in reducing vegatative growth, which tends to be excessive in chickpea sown at the normal time from and October to mid November. However, delayed sowing beyond mid November, normally reduces yield, which must be compensated by additional inputs of fertilizer and irrigation, but these may be available in double cropping situations.

This year we selected desi and kabuli entries from the materials which had given consistently good seed yields under late-sown conditions in the three previous seasons, and compared them in trials sown late and at the normal time. We also continued the trial of contrasting genotypes normal-sown and late, to study the factors influencing adaptation to late sowing. We also made selections in crosses made for late sowing.

As with other materials at Hissar, severe damage was caused by *Botrytis*, so that yield data were highly variable and meaningful conclusions were not possible, but the tests will be repeated in 1981-82.

F_2 POPULATIONS

F_1/F_2 trial. A replicated trial of the F_1 and F_2 populations of 21 crosses made in 1979-80 (R.O.W.1979-80, Table 5.1) was sown at Hissar, following multiplication of the F_1 seeds in Kashmir during the off-season. The F_2 of IC-79512 was omitted due to shortage of seed. The trial was sown in a randomised block design with three replicates and also included eight parents and checks. The plot sizes were one (parents and F_1s) or two rows (F_2s), 4m long and 60 cm apart with 20 cm between plants within the rows. The data recorded included days to 50% flowering, seed yields and a rating for disease.

Coefficients of variation were high for seed yield and the disease rating and seed yields were poor (Table 5.1) but there were significant differences among entries for all three characters. The correlations between F_1s and F_2s for disease score and seed yield were positive and highly significantly greater than zero ($r = 0.63$ and 0.68, $P < 0.01$, respectively) so there was good agreement between F_1 and F_2 performance. The highest yielding crosses were IC-79520 and -79515. The occurrence of a highly significant negative correlation between disease score and seed yield suggested that yields were reduced by heavier disease damage.

Table 5.1. Characteristics of entries in F_1/F_2 trial for late planting at Hissar in 1980-81.

IC. no.	Parentage/name	Days to 50% flowering		Disease score		Seed yield (kg/ha)	
		F_1	F_2	F_1	F_2	F_1	F_2
79510	H-208 x 7332-7-3-B-BH	82.2	84.5	5.0	2.0	672	869
79511	H-208 x 73126-6-2-B-BH	83.0	84.2	3.0	**4.5**	864	825
79512	H-208 x 7357-22-3-B-BH	83.2	-	4.5	-	895	-
79513	H-208 x 73111-7-2-B-BH	83.8	83.2	6.0	4.2	558	888
79514	H-208 x 73308-1-1-1H-BH	82.0	82.5	6.0	3.5	621	862
79515	H-208 x G-543	82.8	83.2	3.8	2.8	1042	1022
79516	H-208 x NEC-989	81.5	81.8	2.5	4.5	905	1062
79517	H-208 x P-1784-1	82.2	81.8	4.2	5.2	736	950
79518	H-208 x K-850	82.5	82.5	4.5	6.0	950	568
79519	K-850 x 7332-7-3-B-BH	81.5	82.5	7.5	5.5	680	820
79520	K-850 x 7388-4-1-2P-BP	81.5	81.0	5.2	5.5	1137	1200
79521	K-850 x 73126-6-2-B-BH	82.8	82.2	4.5	4.8	1264	848
79522	K-850 x 7357-22-3-B-BH	81.5	82.0	5.5	5.0	571	815
79523	K-850 x 73308-1-1-1H-BH	81.2	82.0	3.5	3.5	1281	832
79524	K-850 x NEC-989	81.0	81.2	3.7	5.0	822	710
79525	L-550 x Hyb 16-3	82.5	81.8	8.0	5.2	416	617
79526	L-550 x 7346-9-2-BP-BP	82.8	81.2	7.2	5.5	292	442
79527	L-550 x 7358-6-2-BH-BP	82.8	81.0	8.2	8.2	188	268
79528	L-550 x No.501	82.5	82.2	7.2	6.5	461	392
79529	L-550 x H-208	83.0	81.8	7.5	6.8	320	460
79530	L-550 x K-850	81.5	82.0	8.0	7.8	586	351
Parents and checks							
73213-9-3-B-BH	GW-5/7 x H-223	81.5		7.0		170	
7357-22-3-B-BH	L-550 x K-468	83.8		5.2		796	
73111-8-2-B-BP-BH	K-850 x H-208	88.0		6.5		309	
7325-11-2-1H-3H-BH	H-208 x F-404	81.5		2.8		1048	
7387-3-3-BH-BP	L-550 x E-100	84.0		2.0		474	
	BG-203	82.2		8.0		258	
	ICCC-2	82.2		6.5		698	
	H-208	81.2		3.2		755	
Mean		82.4		5.3		706	
S.E.		0.66		0.96		161.7	
C.V.%		1.6		36.3		45.8	

F_2 populations. F_2s of the same 21 crosses were also sown in non replicated plots, each of 50 rows 4m long and 60 cm apart and 733 single plants were selected for progeny rows in 1981-82 (Table 5.2).

Table 5.2. Numbers of single plants selected in F_2 populations at Hissar in 1980-81.

IC no.	No. of single plants	IC no.	No. of single plants
79510	47	79521	31
79511	32	79522	42
79512	27	79523	37
79513	31	79524	39
79514	29	79525	36
79515	30	79526	30
79516	26	79527	35
79517	41	79528	28
79518	43	79529	31
79519	33	79530	50
79520	35		

Contrasting genotypes

The trial of contrasting genotypes was in the same form as in previous years. The 12 entries were the same and the layouts were randomised complete blocks with 4 replicates and a plot size of 8 rows 4m long and 30 cm apart. Days to 50% flowering, seed size and seed yield were recorded and each plot rated for disease damage on a scale of 1 to 9. The data are summarised in Table 5.3.

Flowering was earlier in the normal sown trial, due principally to the earlier entries flowering very much sooner in the normal sowing than in the late sown trial. In contrast the later entries flowered earlier in the late sown trial than in the normal sowing.

Disease levels were similar in both sowings and there were significant differences in disease ratings among entries. IC-7332-7-3-B-BH, H-208 and G-130 exhibited the least damage and Pant G-121 and K-850 were the worst.

Table 5.3. Characteristics of entries in normal (N) and late (L) sown trials of contrasting genotypes at Hissar in 1980-81.

Entry	Days to 50% flowering		Disease score		Weight of 100 seeds (g)		Seed yield (kg/ha)	
	N	L	N	L	N	L	N	L
7332-7-3-B-BH	88.5	83.3	5.3	5.8	13.6	15.8	1587	230
7358-5-2-B-BH	92.5	84.3	7.5	7.8	22.8	18.5	690	111
73213-9-3-B-BH	61.0	78.3	5.3	7.3	16.3	18.6	1274	385
Annigeri	48.5	76.0	6.8	7.0	19.7	21.3	731	298
G-130	95.0	83.5	6.3	5.0	15.3	17.1	957	441
H-208	87.8	83.3	4.3	6.3	13.5	14.1	1206	453
JG-62	51.8	77.0	8.5	9.0	20.9	15.8	952	340
Pant G-121	73.3	81.3	8.5	8.8	15.1	15.1	609	95
K-850	78.8	81.3	8.3	8.8	29.0	24.4	841	381
Giza	49.5	76.5	7.5	8.5	18.0	15.2	235	148
L-550	80.0	73.3	6.0	7.8	22.0	22.8	1439	615
Rabat	91.5	82.3	6.5	6.8	29.0	26.8	1057	172
Mean	74.8	80.0	6.7	7.4	19.6	18.8	965	306
CD(.05)	13.43	2.59	2.45	1.12	4.67	5.26	579.0	214.0
CV%	12.5	2.3	25.4	10.6	16.6	19.5	41.7	48.7

Seed sizes were similar in the two sowings. There were significant differences among entries in both and the seed size of those with larger seeds in the normal sowing tended to be smaller when sown late. Seed yields were very variable. That of the normal sown trial was three times that of the late sown. There were significant differences among entries. In the normal sowing, IC-7332-7-3-B-BH gave the highest yield (1587 kg/ha) with L-550 (1439 kg) second. In the late sown trial, L-550 was top yielder with 615 kg seed per ha and H-208 ranked second (453 kg).

Comparison of seed yields across the four seasons 1977 to 1981 (Table 5.4) indicated some interactions between genotypes and seasons but interactions between genotypes and sowing dates were generally small indicating the existence of broad adaptation to date of sowing within seasons. K-850, L-550, H-208, 7332-7-3-B-BH and G-130 performed best overall and Giza, Rabat, Pant G-121 and Annigeri gave generally poor yields.

Table 5.4. Seed yields and ranks (in parenthesis) of contrasting genotypes in normal(N) and late (L) sown trials at Hissar in four seasons, 1977-78 to 1980-81

Name/Sel.No.	1977-78		1978-79		1979-80	1980-81		Mean	
	N	L	N	L	N	N	L	N	L
7332-7-3-B-BH	2878(1)	2161(3)	433(8)	1165(3)	1951(2)	1587(1)	230(8)	1712(1)	1185(4)
7358-5-2-B-BH	1544(7)	1361(10)	532(7)	1014(4)	1563(7)	690(10)	111(11)	1082(8)	829(8)
73213-9-3-B-BH	2829(6)	1472(7)	385(9)	682(11)	1946(3)	1274(3)	385(4)	1608(4)	846(7)
Annigeri	1104(10)	1600(6)	269(12)	590(12)	1361(9)	731(9)	298(7)	864(10)	829(9)
G-130	2692(2)	1925(4)	291(11)	785(9)	2495(1)	957(6)	441(3)	1609(3)	1050(5)
H-208	2087(4)	2347(2)	1048(2)	1012(5)	1840(5)	1206(4)	453(2)	1545(5)	1271(3)
JG-62	861(11)	1454(8)	1309(1)	912(7)	1343(10)	952(7)	340(6)	1116(7)	902(6)
Pant G-121	1242(8)	1430(9)	603(5)	423(10)	1704(6)	609(11)	95(12)	1039(9)	649(12)
K-850	2209(3)	2535(1)	751(4)	1436(2)	1863(4)	841(8)	381(5)	1666(2)	1451(1)
Giza	257(12)	1171(12)	384(10)	875(8)	382(12)	234(12)	148(10)	314(12)	731(11)
L-550	1928(5)	1771(5)	913(3)	1588(1)	1397(8)	1439(2)	615(1)	1419(6)	1325(2)
Rabat	1232(9)	1292(11)	573(6)	1006(6)	637(11)	1057(5)	172(9)	875(11)	823(10)
Mean									
CD(.05)									
CV									

Desi lines

Forty five desi lines, fifteen from each of Trials A, B and D in the previous three years, were compared with the checks, G-130, Annigeri, K-850 and ICCC-2 in normal and late sown trials. The trials were 7x7 quadruple lattices with 4 replications. The plot size was 4 rows, 4m long and 30 cm apart. Days to 50% flowering and to maturity and seed yields were recorded and a disease rating was carried out.

Overall there was no effect of sowing date on time to flowering but, as with the trial of contrasting genotypes, short duration lines were considerably delayed by late sowing while long duration genotypes flowered sooner (Table 5.5). The later planting was more severely affected by disease than the early planting which must partially account for its reduced seed yield, which was only one fifth of the early sown trial. Seed yields differed significantly among entries in both sowings. IC-7388-4-1-2P-BP gave the highest seed yield (826 kg/ha) in the late sown trial, followed by -7394-18-3-1P-BP (664 kg), both having K-850 as a parent. In the normal sown trial G-543 gave the highest yield (2311 kg) with NEC-989 second (2289 kg) and IC-7388-4-1-2P-BP, third (2246 kg). Seed yields were closely associated with disease rating.

Table 5.5. Characteristics of desi lines in normal (N) and late (L) sown trials at Hissar in 1980-81.

Selection number	Parentage	Days to 50% flowering		Days to maturity		Disease score		Seed yield (kg/ha)	
		N	L	N	L	N	L	N	L
73111-8-2-B-BP	K-850 x H-208	87.6	86.0	165		5.8	6.8	1819	154
73128-10-1-2P-LB-BP	JG-62 x F-378	49.6	70.6	164		5.8	9.0	1098	299
7362-5-2-1P-BP	L-550 x B-110	71.7	78.7	164		5.0	7.0	1317	355
73167-5-3-B-BP	JG-62 x F-496	72.3	80.2	162		6.8	6.8	1413	343
73152-3-2-B-BP	JG-62 x USA-613	58.5	76.7	163		7.0	9.0	1429	317
7389-18-3-B-BP	K-850 x F-378	80.4	77.2	168		8.0	7.3	790	224
73167-8-1-1H-BP	JG-62 x F-496	76.8	77.4	160		7.8	8.8	932	178
73187-3-3-3H-BH	G-130 x JG-24	93.0	83.4	164		4.0	6.8	1501	113
7394-18-3-1P-BP	K-850 x No.59	50.5	74.9	163		4.0	9.0	1256	664
7388-4-1-2P-BP	K-850 x F-61	85.9	80.4	164		2.5	6.5	2246	826
74279-B-5P-LB-BP	(K-850 x T-3) x P-4245-1	52.8	77.3	164		6.0	9.0	1140	267
7472-B-5H-LB-BP	(F-61 x L-550) x P-272	90.3	78.9	163		4.5	6.5	1668	375
737-14-2-B-BP	H-208 x BG-1	90.8	81.8	165		4.5	6.0	1849	453
7389-20-3-B-BP	K-850 x F-378	50.7	76.9	164		6.3	8.5	968	392
7389-32-2-B-BP	K-850 x F-378	49.6	78.8	165		4.3	8.5	1195	563
73111-8-1-B-BH	K-850 x H-208	87.0	84.4	163		5.5	8.5	1270	315
73111-7-2-B-BH	K-850 x H-208	89.5	81.9	164		4.5	7.8	1707	408
7332-11-4-2H-BH	H-208 x F-370	95.1	86.7	164		5.0	5.8	1285	331
7332-12-4-1H-BH	H-208 x F-370	96.1	86.8	165		3.3	5.0	2023	225
7320-11-1-1H-BH	H-208 x RS-11	94.6	84.8	165		5.0	6.3	1697	414

Contd....Table 5.5.

Selection number	Parentage	Days to 50% flowering		Days to maturity		Disease score		Seed yield (kg/ha)	
		N	L	N	L	N	L	N	L
7343-10-2-1H-BH	H-208 x USA-613	94.3	86.3	163		4.5	8.8	1358	115
73213-9-3-1H-BH	GW-5/7 x H-223	89.4	82.6	167		2.8	6.8	1378	61
7339-3-2-1P-BH	H-208 x E-100	92.2	83.6	163		5.5	6.3	1292	513
7357-22-3-B-BH	L-550 x K-468	80.7	86.1	163		6.0	7.8	1389	221
73126-6-2-B-BH	K-850 x E-100	86.8	80.6	164		6.3	8.3	1658	323
731-8-3-B-BH	H-208 x F-61	91.3	82.4	164		4.0	5.8	1686	366
73308-1-1-1H-BH	F-378 x USA-613	89.8	83.2	164		3.8	7.0	1731	288
73304-10-4-2H-BH	Radhey x Bengal	91.5	85.5	166		5.5	5.8	1507	321
7339-3-3-1H-BH	H-208 x E-100 gram	91.2	86.5	163		3.8	5.0	1783	458
7325-11-2-1H-BH	H-208 x F-404	89.4	80.7	165		4.5	5.3	1353	227
P-326		91.3	88.6	165		5.3	4.8	2163	88
BG-203		89.4	81.9	163		5.5	6.5	1351	312
NEC-989		93.8	85.3	165		3.8	4.3	2289	570
G-543		88.5	84.7	166		4.3	6.0	2311	344
H-208		89.5	82.8	166		4.3	6.0	1557	604
P-840		91.3	82.1	163		2.8	6.0	1997	339
Pant G-113		90.7	84.0	164		4.3	7.3	2052	353
P-946		89.9	82.6	166		3.3	4.3	1657	246
K-468		82.7	85.8	162		5.3	6.8	1716	278
NEC-2368		95.6	90.9	165		3.5	4.5	1758	278
F-61		90.4	83.4	163		5.5	5.8	1571	144
H-355		92.5	85.2	166		4.0	4.8	1642	469
C-214		96.5	86.0	166		5.0	5.8	1268	277
P-127		80.5	79.4	166		8.5	9.0	1811	98
HMS-8		89.4	82.2	166		5.0	6.5	1159	560
G-130		93.1	86.3	167		5.8	4.3	962	365
Annigeri		50.1	76.5	166		5.8	7.5	1280	324
K-850		80.2	80.1	164		4.5	8.8	1401	460
ICCC-2		92.8	84.0	165		3.5	7.3	1757	330
Mean		83.4	82.3	164		4.9	6.8	1540	338
CD(.05)		8.90	3.03	2.7		2.06	1.64	768.3	274.2
CV%		7.6	3.0	1.2		29.8	17.3	35.6	54.8

Kabuli lines

Twenty kabuli lines which had performed well under late-sown conditions in Trial C in the three previous years were compared with L-550 and four other lines in a 5x5 triple lattice trial with three replications. The plot size, spacing and data recorded were the same as the trials of desi lines.

Flowering was delayed in the early sown trial as all the kabulis were late and flowered earlier in the late sowing (Table 5.6). Disease damage was again higher in the late-sown trial and there were significant differences among entries only in the late sowing. Seed yields were lower than in the desi trial and even more depressed by late sowing, which was also extremely variable. The highest seed yield under late sown conditions was 510 kg/ha, from IC-7358-3-2-BP-BP.

Correlations among characters

Correlations between disease score and seed yield were usually negative and significantly different from zero indicating that disease depressed seed yield (Tables 5.7 to 5.9). Early flowering genotypes tended to show higher disease scores. Other correlations were either absent or inconsistent and were in all cases small.

Germplasm evaluation

In collaboration with Pulse Physiology we evaluated 500 germplasm accessions under normal and late-sown conditions. The normal sown set was grown under high and normal fertility conditions to identify genotypes with reduced tendency to excessive vegetative growth. Yields were depressed by Botrytis in all the sets and interfered considerably with the intended comparisons. ICC-547 , -1011, -2215, -2248, -2410, -3223, -3414, -6282, -6819, -10052, -10590, -11092 and -11097 showed less disease damage in both normal and late-sown conditions; and ICC-2328, -3221 and -10589 and ICCC-6 when sown late.

Table 5.6. Characteristics of kabuli lines in normal(N) and late(L) sown trials at Hissar, in 1980-81.

Selection/Name	Parentage	Days to 50% flowering		Disease score		Seed yield (kg/ha)	
		N	L	N	L	N	L
7385-1-1-B-BP	L-550 x L-2	89	82	4.3	8.7	1000	142
7385-10-2-BH-BP	L-550 x L-2	93	82	3.7	7.7	714	115
7387-3-3-BH-BP	L-550 x E-100	95	84	3.0	6.3	955	198
7858-3-2-BP-BP	L-550 x K-4	90	81	3.7	5.7	870	510
73235-5-1-1P-BP	F-378 x Rabat	90	81	4.0	8.3	831	149
7369-3-1-1P-BH	L-550 x USA-613	88	82	5.0	8.3	960	78
7358-6-2-BH-BP	L-550 x K-4	90	80	4.7	9.0	955	15
7358-7-1-BH-BP	L-550 x K-4	87	86	4.0	8.0	904	69
7384-12-3-BH-BP	L-550 x Pant G-104	95	82	4.0	7.7	951	31
7385-17-3-B-BP	L-550 x L-2	91	82	4.0	8.0	1062	94
7369-5-3-1P-BP	L-550 x USA-613	93	82	4.0	6.3	888	156
73242-17-2-1H-BP	K-4 x L-144	96	85	4.7	9.0	912	59
7375-15-1-BP-BP	L-550 x CP-66	96	83	4.0	8.7	957	42
7358-11-3-B-BP	L-550 x K-4	92	84	5.0	7.3	885	104
C-104		97	83	4.0	8.0	882	118
L-550		95	83	3.7	7.0	913	132
Hyb-16-3		94	84	4.3	7.7	946	56
Rabat		96	84	4.7	8.7	754	26
GL-629		96	83	2.7	5.7	789	208
P-6613		97	84	3.0	7.7	710	109
K-4		99	87	3.7	5.3	635	347
74461-1P-1P-1H-1H-BH	(JG-62 x G-130) x (K-850 x Chafa)	87	82	3.7	8.0	863	57
74440-12P-1P-1H-1H-BH	(L-550 x GW-5/7) x (K-4 x L-550)	89	81	4.0	7.0	923	66
74440-13P-1P-1H-1H-BH	(L-550 x GW-5/7) x (K-4 x L-550)	89	80	4.0	8.0	939	222
74440-12P-1P-2H-1H-BH	(L-550 x GW-5/7) x (K-4 x L-550)	93	83	4.3	8.0	817	28
Mean		93	83	4.0	7.6	881	125
CD(.05)		4.3	2.8	1.96	1.97	377	153
CV%		2.9	2.1	29.8	15.8	26.1	74.5

Table 5.7. Correlations among characters in normal (upper diagonal) and late (lower diagonal) sown trial of contrasting genotypes at Hissar, 1980-81.

	Days to 50% flowering	Disease score	Weight of 100 seeds	Seed yield
Days to 50% flowering		-0.22	0.46**	0.26
Disease score	-0.31*		0.20	-0.55**
Weight of 100 seeds	-0.18	-0.56**		-0.49**
Seed yield	-0.29*	-0.24	0.16	

Table 5.8. Correlations among characters of desi lines in normal (upper diagonal) and late (lower diagonal) sown trials at Hissar, 1980-81.

	Days to 50% flowering	Days to maturity	Disease score	Seed yield
Days to 50% flowering		0.11	-0.24**	0.24**
Days to maturity			0.18**	-0.14*
Disease score	-0.42**			-0.56**
Seed yield	-0.18**		-0.18**	

Table 5.9. Correlations among characters of kabuli lines in normal (upper diagonal) and late (lower diagonal) sown trials, at Hissar in 1980-81.

	Days to 50% flowering	Disease Score	Seed yield
Days to 50% flowering		-0.18	-0.25*
Disease score	-0.14		-0.19
Seed yield	-0.10	-0.61**	

PROJECT 6 : DEVELOPMENT OF HIGH PROTEIN BREEDING LINES

OBJECTIVES : a. To breed lines with higher seed protein content and better amino acid profile

b. To breed lines with better consumer acceptance.

INTRODUCTION

Monitoring of seed protein percentage of germplasm and breeding lines continued. Crosses with new high protein line T-1-A were advanced.

SEED PROTEIN PERCENTAGE

The biochemistry unit determined the protein percentages of seed of entries grown in the 1979/80 crossing block and various other trials and nurseries at different locations in 1979/80 and 1980/81.

Crossing block, 1979/80

The seed protein percentages were determined of 397 germplasm and breeding lines in the 1979-80 crossing block (Table 6.1). The range was essentially similar to last year, although lower and upper limits were a unit lower, which could reflect seasonal effects. T-1-A was the highest protein line as in previous years.

Coordinated trials, 1979/80

The biochemistry unit also determined seed protein percentages of entries in the GIET and GCVT sown with inoculated and uninoculated seed in the same fields at Hyderabad in 1979-80. Seed from the uninoculated GIET was significantly higher in protein percentage than the inoculated trial (Table 6.2) but there were no differences between the uninoculated and inoculated GCVT (Table 6.3). In GIET there were no differences among entries (Table 6.4) but in GCVT Annigeri was significantly lower in seed protein than most other entries (Table 6.5). Interactions between trials and entries were absent.

Table 6.1. Seed protein content of crossing block entries grown at Hyderabad, 1979-80.

ICC/ Sel no.	Name/ parentage	Protein %	ICC/ Sel no.	Name/ parentage	Protein %
Desi types					
4918	Annigeri	17.8		HMS-10	21.7
5006	Attock-234	26.4		HMS-11	22.5
12230	B-106	24.2		HMS-12	21.2
4919	B-108	24.2		HMS-13	22.3
11141	BDN-9-3	22.0		HMS-14	24.8
4921	BG-1	24.7		HMS-15	22.3
8294	BG-203	27.2		HMS-16	21.0
11088	BG-212	25.2		HMS-17	22.8
5689	BN-9	19.7		HMS-18	19.0
11172	C-22-1	23.3		HMS-19	23.7
4929	C-156	20.5		HMS-20	22.4
5050	C-169	20.5		HMS-21	24.1
4930	C-214	25.3		HMS-22	26.5
4935	C-235	27.4	11521	HMS-23	23.0
5063	Caina	24.9		HMS-24	22.6
4934	Chafa	23.8		HMS-25	23.0
10596	Coll-327	27.5		HMS-26	25.0
10130	CPS-1	23.7		HMS-27	23.4
4936	E-100	21.3		HMS-28	24.3
5097	EC-21293	24.1		HMS-29	22.7
4939	F-61	23.6	11522	ICCC-1	21.7
4940	F-187	26.9	11523	ICCC-2	24.0
4942	F-272	27.4	11524	ICCC-3	25.8
4943	F-370	25.9	11525	ICCC-4	21.7
4949	F-378	26.0	11526	ICCC-5	23.7
4946	F-496	23.9	11528	ICCC-7	23.4
8282	FG-661	25.8	11530	ICCC-9	23.5
4948	G-130	22.0	11531	ICCC-10	25.3
4950	G-543	23.2	11532	ICCC-11	25.7
10829	G-549	25.4	11534	ICCC-13	20.6
	GG-549	24.6	11535	ICCC-14	20.9
4953	GW-5/7	21.5	11536	ICCC-15	21.6
4954	H-208	23.2	11537	ICCC-16	22.1
4955	H-223	22.6	11538	ICCC-17	20.9
4956	H-355	22,8	11539	ICCC-18	23.0
10805	H-556-1	23.6	11540	ICCC-19	22.0
	HMS-1	23.1	11541	ICCC-20	23.1
	HMS-2	22.3	11542	ICCC-21	22.9
	HMS-3	20.0	6067	JG-39	23.7
	HMS-4	21.7	4951	JG-62	20.9
	HMS-5	23.0	10034	JG-62(Leaf mutant)	24.6
11520	HMS-6	22.5	6094	JG-71	22.5
	HMS-7	22.4	6098	JG-74	24.6
	HMS-8	23.1	6121	JG-112	20.3
	HMS-9	21.1	4961	JG-221	22.2

Contd....Table 6.1

ICC/ Sel no.	Name/ parentage	Protein %	ICC/ Sel no.	Name/ parentage	Protein %
8457	JM-477-1	26.3	104	P-82	24.4
8542	JM-583	24.3	121	P-99	24.3
4963	K-468	22.4	151	P-127	26.0
	K-56567	24.3	154	P-129	23.2
7509	Kaka	22.3	190	P-156	23.8
5314	LG-1227	22.2	229	P-180-1	23.2
11196	LJR-133-1	23.4	267	P-212-1	23.4
5061	Ludhiana-30	22.2	308	P-236-2	23.5
8932	N-31	22.3	341	P-255	24.1
4984	N-59	23.8	346	P-258	22.0
6153	NEC-18	24.6	363	P-270-1	19.9
6285	NEC-177	26.6	365	P-272	21.7
7734	NEC-240	26.4	400	P-296	23.6
7735	NEC-249	23.6	418	P-310-1	23.4
6364	NEC-308	24.8	435	P-319-1	21.8
8970	NEC-318	24.2	438	P-324	22.0
6371	NEC-321	24.6	440	P-326	24.4
6433	NEC-417	22.0	459	P-345	20.0
9003	NEC-431	25.0	460	P-345-1	24.5
9009	NEC-451	23.6	492	P-372-3	20.7
6462	NEC-472	26.0	517	P-392-1	20.8
6509	NEC-555	24.7	539	P-424	23.4
9060	NEC-578	26.4	546	P-427	24.0
6524	NEC-584	24.2	552	P-436	24.6
9070	NEC-607	21.2	554	P-436-2	24.2
6563	NEC-639	24.5	575	P-453-2	21.4
7749	NEC-695	22.6	638	P-500	23.3
9080	NEC-701	22.8	640	P-502	25.1
6626	NEC-714	24.0	645	P-505	20.3
9085	NEC-746	23.4	726	P-573	22.4
6679	NEC-802	21.3	804	P-636	24.8
6708	NEC-850	25.4	867	P-690	22.4
6743	NEC-900	23.9	926	P-735-1	25.3
6805	NEC-970	26.5	947	P-744-2	25.7
6808	NEC-974	24.3	954	P-753	24.0
9202	NEC-1421	20.2	1009	P-840	25.7
7266	NEC-1639	25.3	1030	P-861	22.9
8158	NEC-2305	24.3	1035	P-868	24.8
8181	NEC-2330	27.5	1043	P-876	23.0
8209	NEC-2368	25.5	1074	P-923	25.2
8241	NEC-2404	24.6	1082	P-946	23.0
8250	NEC-2413	27.0	1087	P-949	22.3
8252	NEC-2415	25.4	1097	P-966	22.2
9686	NEC-2635-1	22.1	1104	P-986	21.5
5402	NP-81	19.7	1109	P-992	28.4
25	P-18	21.2	1110	P-993	26.2
38	P-30	22.7	1134	P-1027-1	24.9
43	P-36	20.7	1140	P-1037	23.2
57	P-45	24.7	1143	P-1041-1	24.0

Contd....Table 6.1

ICC/ Sel no.	Name/ parentage	Protein %	ICC/ Sel no.	Name/ parentage	Protein %
1144	P-1042	25.4	3651	P-4301	21.4
1149	P-1051	24.5	3684	P-4321-2	24.0
1156	P-1067-1	21.1	3735	P-4353-1	20.7
1160	P-1071-1	25.7	3839	P-4477	24.9
1164	P-1081-1	25.0	3881	P-4549	23.9
1166	P-1092	23.0	3926	P-4614	24.5
1197	P-1116-1	23.3	4149	P-4968	23.4
1314	P-1198	21.7	4454	P-5462	20.8
1315	P-1198-1	22.2	4464	P-5482	19.3
1342	P-1209-1	25.2	4519	P-6067	22.9
1400	P-1245-1	21.4	4544	P-6090	25.0
1449	P-1269	22.2	4552	P-6099	24.1
1457	P-1273-1	20.3	4562	P-6108	23.0
1516	P-1302	21.8	4649	P-6240-1	19.3
1611	P-1353	20.3	4651	P-6244	24.3
1743	P-1434	25.4	4717	P-6308-1	22.8
1749	P-1437	24.4	7566	P-9656	24.0
1844	P-1488-1	23.3		P-10139	22.9
1856	P-1497	24.5		P-10140	22.8
1909	P-1539-1	26.5	4989	Pant G-104	23.5
1966	P-1590	24.6	10136	Pant G-114	22.2
1994	P-1613	23.5	10137	Pant G-115	21.2
2041	P-1642	26.2	11101	Pant G-12	23.7
2077	P-1675	19.6	5415	Pb-14	24.3
2191	P-1766	24.9	10080	PG-72-8	22.0
2204	P-1774	24.7	10081	PG-72-84	21.9
2210	P-1781	25.5	12198	Phule G-3	18.1
2217	P-1786	25.7	12199	Phule G-4	23.4
2230	P-1798	25.0	5434	Ponaflor-2	22.1
2233	P-1805	23.4	10894	PP-1	25.2
2254	P-1841-1	24.1	4994	Radhey	19.9
2267	P-1863	25.0	10919	RPSP-322-1	21.6
2334	P-2019-1	24.5	4992	RS-11	24.4
2344	P-2035	24.9	8589	SL-972-A	21.7
2388	P-2161	26.6	8397	T-1-A	29.0
2548	P-2520	23.7	4998	T-3	22.3
2784	P-2974	22.0	5864	T-3 Gwalior	22.4
2927	P-3327	24.0	883	T-32	24.9
3145	P-3665-1	20.3	5948	T-68	20.7
3175	P-3720	21.8	6001	T-120	20.6
3210	P-3765	22.4	5001	USA-613	22.4
3351	P-4024-1	20.2	5486	V-27	24.5
3396	P-4083	23.2	5585	V-165	20.0
3405	P-4089	21.0	8619	WP-2654-A	17.0
3500	P-4203	22.9	8933	WR-315	20.1
3533	P-4235-1	21.4	10379	RS-11 x GNR-114	22.3
3637	P-4292	23.4	5591	WF-32-33 x V-746-533	23.5

Contd....Table 6.1

ICC/Sel no.	Name/parentage	Protein %
506-EB-EB	P-386 (BEG-78)	22.5
1981-EB-EB	P-1603-1	24.7
2446-EB-EB	P-2224-2	23.5
2793-EB-EB	P-2990	22.0
3316-EB-EB	P-3959	22.2
3340-EB-EB	P-3999-1	26.5
3474-EB-EB	P-4160	25.4
3928-EB-EB	P-4617	21.0
3999-EB-EB	P-4702	23.6
4767-EB-EB	P-6410	20.7
5264-EB-EB	GL-645	23.8
5634-EB-EB	Ludhiana-3	22.5
5800-EB-EB	Gram 21 Ujjain	26.1
6663-EB-EB	NEC-764	24.9
1381-EB-EB	P-1234-1	21.9
731-9-2-B-EB	H-208 x F-61	25.9
73129-24-1-1H-B-EB	JG-62 x Radhey	22.9
73167-5-3-B-EB-EB	JG-62 x F-496	22.6
73179-24-1-1H-B-EB	G-130 x P-5409	19.7
73266-3-4-1P-EB-EB	Chafa x T-3	22.4
737-18-1-B-BH	H-208 x BG-1	22.9
738-8-1-1P-BP	H-208 x BEG-482	21.8
739-6-1-B-BP	H-208 x Pant G-104	23.6
7313-2-3-1H-BH-BH	H-208 x Chafa	24.8
7325-11-1-1H-BH	H-208 x F-404	23.3
7332-7-2-B-BH	H-208 x F-370	24.3
7341-8-1-B-BP	H-208 x N-59	20.4
7343-14-3-B-BH-BH-BP	H-208 x USA-613	23.9
7357-12-3-B-BH	L-550 x K-468	22.4
7357-22-3-B-BH-BP	L-550 x K-468	19.5
7362-5-2-1P-BP	L-550 x B-110	21.2
7380-1-1-B-BH-BH	L-550 x F-496	24.3
7389-18-3-B-BP	K-850 x F-378	21.6
7389-18-5-B-BH	K-850 x F-378	22.9
7389-18-6-B-BH-BH	K-850 x F-378	19.9
7389-20-3-B-BP	K-850 x F-378	21.8
7389-32-2-B-BH-BH	K-850 x F-378	24.2
7394-14-2-B-BP	K-850 x N-59	20.7
7394-18-2-1P-BP	K-850 x N-59	21.7
73111-8-2-B-BP	K-850 x H-208	25.8
73111-7-2-B-BH-BH	K-850 x H-208	24.6
73111-8-3-B-BH	K-850 x H-208	26.1
73114-16-2-LB-BP	K-850 x GW-5/7	23.4
73129-16-1-B-BP	JG-62 x Radhey	22.5
73129-16-2-B-BP	JG-62 x Radhey	23.4
73136-31-4-1H-BP	JG-62 x BEG-482	22.1
73154-12-1-1P-BP	JG-62 x No.42	22.7
73167-1-1-2H-B-BH	JG-62 x F-496	21.4
73167-5-3-B-BP	JG-62 x F-496	22.5
73167-5-3-B-BH-BH-BP	JG-62 x F-496	19.1

Contd....Table 6.1

ICC/Sel no.	Name/parentage	Protein
73187-3-3-3H-BP	G-130 x JG-24	21.5
73241-3-1-1P-LB-BP	Chafa x JGC-1	20.3
73307-8-1-B-BH	K-468 x F-378	20.7
73367-11-4-1P-BH-BH	JG-62 x H-208	20.9
7588-40-BP	H-208 x K-1258	24.5
1432	5622	24.3
Kabuli types		
4928	C-104	23.2
10755	CRIC-35168	23.6
7773	G-129	24.5
5244	GL-622	25.2
5250	GL-629	23.8
5270	GL-651	25.9
8284	Hyb-16-3	24.8
8466	JM-466	23.9
8465	JM-482	23.4
8921	K-1174	22.8
8922	K-1184	22.8
8923	K-1189	25.3
8924	K-1258	25.2
7512	Kourosh	24.6
5654	Ludhiana-23	23.8
	L.Local PM	22.5
7709	NEC-10	23.7
6165	NEC-30	22.0
7710	NEC-34	22.1
7721	NEC-139	23.0
7723	NEC-143	24.4
6283	NEC-175	25.6
6375	NEC-329	22.4
7775	NEC-1604	22.5
7267	NEC-1640	23.0
7290	NEC-1663	22.9
7848	NEC-1831	21.9
8024	NEC-2147	23.6
8149	NEC-2296	23.9
8265	NEC-2438	23.9
4983	No.501	23.5
537	P-422	27.0
2351	P-2059-1	21.9
2407	P-2178-1	22.4
2452	P-2236	21.7
2573	P-2263	21.9
2473	P-2265	22.4
2554	P-2530	22.9
2584	P-2591	21.2
2692	P-2759	23.2
3010	P-3482	24.2
4840	P-6613	24.1

Contd....Table 6.1

ICC/Sel no.	Name/parentage	Protein
4854	P-9623	22.4
7564	P-9635	20.8
7572	P-9682	23.2
4907	P-9800	25.6
11142	P-9847	25.3
11553	P-10177	23.9
4993	Rabat	22.2
7347-6-4-B-BH	L-550 x G-130	22.2
7358-3-2-B-BH	L-550 x K-4	22.2
7358-8-2-B-BH	L-550 x K-4	24.4
7358-11-3-B-BP	L-550 x K-4	18.6
7369-5-3-1P-BP	L-550 x USA-613	21.6
7376-15-2-1H-BP	L-550 x CP-66	20.8
7378-18-5-2H-BP	L-550 x H-223	23.1
7385-10-2-BH-BP	L-550 x L-2	21.5
7385-17-2-B-BH	L-550 x L-2	21.5
7387-3-3-BH-BP	L-550 x E-100	23.1
Mean		22.2
S.E. $\pm$		0.94
Range		17.0-29.0

Table 6.2. Combined analysis of variance for seed protein percentages in inoculated and uninoculated GIET, grown at Hyderabad in 1979-80.

Source	df	MS
Treatments	1	64.61**
Entries	34	3.05
Treats x Entries	34	3.68
Error	207	3.02

Table 6.3. Combined analysis of variance for seed protein percentages in inoculated and uninoculated GCVT, grown at Hyderabad in 1979-80.

Source	df	MS
Treatments	1	1.93
Entries	13	11.31**
Treats x Entries	13	3.53
Error	81	2.69

Table 6.4. Protein percentages of entries in inoculated and uninoculated GIET at Hyderabad in 1979-80.

Entry	Inoculated	Uninoculated
BDN 9-3	19.7	20.1
BG-234	19.5	18.6
BG-235	18.8	20.3
BG-236	18.6	21.2
BG-237	17.5	18.9
BG-239	19.6	19.3
BG-240	18.0	19.4
BG-401	18.5	18.4
BG-402	18.5	18.7
BG-403	18.5	19.6
BG-404	17.9	22.0
BG-405	20.3	20.0
BG-406	18.0	19.6
GG-588	18.3	19.8
GNG-15	17.3	18.2
GNG-84	19.6	19.9
GNG-88	17.2	18.8
Annigeri	18.6	17.5
H-77-61	18.5	19.5
HMS-6	18.7	20.1
HMS-23	19.6	19.3
ICCC-14	18.5	18.8
ICCC-15	19.2	18.8
ICCC-16	18.3	19.1
ICCC-17	17.7	18.1
ICCC-18	18.0	20.4
ICCC-19	17.0	21.4
JC-1258	18.4	19.5
JG-1259	19.3	19.9
JG-1260	18.5	19.4
JG-1261	18.2	18.2
K-850	16.9	20.4
P-324	17.5	20.3
RSG-40	20.4	19.3
H-76-105	18.9	18.6
Mean	18.5	19.5
CD	2.25	2.55
CV%	8.7	9.3

Table 6.5. Seed protein percentages of entries in inoculated and uninoculated GCVT at Hyderabad in 1979-80.

Entry	Inoculated	Uninoculated
BDN 9-3	22.0	20.8
Phule G-1	20.5	21.0
Phule G-2	20.7	20.0
Phule G-4	21.7	20.0
BG-220	19.7	18.3
ICCC-4	19.2	22.0
ICCC-6	19.2	20.3
ICCC-9	21.4	21.3
ICCC-10	22.9	21.4
ICCC-13	22.3	20.7
RAU-52	22.5	22.2
RAU-54	22.9	22.4
Annigeri	18.9	18.3
K-850	20.2	21.9
Mean	21.0	20.7
CD	2.58	2.12
CV%	8.6	7.2

International nurseries, 1980/81

The seed protein percentages of entries in ICSN-DS 1980-81 grown at Gwalior and Hyderabad were also determined. These were augmented designs and based on the error calculated from the repeated checks, there appeared to be significant differences among entries although the entries x locations interaction was substantial (Table 6.6). On an average seed from Gwalior showed about 3% more protein than at Hyderabad.

The seed protein percentages of seed from the ICSN-DL grown at Hissar were slightly higher than those from Gwalior (Table 6.7). The seed protein percentages of the checks at Hissar were not determined but there were significant differences among entries at Gwalior. The shifts in rankings of the entries again suggested substantial G x E interaction.

Table 6.6. Seed protein percentages of entries in ICSN-DS 1980-81 for two locations.

ICCL No.	Sel.No.	Protein %	
		Gwalior	ICRISAT Center
78042	73367-11-4-1P-LB-1H-BP	20.5	18.4
79001	74656-7P-1P-2P-BP	19.4	16.5
79002	74738-2P-1P-1P-BP	20.9	14.4
79003	747-13P-1P-1P-BP	20.4	14.9
79006	74633-1H-1P-1P-BP	21.8	18.2
79010	74640-6H-1H-1P-BP	22.8	17.3
79013	74598-5P-1P-1P-BP	18.3	15.7
79014	74685-9P-1P-1P-BP	17.8	17.7
79015	74685-14P-1P-1P-BP	15.5	17.2
79017	74683-6H-1H-1H-BP	18.0	17.5
79018	741145-1H-1H-1H-BP	16.2	15.7
79025	74281-B-BH-1H-1P-BP	20.8	19.0
79026	74100-B-1P-1H-1P-BP	20.5	18.5
79037	74693-1P-LB-1P-1P-BP	20.0	15.2
79039	73154-7-2-1P-1P-1H-BP	17.5	14.4
80031	7547-1P-1P-BP-BT-BP	19.8	18.0
80032	75278-1P-2P-BP-BT-BP	19.8	17.6
80033	74540-21H-1P-BP-BP-BT-BP	18.1	17.5
80034	74540-21H-1P-3P-BP-BT-BP	21.3	17.0
80035	74527-4P-1P-1P-BP-BT-BP	17.0	17.3
80036	745400-5H-1P-BP-BP	22.3	18.1
80037	75169-1P-1P-BP	21.5	18.9
80038	75427-1P-1P-BP	22.6	17.3
80039	75690-6H-1P-BP	23.6	18.3
80040	752014-2P-1P-BP	20.2	18.4
80041	75411-2H-1P-BH	21.9	16.5
80042	75479-11H-1H-BP	21.4	17.1
80043	741265-19H-1H-BP	18.5	17.8
80044	75391-3H-1H-BP	22.7	15.2
80045	741338-2P-1P-BP	18.5	18.1
80046	741479-1P-1P-BP	18.3	16.3
80047	7553-2P-1P-BP	18.8	17.3
80048	75159-4P-1P-BP	19.0	19.1
80049	75454-2P-1P-BP	17.7	15.4
80050	75419-9H-2P-BP	22.9	16.9
80051	752337-7H-1H-BP	18.1	13.1
80052	752340-18H-1H-BP	18.6	14.5
80053	741553-2H-1H-BP	19.8	16.4
80054	75341-1H-1H-BP	19.6	16.6
80055	75190-11H-1H-BH	20.8	18.4
80056	75190-15H-1H-BH	19.3	19.4
80057	75438-15H-1H-BH	17.8	16.3
80058	75370-5H-1P-BH	25.1	17.5
80059	752509-4H-1P-BH	20.1	21.1
80060	74100-B-1P-2H-5P-2P-BP	15.1	15.8

Contd....Table 6.6.

ICCL No.	Sel.No.	Protein %	
		Gwalior	ICRISAT Center
80061	74103-B-5P-1H-2P-1P-BP	22.9	16.5
80062	74117-B-2P-1H-1P-2P-BP	21.4	18.4
80063	74119-B-1P-1H-1P-1P-BP	19.8	17.6
80064	74141-B-1P-1H-1P-1P-BP	19.5	18.4
80065	74685-2P-LB-1P-2P-1P-BP	23.0	15.6
80066	74686-8P-LB-1P-1P-1P-BP	20.5	17.9
80067	74290-3H-1H-1P-1P-1P-BP	18.3	18.3
80068	74304-B-2H-1H-1P-1P-BP	17.0	18.9
80069	74257-5-2H-1H-1P-1P-BP	20.1	18.4
80070	7390-B-2H-BH-1P-1P-BP	24.4	20.9
80071	74290-B-6P-1H-1P-1P-BP	21.2	16.0
80072	7499-B-BH-BH-1H-2P-BP	22.3	18.7
80073	74686-3P-LB-1P-2P-2P-BP	19.8	14.2
80074	74754-2P-LB-1P-1P-BP-BP	18.7	15.0
80075	74710-1P-LB-1P-1P-1P-BP	18.9	16.9
	Annigeri	20.1	15.3
	JG-62	17.9	16.8
	G-130	20.5	17.7
Mean		19.9	17.0
SE ±		2.10	1.05
CV%		8.3	4.9

Table 6.7. Seed protein content of entries in ICSN-DL, 1980-81 for two locations.

ICCL No.	Sel.No.	Protein	
		Gwalior	Hissar
78122	73219-2-4-1H-1H-BH	18.7	18.0
78126	7340-5-1-1P-BH-BP	23.2	18.0
79043	73167-5-2-1H-1P-1P -BH	18.1	17.
79044	73190-8-2-1H-1P-BH	22.5	17.6
79045	73213-9-3-1P-1P-1P -BH	19.8	16.1
79046	73167-3-3-1H-BH-1H-BH	19.8	16.3
79047	73308-1-1-1H-2H-1H-BH	22.6	19.7
79048	73167-5-3-1P-2H-1H-BH	17.2	18.7
79049	73307-14-3-1H-1P-1H-BH	20.0	18.1
79050	74314-B-7P-1H-2P-BH	22.1	18.2
79061	7381-B-4H-1H-3H-BH	19.6	18.2
79064	74159-B-2P-1H-1H-BH	20.3	19.2
79068	74261-B-6H-BH-1H-BH	20.1	15.9
79069	74249-19-2P-2H-1H-BH	17.6	16.1
79070	74269-1-1H-1H-1H-BH	18.5	18.4
79071	74926-5P-LB-BH-1H-BH	23.0	16.7
79078	74470-1H-1P-1P-BH	19.5	18.4
79080	74689-17H-1H-2P-BH	22.4	16.4
79086	74753-5P-1H-1P-BH	18.3	17.7
79092	74603-2H-1H-2H-BH	15.9	17.0
80076	751293-2P-1H-BH	22.8	20.4
80077	75375-9H-1H-BH	19.6	25.3
80078	752338-8P-1H-BH	18.7	20.7
80079	752338-10P-2H-BH	20.1	19.4
80080	752338-12P-1H-BH	21.7	24.9
80081	752338-12P-2H-BH	22.8	18.6
80082	75238-1P-1P-BP-BP	20.3	23.5
80083	741543-8P-1P-BH	22.2	18.5
80084	75190-15H-1P-BH	20.8	19.2
80085	752598-4H-1H-BH	19.8	17.5
80086	75190-2H-1H-BH	20.0	17.8
80087	75411-3H-1H-BH	22.0	17.1
80088	75370-3P-2H-BH	23.9	21.0
80089	741543-5H-1P-BH	17.0	17.2
80090	75463-12H-1H-BH	21.9	19.6
80091	75463-12H-2H-BH	19.2	20.1
80092	741507-5P-1P-BH	23.6	18.3
80093	741507-3H-1P-BH	19.2	20.9
80094	752375-4H-1P-BH	19.5	20.3
80095	74902-1H-1P-BP	17.4	20.8
80096	741507-4H-1P-BP	21.3	18.4
80097	741543-1H-1P-BP	17.0	16.6
80098	741543-5H-1P-BP	18.1	18.7
80099	7576-1P-1P-BP	18.8	22.1
80100	75345-8H-1P-BP	18.8	19.2
80101	75370-25H-2P-BP	17.5	23.3

Contd....Table 6.7.

ICCL No.	Sel.No.	Protein %	
		Gwalior	Hissar
80102	75789-6H-1P-BP	15.9	18.0
80103	75186-2H-1P-BP	19.2	17.8
80104	74902-9H-1P-BP	17.6	24.8
80105	752472-1H-1P-BP	22.5	26.0
80106	752571-4H-1P-BP	20.3	25.8
80107	752589-2H-1P-BP	23.4	20.4
80108	741167-2P-1P-BP	18.6	22.8
80109	741222-2P-1P-BP	21.1	21.0
80110	75736-5H-1P-BP	18.9	25.6
80111	75788-5H-1P-BP	20.0	19.8
80112	751075-1H-1P-BP	21.5	22.7
80113	751447-5H-1P-BP	20.7	19.6
80114	75239-17H-1H-BP	21.8	18.1
80115	74479-10P-1H-1H-BH	19.3	19.9
80116	75190-3H-2P-BH	18.2	23.1
80117	751692-2H-1H-BH	17.5	25.0
80118	751201-2P-1H-BH	18.8	19.9
80119	752520-2H-1H-BH	18.0	18.6
80120	752520-3H-1H-BH	17.7	18.8
80121	741543-8H-1P-BP	18.9	21.7
80122	7547-1H-1P-BP	19.1	23.7
80123	75112-7P-1P-BP	21.2	22.8
80124	75365-29H-1P-BP	19.8	22.2
80125	75370-3P-1P-BP	19.3	22.9
80126	75370-3P-2P-BP	18.9	23.8
80127	75382-10H-1P-BP	17.6	23.2
80128	75772-4H-1P-BP	20.9	19.1
80129	75772-7H-1P-BP	22.3	25.5
80130	75779-1P-1P-BP	18.4	26.7
80131	752519-3H-1P-BP	22.7	21.8
80132	752519-4H-1P-BP	20.3	25.8
80133	752519-6H-1P-BP	18.4	24.2
80134	752519-9H-1P-BP	20.0	25.1
80135	752519-15H-1P-BP	17.6	24.1
ICC-4948	G-130	20.2	
ICC-4954	H-208	19.6	
ICC-4918	Annigeri	18.8	
Mean		19.8	20.4
SE $\pm$		1.58	
CV%		6.5	

International trials, 1980/81

The combined analyses of variance for protein content of ICCT-DS entries grown at Gwalior and ICRISAT Center showed a highly significant effect of locations (Table 6.8), the mean protein percentage being higher at Gwalior than that at Hyderabad (Table 6.9). The mean square due to entries was also significant but not so prominent as that due to locations and the interaction between locations and entries was non-significant substantiating earlier results. ICCL-78023 and -78054 were highest in seed protein and Annigeri the lowest.

The seed protein percentages of ICCT-DL entries grown at Gwalior in 1980-81 differed significantly (Table 6.10) but the range was not very wide.

Coordinated trials, 1980/81

In the penninsular zone GIET and GCVT (Tables 6.11 and 6.12) grown at Hyderabad, Annigeri showed the lowest protein percentage and C-235 was the highest. Again the ranges were not very wide.

ICCC-lines, 1980/81

The seed protein percentages of ICCC-1 to -26 grown at Hyderabad were also determined (Table 6.13). They ranged from 13.4 to 17.5. The lower end of the range was not lower than the values recorded for Annigeri in other tests at Hyderabad indicating that the seed protein contents of the ICCC-lines could be commercially acceptable.

BREEDING FOR IMPROVED SEED PROTEIN CONTENT

The protein percentages of seeds harvested from 65 F_3 progenies of T-1-A x T-3 and their parents at Hyderabad ranged from 14.9 to 26.8 percent (Table 6.14). Five lines had seed protein percentages similar to T-1-A and will be evaluated in the F_4 generation.

F_3 progenies of four crosses involving the high protein T-1-A with the high yielding cultivars, T-3, BG-203, Pant G-114 and BDN-9-3, were sown at Hissar. The seed protein percentages for about 40 progenies for each cross are shown in Tables 6.15-6.18. T-1-A was damaged by *Ascochyta*. Six progenies of the cross T-1-A with T-3, seven of that with BG-203, five with Pant G-114 and one with BDN-9-3 had seed protein percentages above 26 and will be tested again in the F_4 generation to identify lines combining high protein and high yield.

Table 6.8. Combined analysis of variance for seed protein percentage at Hyderabad in 1980-81.

Source	df	MS
Locations	1	50.63**
Entries	15	9.71**
Locs x Entries	15	1.69
Error	93	1.54

Table 6.9. Seed protein percentages of entries in ICCT-DS at locations in 1980-81.

Acc.No.	Selection No./ Name	Protein %	
		Gwalior	ICRISAT Center
ICC-552	P-436	17.2	17.4
ICC-4918	Annigeri	17.9	15.1
ICC-5003	K-850	20.3	18.2
ICC-11528	ICCC-7	19.6	18.9
ICC-11530	ICCC-9	19.2	18.4
ICCL-78023	73111-8-2-B-BP	21.2	19.1
ICCL-78054	74169-B-2P-1H-BP	21.4	19.2
ICCL-78073	73119-4-1-1H-BH-BP	19.0	17.5
ICCL-78021	73129-16-1-B-BP	17.8	18.7
ICCL-78026	73136-31-4-1H-BP	18.3	17.0
ICCL-78052	7499-B-3P-BH-BP	17.9	16.6
ICCL-78053	74141-B-1P-1H-BP	18.7	17.2
ICCL-78055	74304-B-7P-1H-BP	18.8	17.4
ICCL-79004	74974-1P-1P-1P-BP	20.2	18.5
ICCL-79008	74633-4H-1H-1P-BP	18.6	17.6
ICC-4951	JG-62	17.6	16.7
Mean		19.0	17.7
SE ±		0.58	0.67
CV%		6.1	7.5

Table 6.10. Seed protein percentages of entries in ICCT-DL in 1980-81 at Gwalior

ACC.No.	Selection No./ Name	Protein %
ICC-4948	G-130	19.1
ICC-438	P-324	20.1
ICC-8294	BG-203	18.9
ICC-10136	Pant G-114	18.8
ICC-11525	ICCC-4	18.7
ICC-11534	ICCC-13	18.4
ICCL-78153	74256-B-2H-1H-BH	19.6
ICCL-79060	73314-B-3P-1H-1P-BH	19.1
ICCL-79063	741663-8-2P-BH-1H-BH	18.3
ICCL-79064	74159-B-2P-1H-1H-BH	18.7
ICCL-79065	74607-1P-LB-1H-2H-BH	18.0
ICCL-79067	74926-7H-LB-BH-1H-BH	18.7
ICCL-79085	741177-1P-1H-1P-BH	19.9
ICCL-79090	74595-9H-1H-1H-BH	19.8
ICCL-79091	74600-1H-1H-1H-BH	21.1
ICC-4998	T-3	20.1
Mean		19.2
SE $\pm$		0.89
CV%		9.2

Table 6.11. Seed protein percentages of entries in GIET grown at Hyderabad in 1980-81.

Acc.No.	Pedigree	Protein %
ICC-4935	C-235	17.9
ICC-11141	BDN 9-3	17.3
ICC-440	P-326	16.9
ICC-12263	BG-246	16.7
ICC-12261	BG-244	16.4
ICC-12199	Phule G-4 (local)	15.8
ICC-12262	BG-245	15.6
ICC-12264	ICCC-22	15.3
ICC-4918	Annigeri	14.5
Mean		16.3
SE ±		0.50
CV%		6.2

Table 6.12. Seed protein percentages of entries in GCVT grown at Hyderabad in 1980-81.

Acc.No.	Pedigree	Protein %
ICC-4935	C-235	20.8
ICC-11141	BDN 9-3	18.2
ICC-12199	Phule G-4	18.2
ICC-11525	ICCC-4	18.5
ICC-11502	BG-405	19.0
ICC-11498	BG-401	19.7
ICC-4918	Annigeri	16.0
ICC-10253	H-73-10	17.6
ICC-11534	ICCC-13	18.6
ICC-5003	K-850 (local)	18.6
Mean		18.5
SE ±		0.56
CV%		6.0

Table 6.13. Seed protein percentages of ICCC lines grown at Hyderabad in 1980-81.

ICCC No.	Protein %
ICCC-1	15.8
ICCC-2	14.2
ICCC-3	15.0
ICCC-4	16.6
ICCC-5	17.0
ICCC-6	16.2
ICCC-7	15.5
ICCC-8	16.3
ICCC-9	15.8
ICCC-10	16.7
ICCC-11	17.5
ICCC-12	16.1
ICCC-13	17.5
ICCC-14	16.2
ICCC-15	15.6
ICCC-16	16.9
ICCC-17	15.8
ICCC-18	17.2
ICCC-19	14.3
ICCC-20	15.1
ICCC-21	14.4
ICCC-22	15.3
ICCC-23	14.4
ICCC-24	14.6
ICCC-25	14.1
ICCC-26	13.4
Mean	15.7+0.22

Table 6.14. Seed protein percentages of F_3 progenies of T-1-A x T-3, at Hyderabad 1980-81.

Sel.No.	Protein %	Sel.No.	Protein %
78218-1P	17.9	78218-41P	19.0
78218-2P	16.0	78218-42P	19.1
78218-3P	16.9	78218-44P	17.1
78218-4P	19.8	78218-45P	18.8
78218-5P	25.5	78218-46P	20.8
78218-6P	19.5	78218-47P	24.6
78218-7P	18.5	78218-49P	26.8
78218-8P	21.3	78218-50P	18.4
78218-9P	19.7	78218-51P	15.8
78218-12P	24.9	78218-52P	18.2
78218-13P	19.5	78218-54P	23.1
78218-14P	19.3	78218-55P	18.4
78218-16P	18.8	78218-57P	21.3
78218-17P	16.4	78218-58P	25.0
78218-18P	17.9	78218-59P	17.9
78218-19P	18.9	78218-60P	18.3
78218-20P	18.9	78218-61P	17.6
78218-21P	15.9	78218-63P	15.0
78218-22P	14.9	78218-64P	15.0
78218-23P	15.7	78218-65P	17.7
78218-24P	24.1	78218-66P	16.9
78218-25P	19.0	78218-67P	17.6
78218-26P	18.0	78218-68P	16.0
78218-27P	18.6	78218-69P	18.3
78218-28P	16.3	78218-70P	15.7
78218-29P	20.0	78218-71P	15.9
78218-30P	19.2	78218-72P	17.0
78218-31P	16.5	78218-73P	16.4
78218-32P	19.2	78218-74P	18.7
78218-33P	18.6	T-1-A[a]	24.5
78218-34P	17.6	T-3[a]	17.4
78218-36P	17.6		
78218-37P	16.9		
78218-38P	21.8	Mean	18.7
78218-39P	15.6		
78218-40P	17.2	SE ±	0.33

[a] Parental values not included for mean.

Table 6.15. Seed protein percentages of F_3 progenies of T-1-A x T-3, grown at Hissar, 1980-81.

Selection No.	Protein %
78218-163P	25.5
78218-165P	23.6
78218-166P	23.7
78218-168P	22.7
78218-169P	27.0
78218-170P	25.1
78218-171P	25.6
78218-172P	25.5
78218-173P	25.4
78218-174P	25.4
78218-175P	25.1
78218-177P	25.8
78218-178P	24.0
78218-179P	23.2
78218-180P	27.4
78218-181P	27.5
78218-182P	26.2
78218-183P	24.1
78218-184P	23.0
78218-185P	25.8
78218-186P	23.4
78218-187P	23.6
78218-188P	24.0
78218-189P	21.9
78218-190P	24.1
78218-191P	24.0
78218-193P	22.2
78218-194P	24.6
78218-195P	28.7
78218-197P	25.3
78218-200P	23.3
78218-201P	25.3
78218-202P	24.7
78218-203P	25.1
78218-204P	23.9
78218-206P	23.3
78218-207P	22.6
78218-209P	23.8
78218-210P	27.0
78218-211P	22.5
T-3	20.9
Mean	24.6
SE +	0.25

Table 6.16. Seed protein percentages of F_3 progenies of T-1-A x BG-203, grown at Hissar, 1980-81.

Selection No.	Protein %
78226-163P	22.4
78226-164P	20.9
78226-165P	22.9
78226-166P	21.8
78226-167P	23.0
78226-169P	23.5
78226-170P	24.9
78226-171P	23.5
78226-172P	25.8
78226-173P	24.8
78226-174P	26.5
78226-176P	24.5
78226-177P	23.9
78226-178P	26.2
78226-180P	22.6
78226-181P	23.1
78226-183P	24.3
78226-185P	22.2
78226-186P	24.5
78226-187P	24.4
78226-188P	26.4
78226-189P	24.3
78226-190P	20.9
78226-191P	21.6
78226-192P	24.1
78226-193P	25.0
78226-194P	22.8
78226-195P	23.0
78226-196P	26.2
78226-197P	26.5
78226-198P	25.7
78226-199P	21.3
78226-201P	24.9
78226-203P	26.6
78226-204P	28.6
78226-205P	20.6
78226-206P	20.6
78226-207P	23.2
78226-208P	22.9
78226-209P	24.5
BG-203	23.7
Mean	23.9
SE +	0.30

Table 6.17. Seed protein percentages of F_3 progenies of T-1-A x Pant G-114 grown at Hissar in 1980-81.

Selection No.	Protein %
78227-201P-BH	26.9
78227-202P-BH	24.5
78227-203P-BH	22.9
78227-204P-BH	25.0
78227-206P-BH	26.6
78227-207P-BH	24.9
78227-208P-BH	21.9
78227-209P-BH	23.8
78227-210P-BH	22.1
78227-211P-BH	20.1
78227-213P-BH	22.7
78227-214P-BH	21.0
78227-215P-BH	25.9
78227-216P-BH	24.6
78227-217P-BH	22.8
78227-219P-BH	22.3
78227-220P-BH	22.8
78227-221P-BH	22.2
78227-223P-BH	20.9
78227-224P-BH	22.7
78227-225P-BH	21.6
78227-226P-BH	24.1
78227-227P-BH	26.5
78227-228P-BH	23.3
78227-229P-BH	23.4
78227-230P-BH	22.9
78227-231P-BH	23.4
78227-232P-BH	24.3
78227-233P-BH	22.9
78227-234P-BH	22.8
78227-235P-BH	26.1
78227-237P-BH	28.0
78227-240P-BH	24.5
78227-241P-BH	24.4
78227-243P-BH	23.8
78227-244P-BH	24.3
78227-245P-BH	26.3
78227-246P-BH	24.3
78227-247P-BH	24.8
78227-248P-BH	22.0
Pant G-114	24.0
Mean	23.8
SE ±	0.28

Table 6.18. Seed protein percentages of F_3 progenies of T-1-A x BDN 9-3, grown at Hissar, 1980-81.

Selection No.	Protein %
78230-201P-BH	23.8
78230-202P-BH	23.7
78230-203P-BH	23.8
78230-204P-BH	20.4
78230-205P-BH	21.9
78230-206P-BH	21.8
78230-207P-BH	23.2
78230-208P-BH	23.8
78230-209P-BH	22.3
78230-210P-BH	24.0
78230-215P-BH	26.0
78230-217P-BH	24.7
78230-218P-BH	26.0
78230-219P-BH	25.4
78230-220P-BH	22.2
78230-221P-BH	20.2
78230-223P-BH	22.5
78230-224P-BH	25.0
78230-228P-BH	25.2
78230-229P-BH	22.9
78230-230P-BH	22.7
78230-231P-BH	21.5
78230-232P-BH	26.2
78230-233P-BH	24.6
78230-234P-BH	25.9
78230-235P-BH	22.7
78230-236P-BH	24.5
78230-237P-BH	24.4
78230-238P-BH	23.1
78230-239P-BH	25.2
78230-240P-BH	24.0
78230-241P-BH	24.6
78230-242P-BH	23.5
78230-244P-BH	23.2
78230-246P-BH	22.5
78230-247P-BH	21.5
78230-249P-BH	23.1
78230-252P-BH	22.6
78230-256P-BH	23.5
BDN-9-3	21.8
Mean	23.5
SE ±	0.24

PROJECT 7 : BREEDING FOR NEW PLANT TYPES

OBJECTIVES :

a. Breeding for mid-tall, compact and high yielding cultivars

b. Developing cultivars suitable for mechanical harvest

c. Combining multi-seeded and double-podded characters to develop more efficient plant types

d. Searching for new concepts of plant type with higher yield potential.

INTRODUCTION

From the beginning of the project the main thrust has been to develop mid-tall and compact plant types with high yield potential. Using the very late maturing tall lines mainly from USSR and Greece we have been successful in developing lines that are early maturing and give yields comparable to conventional types. Trials for two seasons at Hyderabad and Hissar to study the interactions between plant density and plant type suggest that the yields of the tall plant types do not respond to higher populations. However, this year at Hissar compact lines tended to escape *Botrytis* infection and thus gave higher yields.

A program was also initiated to combine the double-podded (two pods/node) and multiseeded (more number of seeds/pod) types to develop high yielding plant types.

MID-TALL AND COMPACT PLANT TYPES

Hybridisation

We crossed 5 tall lines with 8 conventional type parents (Table 7.1) in a line x tester series.

Three short duration and 3 long duration F_6 generation mid-tall compact lines from crosses involving tall and conventional types were crossed in diallel manner to initiate a second cycle of selection. The pedigrees of these lines are given in Table 7.2.

Table 7.1. Tall and conventional type parents in the 5 x 8 line x tester series made in 1980-81.

Lines	Testers
K-1184	BG-203
K-1189	F-378
K-1480	H-208
K-56567	ICCC-10
P-9847	ICCC-13
	K-850
	P-324
	P-326

Table 7.2. Pedigrees of tall and compact F_6 lines involved in a 6 x 6 diallel, 1980-81.

Selection number	Cross	Duration
7573-4-1P-3P-BP	F-378 x K-1184	Short
7573-74-1P-1P-BP	F-378 x K-1184	
7570-3-1P-1P-BP	G-130 x K-1189	
75123-19-1P-1H-BH	P-2426-1 x K-1170	Long
7570-48-1P-2H-BH	G-130 x K-1189	
7570-1-1P-1H-BH	G-130 x K-1189	

F_1 generation

Forty seven F_1's, 8 lines, 6 testers of the 8 x 6 line x tester set made in 1979-80 and 2 checks (Annigeri and ICCC-1) were evaluated in a 8 x 8 triple lattice at Hyderabad. Each plot was one row 4 m long with 60 cm between rows and 20 cm between plants within the row. One cross, F-378 x K-1480, failed and hence the line x tester analysis was based on a 7 x 6 set, excluding crosses involving K-1480.

Means, CV's and LSD's are presented in Table 7.3. The mean squares due to crosses were significantly greater than the error mean squares for all characters studied except for number of primary branches and seed yield (Table 7.4). The mean squares for lines and testers were significant except lines for primary branches/plant and testers for pods and seed yield/plant. Line x tester mean squares were significantly greater than the error only in the case of seed weight.

Table 7.3. Characteristics of entries in the F_1 8 x 6 line x tester plant type study , 1980-81.

Sel.No./ Name	Cross	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant(g)
F_1 generations										
7996	ICCC-4 x K-1170	66.0	116	46.1	2.87	6.60	80	1.21	14.7	14.40
7997	ICCC-4 x K-1174	62.2	111	45.9	2.87	4.87	119	1.22	16.0	23.05
7998	ICCC-4 x K-1184	65.3	116	43.3	2.47	5.27	94	1.13	15.5	16.69
7999	ICCC-4 x K-1258	70.5	122	46.4	2.25	5.75	72	1.16	12.9	9.95
79100	ICCC-4 x K-1480	68.7	114	47.3	3.40	7.00	105	1.13	18.3	21.23
79101	ICCC-4 x K-1481	68.0	113	49.6	3.20	7.40	134	1.13	17.2	25.64
79102	ICCC-4 x K-56567	65.6	112	49.8	2.78	6.58	111	1.08	17.0	20.61
79103	ICCC-4 x P-9847	71.5	121	53.2	3.32	5.93	98	1.13	15.1	16.66
79104	BDN 9-3 x K-1170	67.0	118	49.2	2.93	6.20	118	1.07	15.5	20.07
79105	BDN 9-3 x K-1174	63.2	111	47.0	2.93	5.07	109	1.09	19.3	22.37
79106	BDN 9-3 x K-1184	66.9	113	49.5	2.80	6.40	118	1.14	16.6	22.75
79107	BDN 9-3 x K-1258	69.1	115	53.6	2.60	6.07	96	1.05	16.2	16.88
79108	BDN 9-3 x K-1480	70.0	122	46.7	2.46	6.45	92	1.07	16.5	16.42
79109	BDN 9-3 x K-1481	67.9	118	45.7	2.80	6.53	113	1.05	16.7	19.67
79110	BDN 9-3 x K-56567	65.3	119	52.6	2.80	5.33	94	1.09	15.0	15.39
79111	BDN 9-3 x P-9847	71.6	116	52.5	2.40	4.93	99	1.09	16.3	17.38
79112	F-378 x K-1170	66.8	118	51.0	3.30	6.87	122	1.34	15.1	24.15
79113	F-378 x K-1174	67.4	114	48.0	2.71	7.38	107	1.30	13.7	19.34
79114	F-378 x K-1184	67.5	116	47.4	2.08	4.53	95	1.22	17.4	19.31
79115	F-378 x K-1258	67.2	120	48.3	3.10	7.00	107	1.13	17.2	20.06
79117	F-378 x K-1481	76.1	124	50.2	2.60	6.10	85	1.12	16.3	15.95
79118	F-378 x K-56567	70.2	122	47.8	2.42	6.38	62	1.13	14.6	12.81
79119	F-378 x P-9847	72.4	120	53.9	3.30	6.90	110	1.13	15.1	19.07
79120	Pant G-114 x K-1170	71.1	119	47.6	3.12	5.43	90	1.34	11.9	14.25
79121	Pant G-114 x K-1174	65.0	112	45.1	2.38	6.02	96	1.41	14.5	19.54
79122	Pant G-114 x K-1184	66.9	115	45.6	2.47	5.33	89	1.41	13.9	18.15
79123	Pant G-114 x K-1258	70.4	118	53.4	2.60	6.50	119	1.26	13.2	19.38
79124	Pant G-114 x K-1480	70.0	122	49.0	2.95	6.23	82	1.20	14.9	14.33
79125	Pant G-114 x K-1481	68.1	116	51.0	3.19	7.23	112	1.28	14.6	20.41
79126	Pant G-114 x K-56567	75.3	123	46.1	2.60	6.15	78	1.22	13.6	13.14
79127	Pant G-114 x P-9847	69.7	124	51.1	2.87	7.20	96	1.17	13.9	15.51

Contd....Table 7.3.

Sel.No./ Name	Cross	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant(g)
79128	P-9800 x K-1170	69.3	124	54.4	2.80	6.20	52	1.08	23.6	12.90
79129	P-9800 x K-1174	68.9	122	52.0	2.60	6.33	91	1.05	24.8	23.22
79130	P-9800 x K-1184	71.6	121	55.3	2.28	5.38	73	1.14	21.0	17.36
79131	P-9800 x K-1258	72.4	125	61.2	2.57	5.80	60	1.06	27.1	17.22
79132	P-9800 x K-1480	67.9	109	55.7	2.30	5.70	103	1.12	22.5	23.16
79133	P-9800 x K-1481	70.4	121	58.2	3.02	7.13	57	1.02	28.5	16.76
79134	P-9800 x K-56567	71.5	119	60.4	2.31	5.78	56	1.01	26.9	15.64
79135	P-9800 x P-9847	75.6	124	60.3	2.80	6.47	70	1.05	28.3	20.76
79136	C-104 x K-1170	70.9	123	52.8	2.67	7.20	84	1.11	18.8	17.24
79137	C-104 x K-1174	71.0	122	49.8	2.89	6.87	91	1.11	20.2	20.34
79138	C-104 x K-1184	72.3	120	46.2	2.73	5.28	64	1.12	20.3	14.42
79139	C-104 x K-1258	72.1	123	55.8	3.10	9.60	91	1.10	21.0	20.56
79140	C-104 x K-1480	72.8	122	54.5	3.40	8.13	132	1.08	19.7	26.93
79141	C-104 x K-1481	74.5	123	53.7	3.13	7.33	73	1.05	21.5	16.95
79142	C-104 x K-56567	73.8	123	52.7	2.87	7.73	67	1.06	21.6	15.35
79143	C-104 x P-9847	74.0	125	57.3	2.53	6.80	71	1.05	19.1	14.28
Lines										
ICCC-4		65.6	115	36.9	3.58	8.55	192	1.15	12.2	26.45
BDN 9-3		50.1	104	32.4	2.60	5.00	154	1.09	13.4	22.75
F-378		68.9	112	37.2	2.93	7.20	122	1.16	11.7	16.47
Pant G-114		68.4	115	36.4	3.07	7.60	146	1.39	11.1	23.40
P-9800		68.2	120	50.0	2.60	6.80	64	1.05	31.6	21.28
C-104		76.3	125	48.2	3.87	9.87	114	1.13	22.0	27.54
Testers										
K-1170		75.6	128	65.9	2.42	6.50	54	1.25	16.7	11.83
K-1174		76.0	124	68.5	2.80	5.33	46	1.36	17.6	11.11
K-1184		73.8	126	60.2	2.53	5.57	23	1.23	20.9	6.03
K-1258		66.0	119	62.0	2.13	3.35	50	1.02	20.0	10.25
K-1480		77.1	125	75.2	2.60	6.20	44	1.06	23.2	10.77
K-1481		75.4	120	72.4	2.67	7.47	51	1.01	23.0	11.86
K-56567		66.2	119	61.7	2.60	4.67	49	1.08	20.7	11.17
P-9847		64.0	117	63.7	2.67	4.80	60	1.04	19.8	12.61

Contd....Table 7.3.

Sel.No./ Name	Cross	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant(g)
Checks										
Annigeri		49.6	103	28.1	2.80	4.80	129	1.11	19.6	28.84
ICCC-1		54.5	106	37.6	2.87	6.47	107	1.09	17.8	20.75
Mean		69.0	118	51.3	2.78	6.34	91	1.14	18.2	17.95
CD(.05)		5.29	7.04	6.06	0.76	2.02	47.34	0.10	2.61	9.92
CV%		4.8	3.7	7.4	17.0	20.0	32.4	5.5	9.0	34.5

Table 7.4. Mean squares from analysis of variance and estimates of GCA and SCA variances in the 8 x 6 line x tester trial, Hyderabad, 1980-81.

Source	d.f.	Mean squares								
		Days to 1st flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant (g)
Mean squares										
Replications	2	10.03	52.30**	16.59	0.88*	2.61	2201.95	0.003	1.48	103.10
Crosses	41	33.67**	52.69**	59.69**	0.29	2.70**	1305.86*	0.031**	57.24**	34.93
Testers	6	72.81**	86.89**	115.38**	0.61*	4.79*	965.23	0.037**	10.67**	61.32
Lines	5	103.44**	193.30**	264.75**	0.13	5.37**	5390.63**	0.168**	413.24**	15.33
Line x Tester	30	14.22	22.41	14.37	0.25	1.84	693.19	0.006	7.22**	32.93
Error	82	11.46	16.39	14.31	0.21	1.28	784.89	0.004	1.88	34.73
Variances										
GCA		3.79**	6.04**	9.01**	0.01	0.17*	127.42**	0.005**	10.50**	0.28
SCA		0.92	2.01	0.02	0.01	0.18	-ve	0.001	1.78**	-ve

GCA variances were similarly significantly greater than zero for all characters except primary branches and seed yield/plant, while there was significant SCA variance only for seed weight so there was predominance of additive genetic control for most characters studied.

Among lines BDN 9-3 and ICCC-4 appeared to be good combiners for earliness and pod number (Table 7.5). Kabuli lines, P-9800 and C-104 showed positive and significant GCA effects for days to flowering and maturity, and for seed weight. Among testers, K-1174 was a good combiner for earliness and seed yield.

Few crosses showed significant SCA effects, except for 100 seed weight, which was the only character with significant SCA variance (Table 7.6).

Days to first flower and to maturity were positively correlated with plant height, secondary branches/plant and seed size, but negatively with pod number and seed yield/plant, indicating the earlier genotypes to be shorter and higher yielding. Plant height was also negatively correlated with pod number and seed yield/plant and positively with seed size, reflecting its association with maturity. Primary and secondary branches, pod number and seed yield/plant were positively associated with each other. Pods/plant and seeds/pod were positively correlated and increases in both were associated with reduced seed size (Table 7.7).

F_2 populations

Fifty F_2 bulks of the 10 x 5 line x tester crosses made in 1978-79 (ROW 1979-80, Tables 7.2 to 7.4) and 28 F_2 bulks from other crosses involving tall parents (ROW 1978-79, Table 7.1) were grown at Hyderabad as space planted bulks. From these bulks we selected 399 single plants for evaluation as F_3 progeny rows.

F_3 generation

At Hissar, 52 F_3 bulks and 45 progenies were grown in a spaced planting. From among these, 467 plants were selected for evaluation as F_4 progenies next year. At Hyderabad 47 bulks were grown and 133 single plants were selected.

Progeny rows

The numbers of F_4 to F_8 progeny rows evaluated and single plants selected at Hyderabad and Hissar are shown in Table 7.8.

Table 7.5. Estimates of general combining ability effects and their standard errors from 8 x 6 line x tester trial, Hyderabad, 1980-81.

	Days to 1st flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant (g)
Lines									
ICCC-4	-2.57**	-3.16**	-3.21**	0.06	-0.27*	10.05*	0.00**	-2.41**	0.15
BDN 9-3	-2.29	-3.28	-0.97	-0.01	-0.54	15.83	-0.06**	-1.40**	1.23
F-378	0.06	0.24	-1.46**	0.03	0.12	7.38	0.05**	-2.26**	0.68
Pant G-114	-0.08*	-0.78**	-2.41**	-0.02	-0.06	6.01**	0.15**	-4.23**	-0.79
P-9800	1.81**	3.15**	6.42*	-0.14	-0.17**	-25.56*	-0.08**	-7.84**	-0.30
C-104	3.08	3.83	1.63	0.08	0.93	-13.72	-0.06	2.47	-0.97
SE(g_i)	0.73	0.88	0.82	0.09	0.25	6.07	0.01	0.30	1.27
SE(g_i-g_j)	1.13	1.35	1.26	0.15	0.38	9.34	0.02	0.46	1.96
Testers									
K-1170	-1.06**	0.53**	-0.78**	0.18	0.09	0.03	0.04**	-1.31**	-0.82**
K-1174	-3.31	-3.89*	-3.03**	-0.03**	-0.24**	11.08	0.05**	0.18	3.32
K-1184	-1.16	-1.96	-3.10	-0.29	-0.96	-2.26	0.05	-0.44	0.12
K-1258	0.70	1.43	2.13*	-0.06*	0.46*	-0.30	-0.02**	0.04**	-0.65
K-1481	1.26	0.40	0.42	0.23	0.62	4.78*	-0.04**	1.24	1.24
K-56567	0.68**	0.90**	0.61**	-0.13	-0.01	-13.07	-0.05**	0.22	-2.50
P-9847	2.89	2.59	3.74	0.11	0.04	-0.26	-0.04	0.07	-0.71
SE(g_i)	0.62	0.75	0.70	0.08	0.21	5.18	0.01	0.25	1.09
SE(g_i-g_j)	1.04	1.25	1.17	0.14	0.35	8.65	0.02	0.42	1.82

Table 7.6. Estimates of specific combining ability effects in the 8 x 6 line x tester trial, Hyderabad, 1980-81.

Cross	Days to 1st flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant (g)
ICCC-4 x K-1170	0.05	-0.74	-0.85	-0.14	0.46	-20.94	0.01	0.49	-2.93
ICCC-4 x K-1174	-1.51	-1.39	1.13	0.08	-0.95	6.47	0.01*	0.35	1.59
ICCC-4 x K-1184	-0.52	2.41*	-1.33	-0.06	0.17	-4.85	-0.07	0.44**	-1.57*
ICCC-4 x K-1258	2.78	5.19	-3.52	-0.51	-0.76	-29.31*	0.03	-2.60	-7.55*
ICCC-4 x K-1481	-0.27	-3.22	1.41*	0.15	0.72	28.30	0.02	0.49	6.26
ICCC-4 x K-56567	-2.14	-4.45	1.45	0.09	0.53	23.29	-0.02	1.31	4.96
ICCC-4 x P-9847	1.60	2.20	1.71	0.39	-0.17	-2.97	0.02*	-0.48	-0.77
BDN 9-3 x K-1170	0.76	1.38	-0.02	-0.00	0.32	11.47	-0.06	0.30**	1.67
BDN 9-3 x K-1174	-0.79	-0.99	0.02	0.21	-0.48*	-8.85	-0.05	2.58	-0.16
BDN 9-3 x K-1184	0.80	-0.40	2.56	0.34	1.57	13.03	0.01	0.50	3.41
BDN 9-3 x K-1258	1.14	-2.45	1.43*	-0.09	-0.18	-10.10	-0.01	-0.35	-1.68
BDN 9-3 x K-1481	-0.68	2.38	-4.76	-0.18	0.18	1.78	0.00	-1.07	-0.79
BDN 9-3 x K-56567	-2.65	2.61	1.99	0.18	-0.45	0.24	0.05	-1.69	-1.32
BDN 9-3 x P-9847	1.42	-2.54	-1.22	-0.46	-0.90	-7.57	0.05*	-0.27	-1.12*
E-378 x K-1170	-1.76	-1.80	2.30	0.33	0.33*	23.10	0.10*	0.79**	6.30
E-378 x K-1174	1.01	-1.38	1.49	-0.04	1.17	-2.41	0.06	-2.11**	-2.65
E-378 x K-1184	-0.99	-0.90	0.95	-0.41	-0.95	-0.90	-0.02	2.24*	0.51
E-378 x K-1258	-3.15*	-1.20*	-3.34	0.37	0.09	9.26	-0.05	1.52	2.04
E-378 x K-1481	5.20	4.82	0.26	-0.42	-0.98	-17.83	-0.04	-0.59	-3.96
E-378 x K-56567	-0.18	2.32	-2.28	-0.23	-0.07	-23.10	-0.02	-1.25	-3.36
E-378 x P-9847	-0.13	-1.86	0.64	0.41	0.41	11.89	-0.02	-0.61	1.11
Pant G-114 x K-1170	2.65	0.28	-0.18	0.19	-0.92	-6.96	0.00*	-0.49	-2.12
Pant G-114 x K-1174	-1.25	-2.36	-0.45	-0.33	-0.01	-12.34	0.06*	0.67	0.97
Pant G-114 x K-1184	-1.41	-1.30	0.13	0.01	0.03	-5.89	0.07	0.72	0.83
Pant G-114 x K-1258	0.19	-1.69	2.71	-0.09	-0.22	21.92	-0.02	-0.47	2.83
Pant G-114 x K-1481	-2.64*	-2.26*	2.05	0.22	0.34	10.37	0.02	-0.29	1.97
Pant G-114 x K-56567	5.11	4.11	-3.03	-0.01	-0.11	-6.48	-0.03*	-0.26	-1.56
Pant G-114 x P-9847	-2.66	3.22	-1.24	0.01	0.89	-0.62	-0.08	0.13	-0.98

Contd....Table 7.6.

Cross	Days to 1st flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ pod	Weight of 100 seeds (g)	Seed yield/ plant (g)
P-9800 x K-1170	-1.03	1.28	-2.21	-0.01	-0.04	-13.24	-0.03*	-0.83	-3.97
P-9800 x K-1174	0.85	3.37	-2.36	0.01	0.42	14.01	-0.06	-1.14**	2.20
P-9800 x K-1184	1.36	0.77	1.04	-0.06	0.19	9.54	0.03	-4.31	-0.45
P-9800 x K-1258	0.31	1.05	1.65	0.00	-0.81	-5.38	0.02	1.27	0.17
P-9800 x K-1481	-2.21	-1.59*	0.34	0.17	0.35	-13.49	-0.01	1.55*	-2.17
P-9800 x K-56567	-0.59	-4.09*	2.42	-0.18	-0.37	3.60	0.00	0.93**	0.44
P-9800 x P-9847	1.32	-0.78	-0.87	0.07	0.27	4.95	0.04	2.53**	3.78
C-104 x K-1170	-0.67	-0.40	0.97	-0.36	-0.15	6.56	-0.02	-0.27	1.04
C-104 x K-1174	1.68	2.76	0.17	0.08	-0.15	3.12	-0.02	-0.34	0.00
C-104 x K-1184	0.75	-0.58	-3.34	0.18	-1.01**	-10.92	-0.02	0.41	-2.72
C-104 x K-1258	-1.27	-0.90	1.07	0.31	1.88**	13.61	0.03	0.63	4.19
C-104 x K-1481	0.61	-0.14	0.70	0.06	-0.55	-9.13	0.00	-0.09	-1.31
C-104 x K-56567	0.45	-0.50	-0.55	0.15	0.48	2.45	0.02	0.96	0.83
C-104 x P-9847	-1.55	-0.25	0.98	-0.42	-0.50	-5.69	0.00	-1.30	-2.02
$SE(S_{ij}-S_{ii})$	2.52	3.02	2.82	0.34	0.84	20.88	0.05	1.02	4.39
$SE(S_{ij}-S_{jj})$	2.56	3.06	2.86	0.35	0.86	21.18	0.05	1.03	4.45
$SE(S_{ij})$	2.30	2.75	2.57	0.31	0.77	19.01	0.04	0.93	4.00

Table 7.7. Correlations among characters in 8 x 6 plant type line x tester trial at Hyderabad in 1980-81.

	Days to maturity	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pods/plant	Seeds/pod	Weight of 100 seeds (g)	Seed yield/ Plant (g)
Days to first flowering	.72**	.55**	.06	.21**	-.43**	.01	.21**	-.35**
Days to maturity		.50**	-.01	.16*	-.44**	-.05	.26**	-.34**
Plant height (cm)			-.04	.05	-.43**	-.18*	.47*	-.23**
Primary branches/plant				.53**	.49**	.08	-.03	.52**
Secondary branches/plant					.42**	.07	.04	.48**
Pods/plant						.19*	-.38**	.87**
Seeds/pod							-.52**	.11
Weight of 100 seeds(g)								.03

* and ** denote significance at 5% and 1% levelsof probability.

Each progeny was sown in plots of 2 rows 4m long and 60 cm apart with 20 cm between plants within the row. Four rows of Annigeri at Hyderabad and G-130 at Hissar were sown every twenty progenies for comparison.

At Hyderabad germination was poor, and plant stand was sparse so we selected tall single plants in all generations for evaluation in the coming season. At Hissar the plant stands were good and the heavy grey mold and blight which occurred in many parts of the farm was very low in fields where tall and compact plant type progenies were grown and many were free from disease. This was attributed to the plant habit allowing free air-movement and reducing disease incidence. Many of the progenies yielded 50 to 60% more yield compared to the check H-208, and the selected single plants and rows will be further evaluated in 1981-82.

Plant type x density trials

These trials were conducted in collaboration with the chickpea physiologists and details are presented in the Chickpea Physiology Report, 1980-81 (pp 21-28).

Four experiments were conducted, two each at Hyderabad and Hissar. At Hyderabad, Trial-1 consisted of three conventional (Annigeri, K-850, ICCC-4) and 3 promising tall types. Trial-2 at Hyderabad included Annigeri, K-850 and eight tall types which had been newly bulked in F_5-F_7 generations in 1979-80. At Hissar, Trial-1 comprised four conventional cultivars (K-850, H-355, H-208 and G-130) and 16 tall types. Trial-2 had two normal lines (K-850 and H-208) and six newly bulked tall lines.

In all the trials, the entries were sown at three spacings; 8, 33 and 67 plants/m^2 to assess the interactions between plant type and spacings. Trial-1 at Hyderabad also included three levels of irrigation (0, 1 and 2 applications) and was sown as a split-split plot design with irrigation as main plots and plant densities as sub plots. The others were split plot designs with plant densities as main plots and entries as sub plots. All had 4 replicates.

At Hyderabad, Annigeri gave significantly higher yields than any of the tall types (Tables 7.9, 7.10 and 7.13) In Trial-1, yields were highest at 33 plants m^{-2}. Irrigation increased total dry matter and there were significant interactions between genotypes and irriga-

Table 7.8. Numbers of F_4 to F_7 progenies grown and single plants and rows selected at Hyderabad and Hissar in 1980-81.

	Hyderabad		Hissar		
	Number of progenies grown	Number of plants selected	Progenies grown	Number selected	
				Plants	Lines
F_4	105	40	778	181	4
F_5	379	157	198	61	5
F_6	83	66	273	85	9
F_7	94	48	166	52	7

Table 7.9. Yield (kg/ha) of mid-tall genotypes and checks in the plant density trial-1, Hyderabad, 1980-81.

Genotypes	Plant density(Plants/m^2)			Means
	8	33	67	
7573-4-1P-1P-BP	1526	1699	1596	1607
7573-14-1P-2P-BP	1267	1403	1408	1360
7573-74-1P-1P-BP	1355	1781	1587	1574
Annigeri	2060	2429	2180	2223
K-850	1829	2200	2116	2048
ICCC-4	2239	1541	2277	1352
Means	1546	1842	1694	
S.E.		30.5		64.7

Table 7.10. Yield (kg/ha) of mid-tall genotypes and checks in plant density trial-2, Hyderabad, 1980-81.

Genotypes	Plant density (Plants/m^2)			Means
	8	33	67	
751673-10P-1P-BP	759	1025	1100	962
7571-3P-1P-1P-BP	490	925	1067	828
7569-7H-4P-1P-BP	780	1211	1247	1079
7579-2H-1P-1P-BP	732	896	1043	891
7569-7H-1H-1P-BP	895	1280	1152	1109
7570-69-4P-1P-1P-BP	694	864	1021	860
7573-4-1P-1P-1P-BP	762	1188	1486	1146
7582-12-1P-1P-1P-BP	883	1162	1202	1083
Annigeri	1333	1794	2160	1763
K-850	1248	1543	1798	1530
Means	858	1189	1328	
S.E.		28.3		152.4

tions, the tall types responding better to irrigation than conventional cultivars (Table 7.14). In Trial-2, seed yields were highest at 67 m^{-2}. At Hissar, the trials were very variable due to *Botrytis* gray mold and treatment differences were all non-significant except for the interaction between genotypes and spacings for total dry matter (Tables 7.11, 7.12 and 7.13). In none of the trials was the genotype x spacing interaction significant, indicating that all tall types do not yield higher than conventional cultivars at higher plant densities.

Table 7.11. Yield (kg/ha) of mid-tall genotypes and checks in the plant density trial-1, Hissar, 1980-81.

Genotypes	Plant density (plants/m^2)			Means
	8	33	67	
7570-1-1P-1H-BH	1570	833	1683	1362
7570-1-1P-2H-BH	2532	3639	2033	2735
7570-10-1P-1H-BH	2660	1556	1767	1994
7570-10-1P-2H-BH	1838	2041	1547	1809
7570-48-1P-2H-BH	1386	1289	1461	1379
7512-52-1P-1H-BH	1490	1433	1594	1506
7512-52-1P-2H-BH	1319	1017	1017	1118
7512-52-1P-3H-BH	1677	1894	1294	1622
7516-18-2P-1H-BH	2147	861	1222	1410
7516-76-1P-2H-BH	1806	1311	1361	1493
7573-23-3P-2H-BH	1768	2067	1806	1880
75123-1-3P-1H-BH	860	1215	1317	1130
75123-18-2P-1H-BH	896	1392	1947	1412
75123-19-1P-1H-BH	1159	1317	1170	1215
75123-37-2P-1H-BH	1448	1528	3544	2173
75123-59-1P-3H-BH	1164	1110	2361	1545
K-850	1544	2383	2539	2155
H-355	2089	983	1433	1502
H-208	1870	2389	1956	2071
G-130	2025	1744	3128	2299
Means	1662	1600	1809	
S.E.		110.4		452.5

Table 7.12. Yield (kg/ha) of mid-tall genotypes and checks in plant density trial-2, Hissar, 1980-81.

Genotypes	Plant density (plants/m^2)			Means
	8	33	67	
75112-7H-1P-1H	4979	2817	3100	3632
741293-4P-1P 1H	2500	1850	2433	2261
75148-4H-2H-1H	2042	2383	1967	2131
73123-37-2P-1H-1H	2229	1700	2167	2032
7573-6-2P-1P-1H	1500	2767	2150	2139
7516-42-1P-1P-1H	1812	2117	1817	1915
K-850	2000	2583	2133	2239
H-208	2417	2283	2133	2278
Means	2435	2512	2237	
S.E.		161.5		192.0

Table 7.13. Variance ratios for plant type x density trials of tall and normal genotypes at Hyderabad and Hissar, 1980-81.

Source	Total dry matter	Yield	Harvest Index
Hyderabad Trial-1			
Genotypes	6.91**	31.31**	92.98**
Spacings	23.98**	23.57**	1.11
Irrigations	30.60*	17.92*	0.01
Genotypes x Spacings	0.71	1.01	0.97
Genotypes x Irrigations	3.07*	3.47*	3.64*
Spacings x Irrigations	2.32	1.25	0.14
Genotype x Spacings x Irrigations	1.02	0.99	1.02
Hyderabad Trial-2			
Genotypes	1.06	3.90*	26.20**
Spacings	41.96**	72.70**	5.15*
Genotypes x Spacings	1.49	1.47	1.09
Hissar Trial-1			
Genotypes	0.69	0.91	0.87
Spacings	2.69*	0.94	0.49
Genotypes x Spacings	1.83*	1.12	1.44
Hissar Trial-2			
Genotypes	1.07	0.94	2.96
Spacings	0.43	0.38	1.32
Genotypes x Spacings	0.70	1.44	1.94

Table 7.14. Mean yields of tall and normal type chickpea genotypes tested at 3 population densities trials at Hyderabad and Hissar, 1980-81.

Plant type	Yield (kg/ha)		
	8 plants/m^2	33 plants/m^2	67 plants/m^2
Hyderabad Trial-1			
(a) Unirrigated			
Normal (3)*	1496	1791	1619
Tall (3)	1032	1200	1178
(b) Irrigated			
Normal (3)	1922	2321	2097
Tall (3)	1733	2056	1883
Hyderabad Trial-2			
Normal (2)	1291	1669	1979
Tall (8	750	1194	1165
Hissar Trial-1			
Normal (4)	1881	1874	2264
Tall (16)	1493	1399	1598
Hissar Trial-2			
Normal (2)	2208	2433	2133
Tall (6)	2510	2652	2271

*Values in parenthesis indicate number of lines in each plant type.

MULTISEEDED AND DOUBLE PODDED TYPES

Hybridisation

Five multiseeded lines, HMS-4, -5, -6, and -13 and -23 were included in a diallel cross to combine or concentrate genes for the multiseeded character. These five multiseeded lines were also crossed to six double podded lines, (ICCC-15, JG-62, NP-81, P-2994, P-4203 and RPSP-322-1) and crosses made of multiseeded on to high yielding lines (Table 7.15).

Table 7.15. Crosses between multiseeded and high yielding lines, 1980-81.

Cross No.	Pedigree	Cross No.	Pedigree
800480	HMS-4 x K-850	800491	HMS-13 x ICCC-13
800481	HMS-5 x H-208	800492	HMS-18 x Phule G-1
800482	HMS-6 x BG-203	800493	HMS-23 x Phule G-4
800483	HMS-8 x Pant G-114	800494	HMS-4 x Annigeri
800484	HMS-13 x F-378	800495	HMS-5 x ICCC-9
800485	HMS-18 x ICCC-10	800496	HMS-6 x C-104
800486	HMS-23 x ICCC-11	800497	HMS-8 x L-550
800487	HMS-4 x P-324	800498	HMS-13 x GL-629
800488	HMS-5 x P-326	800499	HMS-18 x P-9623
800489	HMS-6 x BDN 9-3	800500	HMS-23 x JG-74
800490	HMS-8 x ICCC-4		

F_1 generation

Thirty two F_1s and 12 parents of an 8 double podded line x 4 multiseeded tester set were evaluated in a randomised block design with four replications and a plot size of one row 3 m long and 60 cm apart at Hissar, where expression of the multiseeded character is best. Observations were recorded on five random plants. Line P-272 was killed by wilt, and was excluded from the analysis.

There were significant differences among crosses for all characters except days to maturity and seed yield (Table 7.16). The major proportion of the differences was due to differences between lines, those due to testers being significant only for days to flowering, pods per plant and seed size and the line x tester interaction only in the case of primary branches per plant. GCA variances were higher than SCA variances for days to flowering, pods per plant and seed size and the SCA variance was significant only in the case of primary branches perplant. The characteristics of the F_1s and parents are shown in Table 7.17.

Among lines, P-272 and P-502 were good combiners for earliness; Pant G-120 for pods per plant; and Hyb 16-3 for seed size. Among testers, HMS-18 was good for earli-

Table 7.16. Mean squares from the analysis of variance and estimates of general and specific combining ability variances in the 8x4 line x tester MS/DP trial, Hissar, 1980-81.

Source	d.f.	Days to 1st flower	Days to mature	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ plant	Weight of 100 seeds (g)	Yield/ plant (g)
Mean squares										
Replications	3	145.57	178.27	468.93	0.04	37.33	37727.70	0.09	2625.75	4.82
Crosses	31	324.57**	2.52	93.01*	0.29**	35.53*	12879.40**	0.14**	404.54	16.16**
Testers	7	525.27**	2.27	81.63	0.16	31.72	12902.60**	0.12	513.89	21.51**
Lines	3	1634.53**	2.56	221.77**	0.20	67.19**	61580.70**	0.40**	581.54	75.23**
Line x Tester	21	70.54	2.59	78.42	0.35**	32.28	5914.34	0.10	342.81	5.94
Error	93	50.27	2.49	58.56	0.11	21.88	4943.96	0.06	286.11	4.30
Variance estimates										
GCA		42.06**	-ve	3.05*	-ve	0.72*	1305.30**	0.01**	8.54	1.77**
SCA		5.07	0.03	4.96	0.06**	2.60	242.59	0.01	14.18	0.41

Table 7.17. Characteristics of entries in F_1 8 x 4 line x tester trial, Hissar 1980-81.

Entry	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/plant	Seeds/pod	Weight of 100 seeds(g)	Yield/plant (g)
79159	57.8	163	57.2	3.47	22.49	277.7	1.78	15.8	69.3
79160	67.8	163	55.1	3.67	24.20	202.9	1.45	15.2	45.1
79161	59.8	163	50.8	3.78	23.36	232.8	1.64	15.9	57.9
79162	58.2	162	50.9	3.23	19.30	182.5	2.11	15.3	52.8
79163	71.2	163	53.3	3.40	23.95	224.1	1.46	16.1	51.0
79164	71.8	163	59.6	3.36	17.82	235.8	1.46	15.0	51.3
79165	58.5	163	53.4	3.20	20.70	187.1	1.44	17.1	45.4
79166	58.2	163	58.3	3.21	19.82	231.4	1.44	15.2	48.7
79167	61.0	163	47.4	2.45	16.75	189.3	1.28	20.0	47.3
79168	72.8	163	54.4	3.56	19.13	271.0	1.39	16.3	61.6
79169	58.5	162	60.4	3.55	21.98	325.8	1.55	15.5	76.9
79170	58.0	165	60.2	3.20	16.38	249.4	1.66	15.2	55.2
79171	78.0	163	52.0	3.62	20.08	233.8	1.43	17.2	56.0
79172	69.8	163	50.4	3.20	20.60	279.0	1.43	14.0	57.1
79173	62.8	163	53.0	3.33	20.67	220.7	1.33	17.8	52.2
79174	61.8	163	61.0	3.27	24.37	324.9	1.42	15.8	71.7
79175	62.5	163	54.4	4.00	25.02	288.2	1.43	15.3	61.4
79176	77.2	163	59.7	3.47	23.77	273.6	1.78	13.0	62.6
79177	76.8	164	60.6	3.40	26.08	332.5	1.73	14.5	83.3
79178	69.5	164	49.5	3.33	20.69	186.2	1.37	18.7	45.8
79179	76.5	163	59.1	3.25	24.40	263.4	1.57	15.2	62.0
79180	71.8	163	60.2	3.53	24.97	347.5	1.52	13.1	68.8
79181	60.0	164	54.5	2.97	18.31	214.9	1.46	17.7	50.6
79182	60.2	166	66.9	3.47	22.13	243.1	1.64	14.1	55.3
79183	76.5	163	64.3	3.38	18.81	141.4	1.75	19.4	46.6
79184	88.5	163	56.7	3.42	18.00	173.9	1.80	18.5	57.8
79185	82.0	164	56.0	3.20	16.00	146.0	1.87	17.7	47.2
79186	67.8	165	55.2	3.24	17.91	122.6	1.62	20.8	40.6
79187	83.5	164	62.0	3.37	20.92	160.0	1.68	18.1	50.7
79188	78.2	162	64.0	3.73	27.40	217.8	1.72	16.4	59.6
79189	78.5	163	63.3	3.57	20.10	208.6	1.48	19.7	56.1
79190	78.0	163	60.1	3.60	22.90	216.3	1.75	18.7	71.2
P-502	57.5	165	49.8	2.95	11.80	141.5	1.42	14.9	29.6
Pant G-120	90.5	165	56.9	3.20	23.42	182.7	1.58	14.2	41.0
Hyb 16-3	86.0	164	66.6	3.17	14.33	83.6	1.59	16.8	21.4
HMS-4	51.2	163	49.7	3.46	18.93	253.0	1.61	15.6	63.2
HMS-8	83.5	164	60.3	3.37	23.47	192.3	2.06	12.0	44.4
HMS-13	78.5	163	52.9	3.10	17.08	200.1	1.84	13.8	50.4
HMS-18	50.2	166	57.8	3.20	18.23	229.6	1.58	15.1	54.1
HMS-22	90.2	163	56.9	3.38	30.71	174.6	1.55	14.5	41.5
HMS-23	78.0	164	59.0	3.75	24.20	312.8	1.59	12.1	59.5
HMS-28	50.8	165	60.2	3.30	18.51	185.5	1.50	17.6	46.7
HMS-30	50.0	164	54.8	3.50	21.40	222.4	1.83	14.0	57.2
CD (.5%)	9.96	2.32	10.53	0.44	6.12	91.96	0.30	2.78	21.43
CV%	10.4	1.0	13.4	9.3	21.1	29.8	13.8	12.5	28.6

ness and HMS-28 for seed size (Table 7.18). Estimates of specific combining ability were small and usually not significant (Table 7.19).

F_2 populations

At Hyderabad 24 F_2s of the previous season's 6 x 4 line x tester set (R.O.W. 1979-80, Table 7.9) and 37 other F_2's involving multiseeded and double podded parents (Table 7.20); and at Hissar 28 F_2 populations (Table 7.21) were grown in as spaced plants and 686 and 843 single plants were selected for further evaluation.

The frequency distributions for seed number pod for F_2 populations of K-850 and P-502 with HMS-8 are shown in Figure 7.1. Seeds per pod ranged from 1.00 to 1.87 (mean 1.23) in P-502 x HMS-8. Around ninety per cent of the plants have less than 1.5 seeds per pod, HMS-8 x K-850 has 61% plants and HMS-8 x P-502, 69% plants with less than 1.3 seeds per pod.

F_3 progenies

Single plants selected in 1979-80 from F_2 populations were evaluated as F_3 progeny rows at Hyderabad (351 progenies) and at Hissar (166 progenies). Each progeny was 2 rows 4m long, with 60 cm between and 20 cm within rows. Checks (Annigeri at Hyderabad and H-208 at Hissar) were planted after every 20 progenies. From each progeny 100 pods were harvested to estimate the number of seeds per pod. Eighty one progenies with more seeds/pod were selected for further tests

Table 7.18. Estimates of general combining ability effects and their standard errors in F_1 8 x 4 line x tester MS/DP trial, Hissar 1980-81.

	Days to 1st flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Seeds/ plant	Weight of 100 seeds (g)	Yield/ plant (g)
LINES									
P-272	-6.26^{**}_{*}	-0.31	-2.17	0.03	0.24	-9.59	0.02_{*}	-0.82	-4.16
P-502	-3.85	-0.12	-2.15	-0.12	-1.23	30.34_{*}	-0.14	-0.04_{*}	2.90
Pant G-120	0.15_{**}	0.34	1.12	0.04	1.95	37.30_{**}	-0.01_{*}	-1.30_{**}	4.38
Hyb 16-3	9.96	0.09	3.20	0.05	-0.96	-58.05	0.13	2.16	-3.12
SE (g_i)	1.77	0.39	1.91	0.08	1.17	17.58	0.06	0.52	4.23
TESTERS									
HMS-4	-4.73_{**}	-0.13	-1.19	-0.06	-0.45	-7.24	-0.02	1.11	-0.68
HMS-8	7.40	-0.38	-0 53	0.14	0.06	-1.06	0.03	-0.76	-0.08
HMS-13	0.09_{*}	-0.06	-0.02	0.09	0.64	27.93	0.12	-0.60	9.47
HMS-18	-5.79_{**}	0.44	-3.06	-0.14	-2.65	-46.19	0.11	0.96	-8.25
HMS-22	8.15	0.06	-0.39	0.02	1.12	-11.06	-0.04	0.14_{*}	-1.91
HMS-23	3.71	-0.56	1.54	0.07	1.48	38.64	-0.05	-1.87_{*}	2.34
HMS-28	-4.23	0.06	-0.95	-0.12	-1.27	-23.56	-0.15	1.57	-5.78
HMS-30	-4.60	0.56	4.61	0.00	1.09	22.53	-0.01	-0.55	4.89
SE (g_i)	2.51	0.56	2.71	0.12	1.65	24.86	0.09	0.73	5.98

Table 7.19. Estimates of specific combining ability effects in F_1 8 x 4 line x tester MS/DP trial, Hissar 1980-81.

	Days to 1st flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/plant	Seeds/Pod	Weight of 100 seeds(g)	Yield/plant (g)
P-272 x HMS-4	-0.43	0.44	3.58	0.12	1.48	63.14	0.20	-0.97	17.28
P-272 x HMS-8	-2.55	0.44	0.77	0.11	2.69	-17.87	-0.18	0.27	-7.53
P-272 x HMS-13	-3.24	0.13$_*$	-3.97	0.27	1.27	-16.85	-0.08$_{**}$	0.78	-4.28
P-272 x HMS-18	1.13	-1.63	-0.84	-0.04	0.49	6.92	0.40	-1.38	8.34
P-272 x HMS-22	0.20	0.25	-1.16	-0.03	1.38$_*$	13.39	-0.10	0.23	0.27
P-272 x HMS-23	5.13	0.38	3.23	-0.13	-5.11	-24.64	-0.10	1.20	-3.71
P-272 x HMS-28	-0.18	0.25	-0.51	-0.09	0.52	-11.17	-0.01	-0.16	-1.52
P-272 x HMS-30	-0.05	-0.25	-1.10	-0.20$_{**}$	-2.72	-12.91	-0.14	0.04$_*$	-8.85
P-502 x HMS-4	0.41	0.25	-6.30	-0.76	-2.79	-65.18	-0.14	2.39	-11.78
P-502 x HMS-8	0.04	0.25	0.05	0.15	-0.91	10.29	-0.07	0.59	1.90
P-502 x HMS-13	-6.90	-0.81	5.60$_*$	0.18	1.34	36.12	-0.01	-0.31$_*$	7.71
P-502 x HMS-18	-1.52	0.94	8.41	0.06$_*$	-0.97	33.89	0.11	-2.29	3.71
P-502 x HMS-22	4.54	-0.19	-2.45	0.33	-1.03	-16.88	0.04	0.61	-1.87
P-502 x HMS-23	0.73	0.19	-5.98	-0.14	-0.87	-21.36	0.04	-0.62	-4.98
P-502 x HMS-28	1.66	0.06	-0.89	0.18	1.95	-17.49	0.04	-0.25	-1.76
P-502 x HMS-30	1.04	-0.69	1.57	0.00$_{**}$	3.29	40.62	0.00	-0.12	7.06
Pant G-120 x HMS-4	-2.09	-0.72	-2.55	0.64	2.30	26.76	-0.11	-1.01	0.90
Pant G-120 x HMS-8	0.54$_*$	-0.47	2.12	-0.10	0.54	5.98	0.19	-1.45	1.47
Pant G-120 x HMS-13	7.35	0.22	2.54	-0.12	2.28	35.94	0.05$_*$	-0.08$_*$	12.61
Pant G-120 x HMS-18	5.98	-0.53	-5.59	0.04	0.17	-36.24	-0.31	2.52	-7.15
Pant G-120 x HMS-22	-0.96	-0.41	1.40	-0.20	0.11	5.73	0.05	-0.15	2.68
Pant G-120 x HMS-23	-1.27	0.22	0.51	0.04$_*$	0.32	40.14	0.00	-0.24	5.18
Pant G-120 x HMS-28	-5.09	-0.16$_*$	-2.65	-0.34	-3.59	-30.16	0.04	0.93	-4.88
Pant G-120 x HMS-30	-4.46	1.84	4.21	0.04	-2.12	-48.14	0.09	-0.53	-10.81
Hyb 16-3 x HMS-4	2.10	0.03	5.27	0.01	-1.00	-24.71	0.05	-0.41	-6.40
Hyb 16-3 x HMS-8	1.98	-0.22	-2.94	-0.16$_*$	-2.31$_*$	1.61	0.06	0.59	4.16
Hyb 16-3 x HMS-13	2.79	0.47	-4.17	-0.33	-4.89	-55.21	0.04	-0.38	-16.03
Hyb 16-3 x HMS-18	-5.59	1.22	-1.98	-0.06	0.31	-4.57	-0.20	1.14	-4.91
Hyb 16-3 x HMS-22	-3.77	0.34	2.22	-0.09	-0.46$_*$	-2.24	0.01	-0.70	-1.08
Hyb 16-3 x HMS-23	-4.59	-0.78	2.24	0.23	5.67	5.86	0.06	-0.34	3.50
Hyb 16-3 x HMS-28	3.60	-0.16	4.05	0.25	1.12	58.83	-0.08	-0.52	8.15
Hyb 16-3 x HMS-30	3.48	-0.91	-4.68	0.16	1.56	20.44	0.05	0.62	12.60
SE (S_{ij}-S_{ii})	4.34	0.97	4.69	0.20	2.86	43.06	0.15	1.27	10.36
SE (S_{ij}-S_{jj})	4.69	1.04	5.06	0.22	3.09	46.51	0.16	1.37	11.19
SE (S_{ij})	3.54	0.79	3.82	0.16	2.33	35.16	0.12	1.07	8.46

Table 7.20. List of F_2s grown at Hyderabad, 1980-81.

S.No.	Cross No.	Parentage	S.No.	Cross No.	Parentage
1.	78323	JG-62 x HMS-2	19.	79164	P-272 x HMS-23
2.	78324	JG-62 x HMS-3	20.	79165	P-272 x HMS-28
3.	78327	JG-62 x HMS-6	21.	79166	P-272 x HMS-30
4.	78328	JG-62 x HMS-7	22.	79168	P-502 x HMS-8
5.	78330	JG-62 x HMS-9	23.	79169	P-502 x HMS-13
6.	78331	JG-62 x HMS-10	24.	79170	P-502 x HMS-18
7.	78332	P- 36 x HMS-1	25.	79171	P-502 x HMS-22
8.	78333	P-436 x HMS-2	26.	79173	P-502 x HMS-28
9.	78334	P-436 x HMS-3	27.	79174	P-502 x HMS-30
10.	78337	P-436 x HMS-6	28.	79175	Pant G-120 x HMS-4
11.	78338	P-436 x HMS-7	29.	79176	Pant G-120 x HMS-8
12.	78340	P-436 x HMS-9	30.	79177	Pant G-120 x HMS-13
13.	78341	P-436 x HMS-10	31.	79178	Pant G-120 x HMS-18
14.	78357	K-850 x HMS-8	32.	79179	Pant G-120 x HMS-22
15.	78358	PRR-1 x HMS-5	33.	79181	Pant G-120 x HMS-28
16.	79160	P-272 x HMS-8	34.	79182	Pant G-120 x HMS-30
17.	79161	P-272 x HMS-13	35.	79185	Hyb 16-3 x HMS-13
18.	79162	P-272 x HMS-18	36.	79187	Hyb 16-3 x HMS-22
			37.	79190	Hyb 16-3 x HMS-30

Table 7.21. List of F_2s grown at Hissar, 1980-81.

S.No.	Cross No.	Parentage	S.No.	Cross No.	Parentage
1.	78325	JG-62 x HMS-4	15.	78363	Hyb 16-3 x HMS-18
2.	78326	JG-62 x HMS-5	16.	78371	Hyb 16-3 x HMS-30
3.	78362	JG-62 x HMS-18	17.	78342	Pant G-120 x HMS-2
4.	78366	JG-62 x HMS-22	18.	78343	Pant G-120 x HMS-3
5.	78370	JG-62 x HMS-30	19.	78346	Pant G-120 x HMS-6
6.	78360	P-436 x HMS-18	20.	78347	Pant G-120 x HMS-7
7.	78364	P-436 x HMS-22	21.	78349	Pant G-120 x HMS-10
8.	78368	P-436 x HMS-30	22.	78353	P-502 x HMS-4
9.	78345	Pant G-120 x HMS-5	23.	78354	P-505 x HMS-5
10.	78348	Pant G-120 x HMS-8	24.	78355	P-505 x HMS-8
11.	78361	Pant G-120 x HMS-18	25.	78357	K-850 x HMS-8
12.	78365	Pant G-120 x HMS-22	26.	78356	G-130 x HMS-8
13.	78369	Pant G-120 x HMS-30	27.	78359	H-208 x HMS-5
14.	78352	Hyb 16-3 x HMS-8	28.	78358	PRR-1 x HMS-5

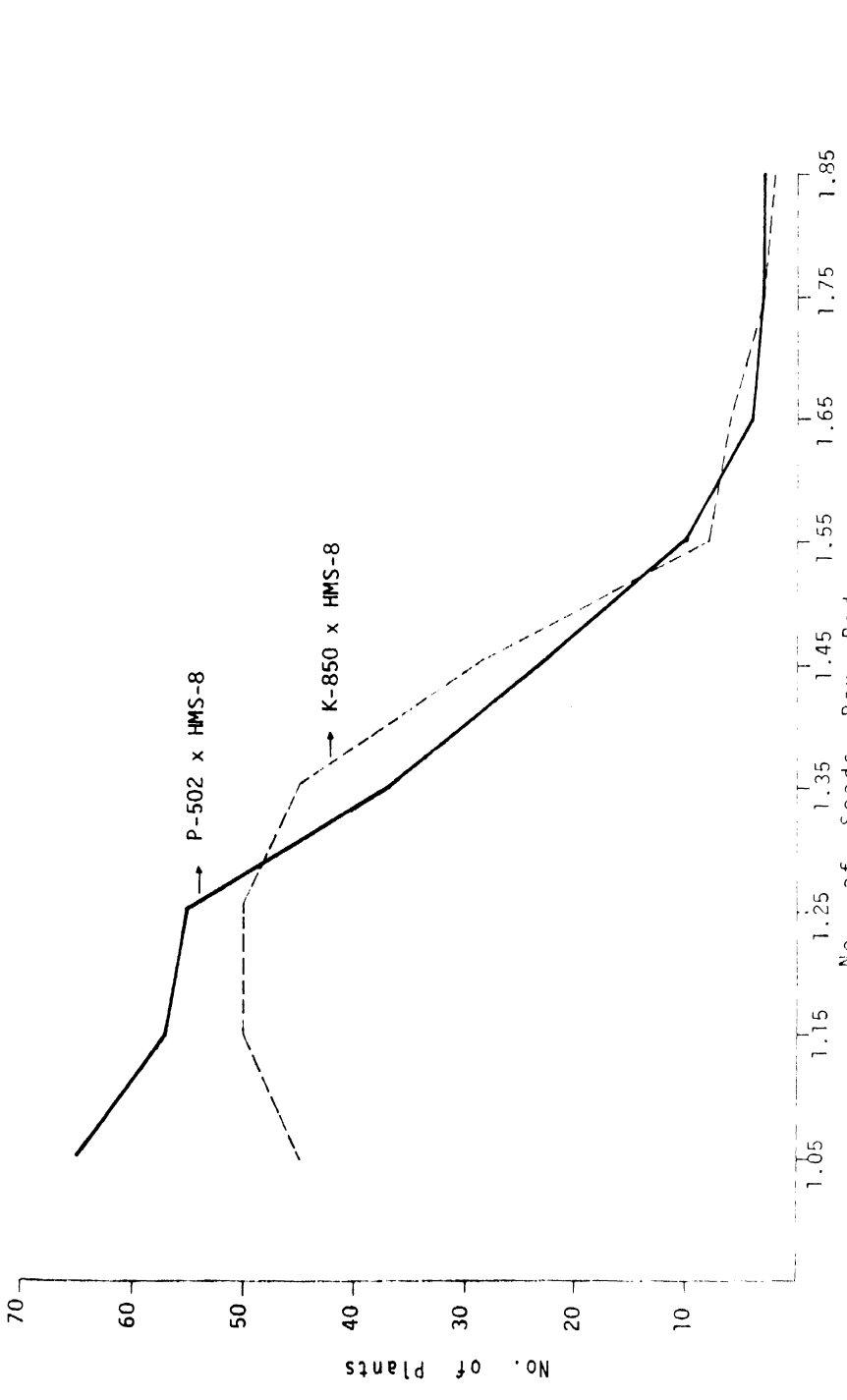

Fig. 7.1. Frequency distribution of seeds per pod in F_2 of two crosses with a multiseeded line.

PROJECT 8 : EVALUATION OF RECURRENT SELECTION AS A BREEDING METHOD

OBJECTIVES : 1. To examine the feasibility of utilising the diallel selective mating system for the production of high yielding cultivars.

2. To create diverse and dynamic gene pools for issue to cooperators.

The diallel selective mating system proposed by Jensen (1970) was initiated to increase recombination through recurrent crossing in the self-pollinated chickpea crop. F_2 families of the first selective mating series were planted in 1978-79 to initiate the second selective mating series. However proper evaluation could not be done owing to poor plant stands caused by poor germination and wilt. Results were therefore biased and difficult to interpret, and the project was discontinued. However, progenies from the first selective mating series in the F_5 generation were tested during the 1980-81 season.

Selected progenies from the single and double crosses, and the first selective mating series (96 + 4 checks) were planted in a 10 x 10 triple lattice during 1980-81. Unfortunately, most entries were killed by wilt and comparisons were not possible. Surviving lines with sufficient seed quantity will be tested in 1981-82.

PROJECT 9: COMPARISON OF BREEDING METHODS

OBJECTIVE: To generate information on suitable breeding methods and related information for developing high yielding cultivars.

INTRODUCTION

Two studies continued to: 1. compare the efficiency of the pedigree, bulk and single pod descent methods of breeding and 2. assess the variation generated by single, 3- and 4-way crosses. The use of off-season nurseries and extended day length to increase the rate of generation turnover is now routine, although further studies of extended day length are in progress in the Pulse Physiology Subprogram.

EFFICIENCY OF BREEDING METHODS

Studies of the pedigree (PM), bulk (BM) and single pod descent (SPDM) methods of breeding continued, based on six crosses made in 1977/78. This year F_4 generations were grown at Hyderabad in 4 m long rows 60 cm apart with 20 cm between plants within the rows.

The PM progenies were in 2 row plots with Annigeri and G-130 every 10 progenies for comparison. The SPDM bulks were sown in 10 to 24 row plots depending on availability of seed and the BM bulks in 50 rows.

Emergence was reduced due to poor seed bed conditions and there was some plant mortality due to wilts and root rots. Single plants were selected from the progenies and populations based on visual appearance and will be multiplied off-season for replicated tests in 1981/82. The numbers of progenies and populations grown and single plants selected are shown in Table 9.1.

Table 9.1. Numbers of single plants selected from the populations and progenies.

Cross No.	Cross	SPDM	Bulk method	Progeny method
IC-77329	Caina x Ponaflar	30	51	61 (86)[a]
IC-77401	JG-221 x F-404	31	54	56 (88)
IC-77402	P-324 x ICCC-5	33	53	38 (88)
IC-77423	F-496 x F-404	33	54	7 (30)
IC-77425	P-790 x P-1798	20	39	30 (64)
IC-77426	B-106 x NEC-989	31	57	27 (62)

[a]Numbers of progenies grown are given in parentheses.

EFFICIENCY OF 2-, 3- AND 4-WAY CROSSES

We continued the assessment of the variation generated by 2-, 3- and 4-way crosses using all possible single, 3- and 4-way combinations of the cultivars Annigeri, K-850, ICCC-1 and ICCC-2. (See ROW 1979/80, Table 9.2).

The multiple cross F_1s were advanced off-season in Kashmir and the 25 F_2s in the main season at Hyderabad. The plots were bulk-harvested for further tests in 1981/82.

PROJECT 11: INTERNATIONAL COOPERATION

OBJECTIVES:

a. To strengthen national and regional programs

b. To supply cultivars, segregating populations, and advanced breeding lines having specific characteristics (disease resistance, high yield, high protein, etc.) to cooperators for use in breeding and for release

c. To identify among lines, differences in adaptation regionally and internationally through multilocation testing, and to characterize environments in which chickpeas are grown

d. To promote international cooperation through personal visits, meetings and information exchange

INTERNATIONAL NURSERIES AND TRIALS

In 1980-81, we distributed 99 sets of seven different trials to 41 cooperators in 17 countries, a marked increase over the previous year. The types of trials were the same as in previous years, with the addition of an adaptation trial of a set of diverse genotypes to examine genotypic responses to environment.

Details of the trials, their distribution and summaries of the data recorded may be found in Chickpea Breeding Report Nos.9 and 11, both of which are available on request.

OTHER MATERIALS DISTRIBUTED

We also supplied a total of 1761 seed samples in response to specific requests. Most of these (1221) were distributed to centers in India and the remainder (541) were sent to other countries. Details of the centers and the materials supplied are given in Chickpea Breeding Progress Report 9. They included 147 species derivatives and various kabuli and desi types for our sister institute, ICARDA.

COOPERATION WITH AICPIP

We contributed three new desi entries (P-326, ICCC-22 and -23) to the Gram Initial Evaluation Trial (GIET) and three kabuli types (ICCC-24 to -26) to the Kabuli Coordinated Trials for 1980-81.

ICCC-4 and -13 were continued for a third year in the GCVT for central and Peninsular Zones.

We selected five desi (ICCC-27 to -31) and three kabuli entries (ICCC-32 to -34) to contribute to coordinated trials in 1981-82.

ICRISAT Chickpea Breeders participated in the Rabi Pulses Workshop at Udaipur in September 1980.

COOPERATION WITH ICARDA

As in the previous years we shared early and advanced generation breeding materials to ICARDA. The breeding material supplied to ICARDA included 85 F_1s of crosses for *Ascochyta* resistance. Thirteen of these were crosses of kabulis with resistant F_4 single plants (from the Isolation Plant Propagator screening) of interspecific crosses with *Cicer reticulatum* ; and others were with available tolerant lines. In addition, 19 F_2 to F_4 populations and 33 advanced breeding lines (ICCLs) were sent for testing at Aleppo. Details of the materials are given in Chickpea Breeding Progress Report-9.

VISITORS TO ICRISAT

Due to change of staff and other circumstances formal breeders meets were not held this year, but invitations were extended to breeders at Indian centers to visit ICRISAT Center and Hissar to examine the breeding plots and to select suitable materials for their own situations.

Three breeders visited Hyderabad in January/February and ten saw the ICRISAT and HAU plots at Hissar in March (Table 11.1) The visit to Hissar, highlighted the very severe disease situation in north India and emphasised the importance of resistance to the leaf diseases - *Botrytis* gray mold and *Ascochyta* and *Alternaria* blights - to improve crop stability.

We however recognise the importance of formal breeders meets in disseminating breeding materials, and plan to re-introduce them in the coming season.

In addition to breeders from Indian centers there were many others from India and elsewhere who visited the Chickpea Breeding Sub-program during 1980-81.

Table 11.1. List of scientists who participated in the Chickpea Cooperators Consultative Meetings at ICRISAT Center (January/February) and at Hissar (March) in 1981

Name	Designation	Institute
ICRISAT Center		
Dr. M.S. Lal	Senior Scientist, (Pulses)	Department of Plant Breeding & Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, JABALPUR-482004, MP
Dr. P.G. Thombre	Senior Scientist, (Pulses)	Agriculture Research Station, Badnapur, Distt: Aurangabad, Maharashtra
Mr. T. Madhava Rao	Assistant Plant Breeder (Pulses)	Medium Research Station, University of Agricultural Sciences, GULBARGA - 585102, Karnataka
ICRISAT, Hissar		
Dr. Md. Fazlul Haque	Senior Breeder (Pulses)	Ranchi Agricultural College, Kanke, RANCHI - 834006, Bihar
Dr. D.B. Raju		Division of Genetics, Indian Agricultural Research Institute (IARI), NEW DELHI - 110012
Dr. M.M. Verma	Senior Scientist (Pulses)	Department of Plant Breeding, Punjab Agricultural University, LUDHIANA - 141004 Punjab
Dr. T.S. Sandhu	Pulses Breeder	Department of Plant Breeding, Punjab Agricultural University, LUDHIANA - 141004, Punjab
Dr. M.P. Pandey	Pulse Breeder	Department of Plant Breeding, G.B. Pant University of Agriculture & Technology, PANTNAGAR - 263145, Distt. Nainital, UP
Mr. S.B. Lal		C.S. Azad University of Agriculture & Technology, KANPUR - 208002, UP
Miss C.N. Lawrance		- do -
Dr. R.V. Maheshwari	Assistant Economic Botanist	Agricultural Research Station, University of Udaipur, SRIGANGANAGAR - 335801, Rajasthan
Dr. D.M. Maurya	Professor & Head	Department of Genetics & Plant Breeding, N.D. University of Agriculture & Technology, P.O. Motinagar, FAIZABAD - 224001, UP
Dr. R.P. Katiyar	Plant Breeder (Pulses)	Department of Genetics & Plant Breeding, H.P. Krishi Vishwa Vidyalaya, PALAMPUR - 176062, Distt. Kangra, Himachal Pradesh

VISITS BY ICRISAT STAFF

We considerably expanded our visits to other centers. Visits overseas included Lebanon, Syria, Turkey, Bangladesh, Pakistan, Jordan, Tunisia, Algeria, Morocco and Spain (Table 11.2). In India we visited most of the centers where chickpea was being grown (Table 11.3) during the cropping season in order to see the ICRISAT and coordinated trials and to learn more of the problems in different areas.

WORKSHOP ATTENDED

Dr. J.B. Smithson attended the Workshop on *Ascochyta* Blight and Winter Sowing of Chickpeas at ICARDA, Aleppo, Syria, from 4 to 7 May 1981.

Table 11.2. Visits by ICRISAT Scientists to locations outside India in 1980-81

Country	Location	Persons contacted	Institution	Scientist visiting	Date
1980					
Lebanon	Terbol	Dr. G.C. Hawtin Dr. K.B. Singh	ICARDA	J.B. Smithson	15 May
Syria	Aleppo	Dr. G.C. Hawtin Dr. K.B. Singh	ICARDA	J.B. Smithson	15-20 May
Australia	Brisbane	Dr. D.E. Byth Dr. D.E. Drake	University of Queensland	J. Kumar	17 May-29 June
		Dr. R.B. Brinsmead	Hermitage Research Station	J. Kumar	18 June
Syria	Aleppo	Dr. G.C. Hawtin Dr. K.G. Singh	ICARDA	C.L.L. Gowda	28 May-3 June
USA	Raleigh	Dr. C.A. Brim	N. Carolina State University	S.C. Sethi	10 Jul - 6 Aug
Pakistan	Islamabad	Dr. Amir Muhammed Dr. B.A. Malik	Pakistan Agricultural Research Council	J.B. Smithson	3 August
	Tarnab	Dr. M. Siddiq	NWFP Ministry of Agriculture	J.B. Smithson	4 August
Turkey	Ankara	Dr. Nazmi Demir	Directorate of Agricultural Research	J.B. Smithson	6/7 August
	Hayman		Directorate of Agricultural Research	J.B. Smithson	7 August
1981					
Bangladesh	Joydebpur	Dr. A.K. Kaul	Bangladesh Agricultural Research Institute (BARI)	J.B. Smithson	14 February
	Jamalpur	Mr. Enamul Haq	BARI	J.B. Smithson	15 and 17 Feb
	Rajbari	Mr. A.H. Talukdar	BARI	J.B. Smithson	16 February
	Dinajpur		Agricultural Extension Training Institute (AETI)	J.B. Smithson	16 February

Contd....Table 11.2

Country	Location	Persons contacted	Institution	Scientist visiting	Date
Bangladesh	Thakurgaon		Rampur-Dinajpur Rehabilitation Center	J.B. Smithson	16 February
	Ishurdi	Mr. A. Islam	BARI	J.B. Smithson	18 February
	Joydebpur	Dr. A.K. Kaul	BARI	C.L.L. Gowda	14 March
	Ishurdi	Mr. A. Islam	BARI	C.L.L. Gowda	15 March
	Bogra	Mr. M.M. Bhuiya	BARI	C.L.L. Gowda	16 March
	Jessore	Mr. A. Ahmed	BARI	C.L.L. Gowda	17 March
	Faridpur	Mr. B. Hussain	AETI	C.L.L. Gowda	18 March
Pakistan	Islamabad	Dr. A. Muhamed Dr. B.A. Malik	PARC	J.B. Smithson	15/16 March
	Karak		NWFP Ministry of Agriculture	J.B. Smithson	17 March
	Tarnab	Dr. M. Siddiq	NWFP Ministry of Agriculture	J.B. Smithson	18 March
	Faisalabad	Dr. M. Aslam	Faisalabad Agricultural University	J.B. Smithson	19 March
	Faisalabad		Nuclear Institute for Agriculture & Biology	J.B. Smithson	19 March
	Faisalabad	Dr. M. Tufail	Ayub Khan Agricultural Research Institute (AARI)	J.B. Smithson	19 March
	Kallurkot		AARI	J.B. Smithson	20 March
	Lahore	Mr. J.R. Lockman	Technical Services Agricultural Project	J.B. Smithson	22 March
	Attock		AARI	J.B. Smithson	23 March

Contd....Table 11.2

Country	Location	Persons contacted	Institution	Scientist visiting	Date
Syria	Aleppo	Dr. G.C. Hawtin Dr. K.B. Singh	ICARDA	J.B. Smithson	4-7 May
Jordan	Amman	Dr.Nasri Haddad	University of Jordan	J.B. Smithson	8 May
	Ramtha		Ministry of Agriculture	J.B. Smithson	10 May
	Marrow		Ministry of Agriculture	J.B. Smithson	10 May
Tunisia	Matur	Mr.B.Hamidi	Office des cereales	J.B. Smithson	12 May
	Fritissa		Office des cereales	J.B. Smithson	12 May
	Beja	Mr.Maomouri	INRAT	J.B. Smithson	12 May
	Tunis	Mr.Mlaiki Mr.El Johari	INRAT	J.B. Smithson	13 May
	Tunis	Mr.Ghaelekan	Office des cereales	J.B. Smithson	13 May
Algeria	Sidi bel Abbiss	Mr. Bouziani	Institute de Developpement des Grandes Cultures (IDGC)	J.B. Smithson	14 May
	Saida		IDGC	J.B. Smithson	15 May
Morocco	Debaq	Mr.M. Kamal Mr.S. Bouazzu	Institut Nationale de la Recherche Agronomique (INRA)	J.B. Smithson	18 May
	Guich		INRA	J.B. Smithson	18 May
	Mechouch	Mr.Lyanaria Abderrahmane	INRA	J.B. Smithson	18 May
	Osayet	Mr.Benhalma Hamid		J.B. Smithson	19 May

Contd....Table 11.2.

Country	Location	Persons contacted	Institution	Scientist visiting	Date
Spain	Cordoba	Dr.J. Cubero Dr. R.J. Diaz	Institut National Investigacionas Agrarias (INIA)	J.B. Smithson	21 May
	Madrid	Dr. Benlloch	INIA	J.B. Smithson	22 May
	Salamanca	Mr.Santos Cordera	INIA	J.B. Smithson	23 May

Table 11.3. Visits by ICRISAT scientists to locations in India, 1980-81.

Location	State	Persons contacted	Institution	Scientist visiting	Date
1980					
Pantnagar	Uttar Pradesh	Dr. B.P. Pandya Dr. M.P. Pandey	G.B. Pant University of Agriculture & Technology	J.B. Smithson	28 June
Ludhiana	Punjab	Dr. T.H. Singh Dr. T.S. Sandhu Dr. B.S. Bhullar	Punjab Agricultural University	J.B. Smithson S.C. Sethi	30 June 29/30 June
Hissar	Haryana		ICRISAT/HAU	J.B. Smithson	1 July
New Delhi	New Delhi	Dr. P.N. Bahl	IARI	J.B. Smithson	3 July
Srinagar	Jammu & Kashmir			J.B. Smithson S.C. Sethi	21/24 August
Srinagar	Jammu & Kashmir			S.C. Sethi	7/14 September
Hissar	Haryana		ICRISAT/HAU	J.B. Smithson	18/19 September
Gwalior	Madhya Pradesh		ICRISAT/College of Agriculture	J.B. Smithson	15 October
Hissar	Haryana		ICRISAT/HAU	J.B. Smithson	16/17 October
Hissar	Haryana		ICRISAT/HAU	C.L.L. Gowda	28/29 October
Gwalior	Madhya Pradesh		ICRISAT	C.L.L. Gowda	30 October
Gwalior	Madhya Pradesh		ICRISAT/College of Agriculture	J.B. Smithson	12 November
Hissar	Haryana		ICRISAT/HAU	J.B. Smithson	13/14 November
Bangalore	Karnataka	Prof. G. Shivashanker	University of Agril. Sciences	J.B. Smithson	29 November
Vamban	Tamil Nadu	Mr. C. Rajagopalan	State Department of Agriculture	J.B. Smithson	1 December
Kudumiamalai	Tamil Nadu	Dr. K. Muthusamy	Agril. Extension Res. Institute	J.B. Smithson	1 December
Hissar	Haryana		ICRISAT/HAU	Jagdish Kumar	1/4 December
Cochin	Kerala	Dr. George Peter	State Ministry of Agriculture	J.B. Smithson	3 December
Coimbatore	Tamil Nadu	Prof. P.V. Marappan Prof. R.S. Annappan	Tamil Nadu Agricultural University	J.B. Smithson	4 December
Hissar	Haryana		ICRISAT/HAU	J.B. Smithson	11/14 December

Contd....Table 11.3.

Location	State	Persons contacted	Institution	Scientist visiting	Date
1981					
Raichur	Karnataka	Mr. T. Madhava Rao	Regional Research Station, UAS	J.B. Smithson	23 January
Gulbarga	Karnataka	Dr. M.M. Raghumurthy Mr. T. Madhava Rao	Regional Research Station, UAS	J.B. Smithson	2 February
Rahuri	Maharashtra	Dr. R.B. Deshmukh	Mahatma Phule Krishi Vidyapeeth	J.B. Smithson	3 February
Badnapur	Maharashtra	Dr. P.G. Thombre	Marathwada Agricultural University	J.B. Smithson	4 February
Nathnagar	Maharashtra	Dr Kalekar	Intensification of Research and Training for Pulses & Oilseeds, Marathwada Agril. University	J.B. Smithson	4 February
Akola	Maharashtra	Dr. G.R. Fulzele	Punjabrao Agricultural University	J.B. Smithson	5 February
Washin	Maharashtra		Agricultural Research Station, Punjabrao Agril. University	J.B. Smithson	6 February
Parbhani	Maharashtra	Dr. Y.S. Nerkar	Marathwada Agricultural University	J.B. Smithson	6 February
Junagadh	Gujarat	Mr. A.S. Kavar	Gujarat Agricultural University	Jagdish Kumar	10 February
Ratia	Gujarat		Agricultural Research Station	Jagdish Kumar	11 February
Nayagarh	Orissa	Mr. L. Mangaraj	Pulses Research Station	C.L.L. Gowda	11 February
Bhubaneshwar	Orissa	Dr. B.N. Samolo	College of Agriculture	C.L.L. Gowda	12 February
Hissar	Haryana		ICRISAT/HAU	J.B. Smithson	11/12 February
New Delhi	New Delhi	Dr. P.N. Bahl	IARI	J.B. Smithson	13 February
Nagpur	Maharashtra	Mr. N.N. Potkile	College of Agriculture, PKV	Jagdish Kumar	4 March
Jabalpur	Madhya Pradesh	Dr. M.S. Lal	AICPIP (Pulses), JNKVV	Jagdish Kumar	5 March
Powarkheda	Madhya Pradesh	Dr. D.P. Nema	Zonal Research Station	Jagdish Kumar	6 March
Bhiwani	Haryana		Haryana Agricultural University	S.C. Sethi	6 March
Durgapura	Rajasthan	Mr. S.M. Bhatnagar	Agricultural Research Station	S.C. Sethi	7 March
Sehore	Madhya Pradesh	Mr. H.K. Sharma	College of Agriculture	Jagdish Kumar	7 March
Indore	Madhya Pradesh	Mr. S.W. Telang	College of Agriculture	Jagdish Kumar	7 March

Contd....Table 11.3.

Location	State	Persons contacted	Institution	Scientist visiting	Date
Khandwa	Madhya Pradesh	Dr. P.N. Bhalla	JNKVV Jaswari Farm	Jagdish Kumar	8 March
Kota	Rajasthan			S.C. Sethi	8 March
Jaipur	Rajasthan			S.C. Sethi	9 March
Bawal	Haryana	Dr. A.S. Faroda	Regional Research Station, HAU	S.C. Sethi	9 March
Mathura	Uttar Pradesh	Dr. Dharam Singh Mr. Brij Pal Singh	Regional Agricultural Testing and Demonstration Station(RATDS) U.P. Department of Agriculture	Onkar Singh	10 March
Etawah	Uttar Pradesh	Mr. P.D. Dube Mr. J.S.L. Srivastava	RATDS, U.P. Department of Agriculture	Onkar Singh	11 March
Jhansi	Uttar Pradesh	Dr. N.K. Gupta Mr. R.S. Gupta	RATDS, U.P. Department of Agriculture	Onkar Singh	12 March
Gwalior	Uttar Pradesh		ICRISAT/College of Agriculture	Onkar Singh	13 March
Faridkot	Punjab		Punjab Agricultural University	S.C. Sethi	16 March
Sriganganagar	Rajasthan	Dr. R.V. Maheshwari	Agricultural Research Station, University of Udaipur	S.C. Sethi	16 March
Loomkansar	Rajasthan			S.C. Sethi	17 March
Hanumangarh	Rajasthan	Dr. D.L. Jain	Agricultural Research Station	S.C. Sethi	18 March
Sirsa	Haryana		IARI Regional Research Station	S.C. Sethi	18 March
Kanpur	Uttar Pradesh	Dr. J.S. Sindhu	C.S. Azad University of Agriculture & Technology	S.C. Sethi	22 March
Faizabad	Uttar Pradesh	Dr. D.M. Maurya	N.D. University of Agriculture & Technology	S.C. Sethi	23 March
Varanasi	Uttar Pradesh	Dr. R.M. Singh	Banaras Hindu University	S.C. Sethi	25 March
Dholi	Bihar	Dr. S.K. Choudhary	Rajendra Agricultural University	Onkar Singh	25 March
Ranchi	Bihar	Mr. A.K. Mukherjee	Birsa Agricultural College	Onkar Singh	26/27 March

Contd....Table 11.3.

Location	State	Persons contacted	Institution	Scientist visiting	Date
New Delhi	New Delhi	Dr. P.N. Bahl	IARI	J.B. Smithson	27 March
Gwalior	Madhya Pradesh	Mr. M.D. Gupta	ICRISAT	J.B. Smithson	28 March
		Dr. A.S. Tiwari	Agricultural Research Institute	J.B. Smithson	28 March
Berhampore	West Bengal	Dr. K. Sengupta	Pulses and Oilseeds Research Station	Onkar Singh	28 March
Gwalior	Madhya Pradesh	Mr. M.D. Gupta	ICRISAT	K.S. Prakash	27/28 March
Hissar	Haryana		ICRISAT/HAU	Jagdish Kumar	29 March/ 3 April
Hissar	Haryana		ICRISAT/HAU	K.S. Prakash	30/31 March
Hissar	Haryana	Dr. B.S. Dahiya	ICRISAT/HAU	J.B. Smithson	30 March
New Delhi	New Delhi	Dr. P.N. Bahl Dr. D.B. Raju	IARI	Jagdish Kumar S.C. Sethi H.D. Upadhyaya	(4 April
Pantnagar	Uttar Pradesh	Dr. B.P. Pandya Dr. M.P. Pandey	G.B. Pant University of Agriculture & Technology		(6 April
Palampur	Himachal Pradesh	Dr. H.R. Kalia Dr. R.P. Katiyar Dr. O.P. Sood	H.P. Krishi Vishwa Vidyalaya (HPKVV)		(9 April
Mallan		Dr. H.C. Gautam	Rice Research Institute (HPKVV)	Jagdish Kumar Onkar Singh	(9 April
Gurdaspur	Punjab	Mr. A.S. Gill	Regional Research Station (PAU)	H.D. Upadhyaya	(10 April
Ludhiana	Punjab	Dr. M.M. Verma Dr. T.S. Sandhu Dr. B.S. Bhullar	Punjab Agricultural University		(11 April
Hissar	Haryana		ICRISAT/HAU	Jagdish Kumar C.L.L. Gowda	13/20 April 21/26 April
Srinagar	Jammu & Kashmir			S.C. Sethi	29 May/13 June

PROJECT 12: GENETIC STUDIES OF QUALITATIVE AND QUANTITATIVE CHARACTERS

OBJECTIVES:
a. To collect information on mode of inheritance of qualitative and quantitative characters of interest.
b. To work out correlations between yield and other characters for computing selection indices.

We study inheritance of qualitative characters to help us plan better the breeding strategy.

RESISTANCE TO *FUSARIUM* WILT

The F_1, F_2 and F_3 generations of a diallel cross of WR-315, CPS-1 and C-104 were studied in screenhouse and field conditions for resistance to race 1. WR-315 and CPS-1 showed no segregation for resistance and each differed by one gene for resistance from C-104. Crosses of resistant parents with JG-62 gave more susceptible segregates than expected for one gene segregation. A paper on inheritance of resistance was submitted for publication in Phytopathology. Further studies are in progress.

NODULATION CAPACITY

F_2 populations, F_3 single plant progenies and parents of the cross K-850 x 12-071-04244 involving high and low nodulating parents (ROW 1979-80) were studied by pulse microbiology in pots in glasshouse conditions for nodule number and weight. There were much variations for nodule number and weight within parents. The range in K-850 (high) and 12-071-04244 (low) overlapped. It was apparent that environmental conditions were not uniform so no conclusions were drawn. It was decided to harvest single plant seed of the parents and study their performance.

PROTEIN CONTENT

Under Project CP-brd-6.

INHERITANCE OF SEED COAT COLOR

A black seeded strain, Kaka, was crossed to a yellow seeded (desi) and a white seeded (kabuli) strains in 1976-77 to study inheritance of seed coat color. Segregation occurred

in the F_2 seed itself, but most were black seeded. This indicated that genes for black seed coat may be dominant. The seed was grouped into six color classes ranging from yellow to black. Segregation in yellow seeded plants (assumed recessive because of low frequency in F_3 seed) continued in the F_4 generation studied in this season. This indicates complex mechanism of inheritance. The data are being summarized and will be reported later.

PROJECT 13: BREEDING CHICKPEAS FOR EARLY SOWING

OBJECTIVE : Breeding for adaptation to early sowing in peninsular India.

INTRODUCTION

In peninsular India the growth of chickpeas is terminated by increasing temperatures and moisture stress after mid-February. Early planting, in mid-September, can be expected to increase yields by prolonging the growing season and providing better soil moisture conditions during crop establishment.

Experiments were initiated in the 1978/79 season at ICRISAT Center to study cultivaral responses to early sowing, as indicated by plant growth characteristics and yield components, and to identify genotypes adapted to September planting. In the past two years nearly 500 germplasm collections and 100 breeders' lines have been evaluated in various screening trials under early planted conditions. Medium to long duration lines produced the highest yields. The relationship between yield and flowering duration indicated that for producing higher yields a cultivar should possess the ability to utilize the longer growing season provided by early planting.

HYBRIDISATION

Twenty crosses (Table 13.1) were made among parents giving consistently good performance in early sown trials during the past two seasons.

Table 13.1. Crosses made for adaptation to early sowing.

Cross number	Pedigree
IC-800520	IC-7357-22-3-B-BH x K-850
800521	IC-7389-18-6-B-BH x K-850
800522	IC-73167-5-3-B-BH x CPS-1
800523	P-1329 x Chafa
800524	IC-7343-14-3-B-BH x N-59
800525	P-4089-1 x NEC-229
800526	P-18 x WR-315
800527	IC-73111-8-2-B-BP x K-850
800528	P-1067-1 x Annigeri
800529	Check-2 x CPS-1
800530	P-258 x Chafa
800531	IC-73187-3-3-3H-BP x WR-315
800532	Pusa-63 x N-59
800533	IC-73154-12-1-1P-BP x Annigeri
800534	P-1329 x P-4089-1
800535	IC-7357-22-3-B-BH x P-18
800536	P-1067-1 x IC-73111-8-2-B-BP
800537	Check-2 x P-258
800538	IC-7389-18-6-B-BP x Pusa-63
800539	IC-73187-3-3-3H-BP x IC-73154-12-1-1P-BP

The F_1s have been sown in an off-season nursery in Kashmir to produce F_2 seed for screening under early sown conditions in 1981/82.

EARLY VS. NORMAL SOWN TRIAL

On the basis of past two years performance a set of 47 genotypes was chosen to constitute an Early vs. Normal Sown Trial for the 1980/81 season. The trial comprised 49 entries - 47 test lines and two check cultivars, Annigeri and G-130 - and was sown on 15 September and 20 October in a 7 x 7 quadruple lattice design in two separate but adjacent blocks. The soil type was Vertisol. Due to dry conditions a presowing irrigation was given to the normal sown trial to ensure good germination and plant stand but the early sown trial was unirrigated. Each entry was planted on three ridges, two rows per ridge, 4 m long. The spacing between the ridgeswas 60 cm and within the rows 10 cm.

Final plant stand, days to 50% flowering, days to end of flowering, days from 50% flowering to end of flowering(flowering duration), days to maturity, days from 50% flowering to maturity (reproductive period) were recorded for each plot. Plant height, number of primary and secondary branches, pod number, number of seeds per pod, seed number and 100-seed weight were recorded on 5 plants per plot. At harvest 4 central rows of 3.5 m length were harvested as net plot for grain yield. In addition, the entries were scored for plant vigour, iron chlorosis and reaction to *Fusarium* wilt.

The data were combined to compare the effects of sowing dates, entries and the interaction between them. Mean squares from the analysis of variance are given in Table 13.2 and the characteristics of the 49 entries are summarised in Tables 13.3 and 13.4.

Early planting significantly delayed flowering, end of flowering and maturity, and reduced the reproductive period, plant height, pod number, seed number and grain yield. The normal sown trial was more vigorous and showed less iron chlorosis than early sown trial. The incidence of *Fusarium* wilt was higher in normal planting than in early planting. There were no significant differences between the two sowings for flowering duration, primary and secondary branches, seeds per pod and 100-seed weight. The reduced yields in the early planting thus appears to result from a decrease in the numbers of pods and seeds per plant.

There were significant differences among entries for all characteristics and for the interaction between sowing dates and entries for all characteristics except plant height. In both sowings, N-31, T-120, JG-112 and K-4-1 began and completed flowering, and K-4-1 and T-120 matured, significantly earlier than other genotypes and P-1092, P-1620-1 and C-162 were the latest to flower and to maturity. The flowering of the longer

ble 13.2. Mean squares from the combined analysis of variance of Early vs Normal Sown Trial at Hyderabad, 1980/81.

urce of riation	D.F.	Final plant stand	Days to 50% flowering	Days to end of flowering	Days to maturity	Flowering duration	Reproductive period	Plant height (cm)	Primary branches	Secondary branches	Pod Number	Seed Number	Seeds/ pod	Weight of 100 seeds (g)	Seed Yield (kg/ha)
wing date	1	24483.70*	3030.86**	2182.71**	1081.12**	69.45	491.63*	1770.80**	6.95	2.96	10869.5*	15928.4*	.083	0.11	7164040**
ror(a)	6	1951.39	20.40	70.82	66.84	61.37	63.66	56.76	1.33	8.72	1908.9	2347.9	.052	10.17	158731
tries	48	1338.17**	1657.45**	1661.47**	1872.24**	50.86**	60.37**	91.60**	0.40**	4.79**	672.9**	873.0**	.069**	47.14**	903376**
wing date x entries	48	758.74**	52.13**	76.28**	234.96**	19.09**	108.74**	5.58	0.32*	3.97**	328.6**	354.0**	.037**	6.58*	141638**
ror(b)	288	307.15	8.97	12.15	18.16	7.85	15.47	5.45	0.21	0.95	0.2	190.5	.023	3.19	54949

*, ** Significant at 0.01 and 0.05 levels of probability, respectively.

Table 13.3. Plant characteristics of entries in Early and Normal Sown Trial at Hyderabad, 1980/81.

ICC/IC number	Pedigree	Final plant stand		Days to 50% flowering		Days to end of flowering		Flowering duration		Days to maturity		Reproductive period		Plant height (cm)		Primary branches/ plant		Secondary branches/ plant	
		Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.
7357-22-B-BH-BH	L-550 x K-468	91	80	61	61	82	84	20	23	100	106	39	44	34	39	2.7	3.3	3.6	5.2
1496	P-1292-1	101	85	60	53	82	81	23	28	101	105	41	52	34	38	2.9	3.2	4.3	4.1
73129-16-1-B-BP	JG-62 x Radhey	111	83	52	48	75	73	23	24	87	92	35	43	30	35	2.7	3.1	4.1	3.6
445	P-332-1	120	43	48	48	70	70	22	23	83	98	35	50	29	32	2.8	2.8	3.8	2.6
73167-5-3-B-BH-BH	JG-62 x F-496	112	103	58	54	86	81	27	27	101	104	42	49	31	38	3.0	3.3	4.3	4.9
5676	K-4-1	105	75	45	44	62	65	18	22	77	88	33	44	33	35	2.6	2.7	3.6	1.7
7389-18-6-B-BH-BH	K-850 x F-378	112	83	52	49	74	71	22	21	87	101	34	52	32	35	2.7	3.0	3.6	4.1
915	P-726-1	108	96	50	48	71	67	20	19	85	92	33	43	29	30	2.4	2.7	3.1	2.4
867	P-690	121	110	54	49	76	70	21	21	89	96	34	46	27	30	2.9	2.5	3.8	3.4
6121	JG-112	107	70	44	44	62	65	17	21	87	87	42	43	31	33	2.7	2.4	3.9	0.6
8932	N-31	96	67	45	42	64	64	18	22	87	88	42	45	31	34	2.6	2.7	4.7	1.4
73136-31-4-1H-BP	JG-62 x BEG-482	82	59	58	58	79	84	21	25	94	105	35	46	32	38	3.2	3.1	4.3	5.0
6001	T-120	83	83	44	43	60	65	16	22	79	89	34	46	31	35	3.1	2.5	3.2	0.7
1565	P-1329	111	93	55	54	79	78	24	24	96	103	41	49	31	35	3.1	2.5	4.0	4.1
3405	P-4089-1	96	91	58	55	78	78	21	24	96	101	39	47	29	33	2.4	3.1	4.2	3.4
1896	P-1515-3	116	88	61	55	83	82	22	26	103	105	41	50	33	38	2.2	3.0	4.1	4.6
25	P-18	119	102	54	52	75	75	21	23	89	99	35	47	31	37	2.8	2.8	3.8	2.9
7343-14-3-B-BH-BH	H-208 x USA-613	104	87	62	63	83	82	20	18	102	106	40	42	34	39	2.4	2.7	3.4	4.2
73162-2-2-2P-BH-BH	JG-62 x F-370	110	73	63	64	85	84	22	19	105	106	41	41	33	38	2.4	2.8	3.4	4.1
517	P-392-1	116	101	61	57	85	80	23	23	102	102	41	45	30	34	2.6	2.6	5.0	4.0
638	P-500	79	105	63	63	83	80	20	17	100	103	37	40	31	35	2.7	2.4	4.5	3.3
73111-8-2-B-BP	K-850 x H-208	108	100	71	67	91	87	20	20	113	108	42	41	33	35	2.8	3.0	4.7	4.9
1156	P-1067-1	111	95	62	58	85	83	23	26	103	104	40	47	33	38	3.0	3.4	5.3	4.3
73154-12-1-1P-BP	JG-62 x No.42	89	37	71	68	91	87	20	19	113	107	42	39	35	41	2.8	2.7	4.7	5.2
1681	P-1395-2	105	68	67	67	89	89	23	22	112	110	45	43	33	37	2.9	3.1	4.5	5.1
304	P-234-1	86	93	67	66	87	87	20	21	104	106	37	40	32	37	2.5	3.0	4.3	4.3
5486	V-27	111	98	64	61	82	82	19	22	100	104	37	43	29	35	2.8	3.1	4.1	4.3
885	P-702	93	80	84	76	104	96	20	19	133	116	49	40	33	37	2.6	3.1	4.2	4.9
73141-3-2-1P-BP	JG-62 x K-4	70	31	62	59	85	86	23	27	103	110	42	51	32	35	2.8	2.0	3.9	3.4
226	P-179	93	83	81	71	101	95	21	24	122	112	42	42	29	35	2.7	2.7	4.9	4.7
5061	Check-2	91	103	85	75	105	96	21	21	130	116	46	42	32	38	2.3	2.8	2.9	5.4
190	P-156	98	81	86	78	107	98	21	20	135	121	49	42	35	40	2.5	2.9	3.6	6.5
1737	P-1430	83	86	83	73	104	97	21	24	131	113	48	40	34	35	2.3	2.8	4.3	4.5
346	P-258	88	59	91	78	115	101	24	24	138	125	48	47	34	40	2.6	3.3	3.7	6.8
435	P-319-1	90	95	86	68	106	98	22	30	134	117	49	49	33	37	2.3	2.9	3.5	4.6
1745	P-1435	83	71	85	77	106	97	21	19	132	116	47	38	37	39	2.5	2.9	4.2	5.6
1743	P-1434	100	87	72	69	95	90	22	22	116	110	44	41	33	38	2.9	3.0	5.1	4.3
1160	P-1071-1	83	105	85	75	107	96	23	21	130	115	45	40	35	39	2.5	2.6	4.3	4.5
3556	P-4243-3	90	92	85	76	106	99	21	23	137	115	52	39	31	37	2.0	3.1	4.0	4.9
772	P-613	119	84	74	72	95	92	21	20	120	113	45	41	33	39	2.4	3.2	4.3	4.8

ntd....Table 13.3.

ICC/IC number	Pedigree	Final plant stand		Days to 50% flowering		Days to end of flowering		Flowering duration		Days to maturity		Reproductive period		Plant height (cm)		Primary branches/ plant		Secondary branches/ plant	
		Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.
30	Pusa-63	102	88	84	73	110	97	25	24	134	118	50	45	36	41	2.2	2.7	3.3	4.7
187-3-3-3H-BP	G-130 x JG-24	78	56	88	77	109	97	21	20	128	118	40	41	36	39	2.3	2.8	4.1	6.6
3	P-476	107	66	96	79	116	101	19	22	139	119	43	40	33	39	2.0	3.0	4.0	6.9
25	P-4228	84	95	86	79	116	102	29	22	139	121	52	41	34	37	1.8	2.8	3.5	4.5
03	P-1620-1	88	78	99	86	118	103	19	17	141	126	42	40	44	52	2.3	2.8	3.6	3.6
66	P-1092	77	92	103	86	118	103	15	17	143	125	40	39	42	45	2.5	2.7	3.0	3.9
57	C-162	85	83	98	86	118	103	19	18	142	126	44	41	41	42	2.5	2.8	4.0	4.9
48	G-130	80	71	83	70	114	93	31	24	134	115	52	46	35	40	2.4	3.2	4.2	5.7
18	Annigeri	83	42	48	47	64	67	16	19	81	93	33	46	27	30	3.5	3.3	4.0	2.1
	S.E.	8.8		1.5		1.7		1.4		2.1		2.0		1.2		0.2		0.5	
	Mean	97	81	69	64	91	86	21	22	111	108	42	44	33	37	2.7	2.9	4.0	4.3
	S.E.	3.2		0.3		0.6		0.6		0.6		0.6		0.5		0.1		0.2	
	CV%	18.0	24.2	4.0	4.9	3.5	4.4	12.5	13.4	4.5	3.0	11.1	6.4	6.9	6.4	17.8	15.8	20.5	25.7

Table 13.4. Yield and disease characteristics of entries in Early and Normal Sown Trial at Hyderabad, 1980/81.

ICC/IC number	Pedigree	Pod number/ plant		Seed number/ plant		Seeds/pod		Weight of 100 seeds (g)		Seed Yield (kg/ha)				*Fusarium* wilt score		Vigor score 5 Nov		Vigor score 10 Nov		Iron chlorosis score	
		Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Rank	Nor.	Rank	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.
'357-22-B-BH-BH	L-550 x K-468	33	46	42	57	1.25	1.22	18.83	19.72	890	21	1337	16	1	2	5	5	5	2		
496	P-1292-1	33	29	38	32	1.16	1.15	19.28	21.79	820	25	1003	26	1	1	4	5	1	1		
'3129-16-1-B-BP	JG-62 x Radhey	29	46	29	50	1.05	1.09	16.07	18.04	1017	13	1327	17	1	3	5	6	1	1		
45	P-332-1	40	68	42	88	1.05	1.20	12.44	11.12	850	22	627	42	2	7	6	5	1	1		
'3167-5-3-B-BH-BH	JG-62 x F-496	40	45	46	54	1.15	1.22	12.18	14.39	947	17	1454	13	1	2	4	4	1	1		
676	K-4-1	26	49	27	49	1.03	1.00	34.68	30.26	1156	5	1743	2	1	1	7	9	1	1		
'389-18-6-B-BH-BH	K-850 x F-378	32	60	34	61	1.05	1.03	23.41	23.02	1011	14	1516	11	1	2	5	5	1	1		
15	P-726-1	32	49	35	48	1.10	0.94	19.49	18.45	1048	10	1370	15	1	1	5	5	1	1		
67	P-690	36	41	39	43	1.06	1.07	15.99	15.97	1239	3	1635	6	1	1	5	5	1	1		
121	JG-112	21	34	21	34	1.00	1.00	33.98	30.01	1138	6	1519	10	1	1	7	8	1	1		
1932	N-31	22	50	22	49	1.05	1.00	36.11	32.03	1040	12	1679	4	1	1	7	9	1	1		
'3136-31-4-1H-BP	JG-62 x BEG-482	39	43	40	53	1.03	1.30	15.34	13.70	790	27	552	44	3	5	5	5	1	1		
001	T-120	22	46	23	48	1.02	1.03	33.31	29.76	952	16	1760	1	2	1	6	9	1	1		
565	P-1329	34	43	45	56	1.31	1.30	18.15	18.40	1461	1	1633	7	2	1	4	5	1	1		
405	P-4089-1	48	39	49	44	1.02	1.15	13.79	15.15	1057	8	1695	3	2	2	5	5	2	1		
896	P-1515-3	28	33	33	37	1.16	1.11	29.41	22.08	1011	14	1524	9	1	2	4	6	1	1		
25	P-18	31	29	38	38	1.10	1.20	16.27	16.37	1053	9	1651	5	1	1	6	5	1	1		
'343-14-3-B-BH-BH	H-208 x USA-613	27	45	28	48	1.01	1.06	27.28	24.76	1042	11	1411	14	1	2	4	5	2	2		
'3162-2-2-2P-BH-BH	JG-62 x F-370	25	34	28	34	1.09	1.02	18.23	19.60	891	20	846	34	1	3	5	5	1	1		
517	P-392-1	49	53	50	59	1.01	1.11	12.20	12.49	1126	7	1560	8	2	2	3	5	9	1		
538	P-500	46	42	53	45	1.13	1.10	14.77	12.48	1220	4	1301	19	1	1	5	4	1	1		
'3111-8-2-B-BP	K-850 x H-208	39	39	39	52	1.00	1.30	16.23	15.31	826	24	1236	21	1	2	4	5	1	1		
1156	P-1067-1	29	34	40	41	1.35	1.19	18.75	19.79	1282	2	1461	12	2	1	4	5	4	1		
'3154-12-1-1P-BP	JG-62 x No.42	49	76	49	78	1.00	1.01	13.69	15.18	722	28	427	46	1	4	5	5	1	1		
1681	P-1395-2	33	48	40	55	1.20	1.15	17.34	17.70	807	26	1088	22	1	2	4	3	3	2		
304	P-234-1	29	39	28	46	0.94	1.20	17.44	18.93	650	32	1070	23	1	2	4	5	1	1		
5486	V-27	33	41	40	57	1.20	1.11	15.72	16.15	932	18	1246	20	1	3	3	5	1	1		
385	P-702	28	42	31	46	1.08	1.09	17.54	19.54	551	38	883	30	1	2	3	3	5	2		
'3141-3-2-1P-BP	JG-62 x K-4	43	37	50	40	1.16	1.09	17.83	14.19	565	37	186	49	3	2	4	4	2	1		
226	P-179	60	38	70	59	1.21	1.50	11.77	11.35	524	40	894	29	1	2	2	4	9	5		
5061	Check-2	20	37	18	44	1.11	1.20	18.87	20.00	538	39	1058	25	1	2	3	4	3	3		
190	P-156	26	48	35	48	1.26	1.00	21.46	19.87	674	31	794	36	1	2	4	3	3	2		
1737	P-1430	36	30	43	37	1.18	1.20	14.74	12.24	621	33	906	28	2	2	3	3	4	2		
346	P-258	20	50	21	60	1.11	1.19	17.99	16.70	616	35	600	43	1	1	3	4	3	2		
435	P-319-1	16	36	18	41	1.09	1.13	20.11	19.40	621	34	1065	24	1	1	3	4	3	2		
1745	P-1435	41	44	48	53	1.15	1.20	13.72	12.65	708	30	701	40	2	4	3	3	3	1		
1743	P-1434	42	35	42	43	1.01	1.22	13.66	16.21	849	23	851	33	1	3	4	5	1	1		
1160	P-1071-1	28	30	30	36	1.08	1.21	12.13	13.46	323	48	821	35	1	1	3	4	7	3		
3556	P-4232-3	20	29	24	37	1.19	1.20	12.74	12.85	297	49	722	39	1	2	3	4	4	2		
772	P-613	32	37	38	48	1.17	1.20	11.65	13.29	597	36	878	31	2	1	4	4	2	1		

)ntd....Table 13.4.

ICC/IC number	Pedigree	Pod number/ plant		Seed number/ plant		Seeds/pod		Weight of 100 seeds (g)		Seed Yield (kg/ha)				*Fusarium* wilt score		Vigor score 5 Nov		Vigor score 10 Nov		Iron chlorosis score	
		Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.	Early	Rank	Nor.	Rank	Early	Nor.	Early	Nor.	Early	Nor.	Early	Nor.
430	Pusa-63	25	37	33	49	1.33	1.20	11.84	12.26	467	42	930	27	1	1	3	4	5	2		
3187-3-3-3H-BP	G-130 x JG-24	25	40	28	46	1.09	1.14	13.89	14.46	433	45	871	31	2	4	3	4	4	1		
03	P-476	22	44	30	61	1.38	1.30	11.55	12.39	714	29	666	41	1	4	3	4	2	1		
525	P-4228	29	36	34	43	1.19	1.23	11.71	11.26	461	43	748	37	1	1	3	4	4	1		
003	P-1620-1	12	14	11	17	1.11	1.19	16.58	15.57	456	44	231	48	1	2	6	6	1	1		
166	P-1092	13	21	16	26	1.23	1.16	18.93	20.15	350	47	463	45	1	1	5	5	1	1		
457	C-162	20	23	22	24	1.10	1.06	17.92	20.39	373	46	407	47	2	2	5	5	1	1		
948	G-130	34	48	40	48	1.16	1.11	12.75	14.12	489	41	725	38	1	3	3	5	6	1		
918	Annigeri	35	81	50	91	1.43	1.12	17.64	18.91	924	19	1313	18	1	1	6	6	1	2		
	S.E.	5.9		6.9		0.08		0.89		117.2											
	Mean	31	42	37	48	1.1	1.2	17.7	17.6	799		1069		1.3	2.0	4.1	4.8	2.4	1.4		
	S.E.	3.1		3.5		0.02		0.23		28.5											
	CV%	35.6	29.1	36.6	30.6	11.0	15.0	10.6	9.6	30.4		21.1									

duration entries was delayed when sown early so that days to 50% flowering ranged from 44 to 103 days in the early sown trial and 42 to 86 in the normal sowing and this was reflected in significant interactions for days to beginning and end of flowering and to maturity.

Most entries had similar or longer flowering durations in the normal than in the early sowing, that of P-319-1 being extended from 22 to 30 days. Exceptions were G-130 and P-4228 which exhibited much longer flowering durations in the early than in the normal sowing. Among early lines reproductive periods tended to be longer in the normal than in the early sowing but the reverse occurred among the late cultivars. G-130 and P-4228 showed much longer reproductive periods when sown early but in the other cultivars differences in reproductive period did not reflect flowering periods.

P-1620-1 and P-1092 were the tallest and P-690 and Annigeri the shortest cultivars, in both sowings. Differences in numbers of primary and secondary branches were small but longer duration cultivars tended to branch more than short duration cultivars in the normal sowing. Most entries produced more pods and seeds per plant when sown at the normal time than when sown early but P-179 produced more pods and seeds in the early than in the normal sown trial. Annigeri produced the most pods and seeds in the early sown trial but this was not reflected in seed yield due to reduced stand.

Differences in seeds per pod were small. N-31, K-4-1, T-20 and JG-112, which were the earliest maturing entries, also had the largest seed, in both sowings. P-1329, K-4-1, P-726-1 and P-4089-1 gave the highest yields overall. In the early sown trial seed yields ranged from 297 to 1461 kg per ha with P-1329, P-1067-1 and P-690 the highest yielders. In the normal planting seed yields were from 186 to 1760 kg per ha with the highest yields from T-120, K-4-1 and P-4089-1.

P-332-1 was highly susceptible to *Fusarium* wilt and P-179 and P-392-1 showed symptoms of iron chlorosis.

EARLY SOWN SCREENING TRIALS (ESSTs)

A new set of 248 germplasm accessions was compared with Annigeri and G-100 in four early sown trials grouped according to duration as follows:

ESST-1	Less than 50 days to 50% flowering
ESST-2	51 to 60 days to 50% flowering
ESST-3	61 to 70 days to 50% flowering
ESST-4	More than 70 days to 50% flowering

Each trial was an 8 x 8 triple lattice with 62 test entries, compared with Annigeri and G-130. The trials were sown on 15 to

17 September. The plot size was 4 rows, at the same spacing as the early x normal sown trial. Records were taken as for the early x normal sown trial. Grain yield was estimated from the two central rows of 3.5 m length.

Mean data from the four trials are given in Table 13.5 and the characteristics of the entries in Tables 13.6 to 13.9. As in previous years, days to the beginning and end of flowering and maturity were progressively longer from trials 1 to 4 and pod and seed numbers and seed yields were reduced. However, there was considerable overlap among trials for all characteristics.

Only in Trial 1 (Table 13.6) were there entries (P-1293-2, RPSP-333, 123-10, P-96 and T-3 Gwalior) giving significantly higher yields than Annigeri, the best check. NEC-2637-2 and NEC-2714-2 were highly susceptible to *Fusarium* wilt and L-146, RPSP-281, RPSP-211-1, P-1780, P-6524, P-6257, RPSP-294, P-80 and NP-62 showed severe iron chlorosis.

CORRELATIONS

Correlations among characters were computed in an attempt to identify the characteristics contributing to higher yields under early sown conditions. Seed yields were positively correlated with plant stand, pod number and plant vigor and negatively with days to 50% flowering, plant height, reproductive period and *Fusarium* wilt score (Table 13.10). Other correlations were small or inconsistent.

CONCLUSIONS

This season, the crop sown at the normal time gave significantly higher yields than the early sown crop but this may have stemmed from the improved soil moisture resulting from the application of a presowing irrigation to the normal sown crop to promote seed germination. In south India, few farmers have facilities for irrigation so a more realistic comparison would be a reasonable seed yield from the early sowing compared with nothing from the October sown crop, in the absence of irrigation.

Correlations were recorded between seed yields and other plant characters but the absence of correlations with flowering and reproductive periods indicated that the genotypes were not taking advantage of the longer growing period conferred by early sowing.

However, a number of genotypes (Table 13.11), notably P-1329, P-1067-1, P-4089-1 and P-18, have given consistently good performance over two or three years of trials in early sown conditions and these will be examined in more detail in 1981/82.

Table 13.5. Ranges and means of characteristics of entries in Early Sown Screening Trials at Hyderabad, 1980/81.

Character	ESST-1	ESST-2	ESST-3	ESST-4
Final plant stand	50 (25-65)	45 (19-61)	45 (27-66)	39 (11-59)
Days to 50% flowering	54 (43-85)	64 (45-85)	70 (44-100)	86 (46-104)
Days to end of flowering	76 (64-108)	85 (66-114)	92 (65-119)	108 (67-123)
Flowering duration	22 (16-31)	22 (17-28)	22 (18-29)	22 (16-34)
Days to maturity	91 (75-137)	110 (80-136)	119 (74-144)	133 (81-145)
Reproductive period	38 (28-53)	46 (34-61)	50 (29-71)	45 (35-60)
Plant height (cm)	30.7 (26.2-39.7)	35.9 (24.8-46.3)	35.8 (26.6-50.4)	38.0 (28.2-48.2)
Primary branches/plant	2.41 (1.80-3.26)	2.63 (1.94-3.62)	2.76 (1.79-3.39)	2.45 (1.80-3.20)
Secondary branches/plant	2.60 (1.33-4.14)	3.72 (1.68-5.91)	3.51 (1.82-5.26)	3.21 (1.46-5.26)
Pod number/plant	32 (18-50)	30 (9-51)	25 (7-54)	24 (8-58)
Seed number/plant	37 (21-59)	35 (9-75)	30 (7-70)	27 (8-70)
Seeds/pod	1.16 (0.99-1.48)	1.15 (0.90-1.48)	1.17 (0.93-1.48)	1.19 (0.93-1.43)
Weight of 100 seeds (g)	16.2 (11.6-25.8)	18.1 (10.0-37.0)	17.6 (8.8-36.9)	15.8 (9.2-30.7)
Seed Yield (kg/ha)	845 (235-1281)	605 (156-1302)	632 (210-1368)	519 (84-1469)

Table 13.6. Characteristics of entries in Early Sown Screening Trial-1 at Hyderabad, 1980/81.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/plant	Seed number/plant	Seeds/plant	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 October	Vigor score 8 November
118	P-96	58	59	79	20	93	34	29.0	2.7	2.1	31	32	1.01	15.34	1158	4	2	3	4	6
303	P-234	54	54	75	21	90	36	28.3	2.2	2.5	33	34	1.00	14.44	823	40	2	1	3	5
686	P-538	36	53	76	23	101	48	32.5	2.5	2.7	39	45	1.15	21.45	862	34	3	1	4	6
1306	P-1193-1	53	47	68	21	81	34	26.2	2.1	2.5	30	29	0.99	17.11	853	48	3	2	4	6
1361	P-1220	56	51	73	22	86	35	30.2	2.2	2.7	25	25	1.00	19.57	859	35	2	1	4	6
1502	P-1293-2	57	57	78	21	99	42	31.4	2.2	3.1	24	31	1.25	19.75	1281	1	2	1	4	5
1632	P-1361-1	37	54	76	22	99	45	33.3	2.4	3.7	23	27	1.16	23.92	515	55	3	1	4	5
2577	P-2578	40	53	75	22	90	37	33.1	2.7	4.1	26	26	1.02	19.05	557	53	3	1	4	6
3294	P-3924-3	28	58	80	22	98	40	31.2	2.7	2.8	31	42	1.35	21.44	605	51	2	1	4	5
3466	P-4146	47	50	73	23	85	35	31.5	2.6	2.7	32	35	1.05	21.18	1082	10	2	1	4	6
3649	P-4300	38	59	76	17	92	33	36.5	2.2	2.2	24	32	1.33	16.55	646	50	4	1	4	4
3715	P-4340-2	48	69	95	26	127	58	32.5	2.7	3.4	21	22	1.07	14.57	438	58	2	3	3	4
5295	L-169	49	54	75	21	92	38	34.7	2.4	3.3	26	26	1.01	19.48	900	25	3	1	4	4
5342	No.482	52	51	75	24	92	41	30.6	2.4	2.7	25	37	1.43	16.15	681	47	2	1	3	5
5598	4/62	52	49	72	23	82	33	26.7	1.9	2.1	31	37	1.14	14.39	905	24	2	1	3	6
5864	T-3 Gwalior	57	51	73	22	88	37	30.4	2.6	2.3	38	44	1.14	13.58	1152	5	2	1	3	6
5906	T-36	29	63	84	21	116	53	36.1	3.2	3.4	30	30	1.00	21.37	381	60	2	1	3	5
5907	T-37	58	59	76	17	93	34	32.7	2.3	2.1	30	30	1.00	20.70	881	31	1	1	4	6
5908	T-37A	46	57	79	22	98	41	33.7	2.3	2.5	34	34	1.00	21.90	995	18	1	1	4	5
5913	T-40	47	63	94	31	108	45	38.5	3.0	2.8	23	23	1.02	19.34	533	54	1	1	3	5
5949	T-69	32	46	70	24	78	32	28.8	2.8	2.2	36	48	1.32	15.53	600	52	1	2	4	6
8400	T-15-A	45	59	85	26	109	50	35.5	2.3	2.9	23	23	1.00	25.80	661	49	2	1	3	6
8680	NEC-2522	44	59	82	23	102	43	39.6	2.6	2.7	32	35	1.09	18.07	505	56	4	1	4	5
8705	NEC-2548	25	60	82	22	107	47	34.8	2.2	2.5	29	31	1.06	16.90	234	62	7	1	4	5
9831	NEC-2637-2	39	57	79	22	99	42	36.0	2.5	1.3	26	33	1.26	14.63	492	57	5	1	4	5
9862	NEC-2714-2	36	60	88	28	103	43	36.8	3.9	2.2	26	27	1.02	12.76	357	61	6	1	3	5
10462	RPSP-195-B	61	45	67	22	77	32	31.3	1.8	1.6	37	46	1.23	11.57	1084	9	1	1	4	7
10516	RPSP-247	45	54	77	23	93	39	28.4	2.8	3.4	49	55	1.12	14.17	884	30	2	3	4	6
10612	BG-7 SP-1	52	47	69	22	80	33	29.2	2.7	2.7	42	42	1.00	12.34	675	48	3	1	4	6
10639	Palladan	51	47	72	25	85	38	28.1	1.8	2.8	35	38	1.09	12.15	758	44	3	1	4	6
10655	Sel.431	61	51	72	21	85	34	32.1	2.1	2.1	28	35	1.28	16.14	995	18	1	1	3	6
10814	1-57-1	57	54	75	21	88	34	30.7	2.0	2.1	36	41	1.15	14.06	1060	11	1	1	5	6
10821	123-10	54	48	72	27	86	38	30.2	2.3	2.2	36	42	1.20	14.42	1179	3	3	1	4	6
10917	RPSP-312-1	49	51	75	24	90	39	30.1	2.7	2.3	36	51	1.48	13.64	1098	8	2	1	4	5

Contd....Table 13.6.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height(cm)	Primary branches/plant	Secondary branches/plant	Pod number/plant	Seed no./plant	Seeds/plant	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.	Vigor score 8 Nov.
10920	63-8-12-41-1	46	51	81	30	99	48	37.7	1.9	2.6	36	37	1.05	15.31	854	37	2	1	4	5
10921	N-51-1	55	52	73	21	86	34	27.7	2.3	2.7	31	37	1.20	13.88	907	23	2	1	4	6
10924	1-1-2	54	51	71	20	84	33	28.8	1.9	2.3	37	44	1.17	14.69	1053	12	2	1	4	6
10927	2-57-61	48	50	66	16	78	28	27.4	2.2	1.5	26	28	1.08	20.79	876	32	2	1	4	7
10940	RPSP-333	59	56	75	19	88	32	27.4	2.4	2.5	35	45	1.29	13.55	1183	2	1	2	4	6
10941	RPSP-333-1	63	56	72	16	85	29	28.0	2.3	2.3	28	37	1.28	14.68	1103	7	2	1	4	6
10951	RPSP-340	49	49	72	23	84	35	28.6	2.8	2.5	36	44	1.26	13.65	859	36	3	2	3	5
10952	RPSP-341	56	48	71	23	84	36	28.5	2.0	2.3	34	45	1.29	14.42	891	28	3	1	4	5
10954	RPSP-343	58	51	73	22	86	35	28.5	1.8	2.6	32	40	1.27	14.29	1019	15	2	1	4	5
10957	RPSP-345	56	58	79	21	93	35	29.6	2.2	2.9	38	45	1.20	13.71	987	20	2	2	4	5
10960	RPSP-347-1	53	52	72	20	83	31	28.6	2.3	2.7	37	42	1.14	13.67	989	19	2	1	4	6
10961	RPSP-348	53	45	69	24	78	33	30.9	2.1	2.4	32	43	1.32	16.72	982	21	2	1	4	7
10963	RPSP-350	46	45	68	23	78	33	30.7	2.5	2.2	38	39	1.03	16.94	809	41	2	1	4	6
10974	RPSP-361	56	46	70	24	78	32	26.4	2.5	3.5	34	40	1.22	14.89	890	29	3	1	3	6
10980	RPSP-371-1	59	43	64	21	75	32	26.5	2.2	2.8	33	39	1.18	13.00	898	26	2	1	4	6
11002	RPSP-394	53	60	80	20	96	36	28.5	1.9	2.5	32	40	1.23	15.18	1034	13	2	1	3	5
11004	RPSP-396	49	55	76	21	90	44	28.6	2.5	3.2	38	49	1.31	12.10	869	33	4	4	4	5
11006	RPSP-397-1	46	54	74	20	92	38	30.1	2.6	2.8	32	46	1.47	13.87	895	42	2	6	4	5
11010	RPSP-401	44	58	82	24	98	40	27.0	3.0	3.4	50	58	1.16	12.58	753	46	3	5	3	4
11015	RPSP-405	56	54	75	21	89	35	30.5	2.1	2.7	32	45	1.42	13.60	1009	16	3	1	4	5
11016	RPSP-406	55	55	74	19	88	33	28.3	2.6	2.4	38	44	1.15	13.70	898	27	2	1	4	6
11045	RPSP-432	58	45	65	20	79	34	28.1	2.3	2.0	31	33	1.04	17.22	1029	14	3	1	4	6
11052	RPSP-438	49	47	68	21	81	34	26.8	1.8	2.4	41	59	1.41	12.58	864	43	4	1	3	5
11101	Pant G-121	65	57	80	23	93	36	27.2	2.5	2.7	36	39	1.04	12.78	954	22	3	7	3	5
11143	BG-200	50	59	81	22	99	40	33.7	2.4	3.0	32	40	1.27	21.88	1125	6	1	1	3	5
11148	JG-1255	45	61	84	23	104	43	31.0	2.8	3.2	34	39	1.15	20.10	754	45	2	1	4	5
11171	SITM-20	52	44	67	23	84	40	27.6	2.0	2.4	22	25	1.11	16.04	884	30	2	1	5	6
11174	SITM-23	56	45	67	22	81	36	29.2	2.0	2.2	30	30	1.01	17.22	1000	17	3	1	4	6
4918	Annigeri	50	47	66	19	81	34	26.1	2.3	1.7	25	32	1.30	18.97	851	39	2	1	4	5
4948	G-130	48	85	108	23	137	52	33.9	2.4	3.6	18	21	1.15	13.77	394	59	2	3	4	4
	Mean	50	54	76	22	91	38	30.7	2.4	2.6	32	37	1.16	16.22	845		2.5	1.5	3.8	5.5
	CD at 5%	11.8	5.5	4.0	5.8	5.2	6.7	2.9	0.7	1.2	10.7	14.2	0.22	1.96	295.3					
	CV%	14.9	6.4	3.3	16.5	3.6	11.1	5.9	18.1	29.4	21.0	23.5	11.9	7.6	21.8					

Table 13.7. Characteristics of entries in Early Sown Screening Trial-2 at Hyderabad, 1980/81.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/ plant	Seed number/ plant	Seeds/pod	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.
1517	P-1304	55	65	86	21	106	41	37.0	2.9	4.7	33	40	1.19	14.05	754	16	1	1	4
2087	P-1683-1	57	73	93	20	112	39	32.3	2.3	4.1	25	31	1.21	11.30	534	31	3	4	4
2099	P-1693-2	52	70	91	21	115	45	37.2	2.3	4.9	34	41	1.17	13.58	630	24	2	1	4
2105	P-1696-2	54	72	93	21	116	44	32.7	2.5	5.1	37	43	1.15	11.31	797	15	1	4	4
2169	P-1749-1	53	64	83	19	100	36	31.2	2.5	5.9	39	47	1.21	15.55	1102	4	2	1	5
2223	P-1789	49	64	86	22	107	43	30.7	2.4	4.6	32	39	1.24	14.62	939	10	2	7	4
2332	P-2010	41	51	77	26	95	44	33.4	3.0	3.8	24	28	1.13	20.77	460	43	4	1	5
2486	P-2338	36	52	75	23	95	43	33.5	2.6	3.9	24	29	1.24	19.46	531	32	3	1	4
2492	P-2346-1	52	54	75	21	98	44	36.6	2.4	3.5	24	33	1.35	18.88	626	25	3	1	4
2701	P-2788	33	68	90	22	111	43	33.8	2.4	2.7	29	36	1.24	22.01	367	55	4	1	4
3103	P-3617	60	61	80	19	95	34	24.8	3.0	4.8	34	42	1.22	12.30	999	7	2	1	4
3166	P-3708	34	71	94	23	132	61	41.7	2.8	2.7	29	30	1.01	17.04	318	57	4	1	4
3312	P-3943-1	33	55	81	26	99	44	34.3	3.0	3.8	23	24	1.05	20.88	571	27	3	1	4
3557	P-4244	48	56	79	23	99	43	33.8	2.8	3.5	24	27	1.13	19.96	698	19	3	1	4
3575	P-4253-2	44	54	76	22	99	45	31.0	2.5	3.2	25	31	1.27	18.86	559	28	3	1	4
3799	P-4422	52	64	89	25	112	48	46.2	2.6	3.2	42	52	1.25	12.41	493	36	3	1	4
3838	P-4474	41	62	86	24	114	52	45.5	2.8	3.2	51	75	1.37	11.77	496	34	2	1	5
3901	P-4580-1	47	57	82	25	115	58	36.2	2.4	2.7	26	31	1.14	20.68	412	51	4	1	4
4567	P-6112-2	42	56	77	21	96	40	32.3	2.8	5.2	42	58	1.38	15.80	1067	6	2	1	4
4826	P-6594	37	58	83	25	106	48	39.7	2.1	2.6	28	36	1.26	17.88	434	47	4	1	4
5078	CP-64	57	76	98	22	124	48	33.0	2.2	3.9	30	33	1.07	16.86	544	30	2	1	4
5112	EC-26428	43	69	88	19	115	46	45.3	2.3	3.0	18	18	1.01	33.53	372	54	2	1	4
5184	GC-663	55	65	84	19	104	39	25.6	3.0	4.4	33	40	1.21	12.32	728	18	3	9	3
5293	L-146	41	68	89	21	110	42	31.5	2.2	3.7	23	24	1.04	26.17	925	11	3	1	4
5301	L-477	34	70	88	18	120	50	38.7	2.2	2.1	21	22	1.03	29.94	476	40	3	1	4
5902	T-33	54	63	83	20	103	40	36.8	2.9	4.6	24	21	0.90	25.70	982	8	3	1	5
6142	NEC-4	39	69	89	20	123	54	41.1	2.3	3.2	24	26	1.05	28.83	443	46	3	1	4
6171	NEC-37	19	71	90	19	124	53	34.7	1.9	2.2	9	9	1.04	36.99	239	60	3	1	4
6945	NEC-1185	52	73	99	26	126	53	37.3	2.5	5.1	51	62	1.20	9.98	490	38	3	1	4
6981	NEC-1236	61	63	89	20	112	49	36.1	2.4	3.3	25	37	1.48	10.30	640	23	3	1	4
7083	NEC-1366	55	63	90	27	118	55	42.6	2.6	1.9	24	24	0.97	23.73	483	39	3	1	4
7200	NEC-1573	31	72	92	20	115	43	32.0	3.0	5.0	39	40	1.04	18.99	644	22	2	1	3
7233	NEC-1606	41	68	87	19	121	53	42.0	2.8	3.3	25	28	1.00	22.41	548	29	3	1	4
7364	3427	51	45	69	24	80	35	29.0	2.8	3.8	38	44	1.16	15.76	862	12	1	1	5
7404	T-44-A	41	59	87	28	104	45	33.6	2.8	5.1	40	30	0.96	20.71	743	17	1	1	4
7569	P-9678	46	71	92	21	131	60	38.4	2.9	3.6	26	29	1.17	17.82	353	56	3	1	5
7752	NEC-721	50	71	91	20	121	50	46.3	2.8	4.0	30	34	1.11	15.69	379	53	3	1	4
7794	NEC-1713	44	61	84	23	112	51	34.7	3.1	3.1	28	32	1.14	21.54	466	42	3	1	3

Contd....Table 13.7.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/ plant	Seed number/ plant	Seeds/pod	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.
8545	JM-969	40	57	79	22	104	47	39.5	2.5	4.1	31	33	1.06	13.97	467	41	5	1	4
8672	NEC-2514	28	60	82	22	109	49	39.2	2.9	3.6	44	52	1.18	16.76	444	45	5	1	4
8909	NEC-2760	35	59	71	19	109	50	39.3	2.6	3.8	30	35	1.16	18.32	446	44	5	1	5
9480	NEC-2251	46	67	88	21	126	59	45.1	2.5	2.9	23	25	1.08	28.79	494	35	3	1	4
9497	NEC-2362	43	74	96	22	131	57	33.0	2.1	2.1	13	13	1.00	33.80	209	61	3	1	4
9615	NEC-2500-1	38	68	88	20	117	49	40.5	2.2	1.8	28	28	1.00	15.55	271	59	5	1	4
9686	NEC-2635-1	36	64	86	22	109	45	39.8	2.5	3.4	35	37	1.05	15.00	282	58	5	1	4
9839	NEC-2673-2	40	61	83	22	110	49	37.6	2.1	3.4	25	31	1.24	14.96	388	52	5	1	5
9864	NEC-2716-2	43	68	86	18	110	42	41.6	2.6	2.5	41	49	1.20	15.65	529	33	4	1	5
9868	NEC-2722-2	32	57	81	24	110	53	37.9	3.0	3.2	26	27	1.04	19.29	417	50	5	1	5
9902	NEC-2759-2	43	59	83	24	107	48	35.7	2.3	3.7	25	29	1.16	14.06	423	48	4	1	4
9903	NEC-2760-2	39	67	89	22	118	51	41.7	2.3	2.9	33	38	1.15	14.37	419	49	5	1	4
9907	NEC-2765-2	25	67	86	19	116	49	38.5	2.6	2.3	45	37	1.04	15.83	388	52	5	1	5
10125	GNR-1	57	76	96	20	121	45	31.6	2.5	3.9	36	43	1.18	13.15	574	26	2	2	4
10543	RPSP-274	55	59	77	18	94	35	28.3	2.6	4.5	36	42	1.15	14.81	1073	5	2	1	4
10544	RPSP-275	49	51	73	22	86	35	32.7	2.6	4.0	34	42	1.26	15.31	834	14	2	1	4
10547	RPSP-278	52	57	77	20	95	38	30.5	2.6	4.7	37	45	1.23	15.16	1229	3	2	4	4
10550	RPSP-281	41	61	85	24	105	44	26.3	2.9	4.6	39	46	1.18	13.06	691	20	2	8	4
10850	JM-2560	24	74	98	24	128	54	45.6	2.3	1.6	16	18	1.08	23.47	156	62	4	1	4
10911	RPSP-211-1	50	66	85	19	105	39	26.3	2.9	3.8	28	33	1.19	13.40	675	21	1	8	4
10965	RPSP-351-1	56	58	77	19	94	36	29.9	2.8	4.8	40	43	1.07	15.33	1228	2	1	1	4
11085	BG-208	61	67	85	18	105	38	32.2	2.6	4.8	28	39	1.38	13.74	1302	1	2	2	3
11191	LJR-126	55	45	69	24	81	36	28.8	2.6	3.4	30	33	1.09	17.25	843	13	2	1	4
11247	JM-2776-2	38	69	92	23	123	54	42.5	2.1	3.0	33	36	1.09	15.93	490	38	4	1	4
4918	Annigeri	46	46	66	20	82	36	28.1	3.6	5.6	31	40	1.27	19.00	952	9	2	1	4
4948	G-130	50	85	113	28	136	51	38.1	2.3	3.8	29	33	1.15	13.11	492	37	2	3	5
	Mean	45	64	85	22	110	46	35.9	2.6	3.7	30	35	1.15	18.13	605		2.9	1.7	4.2
	CD at 5%	13.3	6.5	7.2	5.3	9.0	7.8	4.04	0.73	1.34	13.5	18.6	0.149	2.82	367.9				
	CV%	18.6	6.4	5.3	15.1	5.2	10.6	7.0	17.2	22.6	27.9	33.0	8.1	9.7	38.0				

Table 13.8. Characteristics of entries in Early Sown Screening Trial-3 at Hyderabad, 1980/81.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/plant	Seed number/plant	Seeds/pod	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.
70	P-56	63	56	77	21	95	39	28.7	3.2	3.8	30	43	1.42	11.52	1268	5	2	1	4
600	P-474-1	47	45	65	20	74	30	30.3	2.8	3.3	39	51	1.33	12.42	1011	14	4	1	5
872	P-691-3	47	54	74	20	89	35	27.7	3.2	4.5	41	45	1.07	20.56	1318	3	2	1	4
1412	P-1249-2	66	53	72	19	85	32	29.7	3.0	4.6	39	46	1.18	14.40	1288	4	2	1	3
1415	P-1252	42	53	75	22	87	34	33.0	2.3	3.8	36	47	1.29	17.64	1137	8	3	1	4
1422	P-1255-3	54	44	67	23	76	32	28.0	3.0	4.0	26	29	1.09	18.38	1044	13	3	1	4
1986	P-1606-1	38	60	88	28	115	55	35.8	2.6	2.2	21	23	1.08	23.12	570	26	2	1	3
2209	P-1780	49	65	89	24	107	42	29.7	2.9	5.1	38	44	1.17	14.35	1093	11	3	8	3
2314	P-1985-1	36	72	100	28	130	58	39.6	2.9	3.9	25	26	1.00	17.80	349	48	3	1	4
2912	P-3297	41	58	83	25	103	45	40.2	2.5	3.1	20	20	1.00	23.70	336	49	3	1	4
3141	P-3661-1	45	67	91	24	112	67	32.0	2.2	3.7	29	38	1.30	8.76	565	27	3	1	4
3188	P-3741	42	86	114	28	144	58	46.9	3.0	2.2	7	7	1.00	26.88	219	62	2	1	5
3637	P-4292	52	68	88	20	109	41	31.7	3.3	4.9	37	40	1.08	15.88	1062	12	2	1	3
3821	P-4449	48	69	93	24	126	57	44.8	2.6	3.1	19	24	1.29	12.21	499	35	4	1	5
3916	P-4603	42	69	92	23	119	50	30.9	3.0	2.4	24	28	1.18	9.85	458	41	3	1	4
4038	P-4744-2	38	70	93	23	118	48	50.3	2.5	2.6	31	39	1.26	12.34	465	39	3	1	4
4574	P-6134	60	71	94	23	114	43	35.8	2.9	5.0	26	30	1.16	20.04	1221	6	2	1	5
4580	P-6142-1	48	86	111	25	135	49	34.2	3.0	3.9	25	28	1.14	13.89	522	30	2	5	4
4598	P-6180	52	68	89	21	109	41	26.7	2.7	5.2	42	53	1.24	13.53	958	15	2	8	4
4660	P-6251	59	59	78	19	95	36	30.8	3.1	3.1	37	43	1.15	15.55	1334	2	2	1	4
4667	P-6257	44	65	86	21	105	40	27.0	2.9	4.1	54	70	1.31	11.18	1368	1	3	9	4
4811	P-6524	44	72	98	26	121	49	43.0	2.5	2.7	16	19	1.15	13.48	372	47	3	1	5
4821	P-6576	41	67	91	24	122	55	41.6	2.5	3.6	32	39	1.24	13.10	606	24	3	1	4
4973	L-550	47	71	93	22	117	46	32.7	2.8	4.3	34	34	1.01	20.34	753	20	3	1	6
4982	No.296	56	75	94	19	132	57	32.6	2.8	3.1	23	23	1.00	13.36	549	28	3	3	4
5557	V-125	49	81	95	19	125	44	36.1	2.5	4.7	26	29	1.11	18.96	513	31	2	1	4
5559	V-127	41	73	97	24	128	55	40.7	3.0	3.2	15	16	1.07	19.84	463	40	3	1	4
5578	V-153	46	66	89	23	118	52	35.9	2.9	3.7	21	26	1.23	21.27	710	21	2	1	4
5587	V-167	42	73	95	22	131	58	34.8	2.7	3.9	18	20	1.10	18.82	502	34	2	1	4
5648	Ludhiana-17	32	72	95	23	131	59	31.7	2.5	3.1	15	19	1.27	12.14	276	59	3	1	5
5649	Ludhiana-18	47	74	95	21	129	55	34.6	2.9	4.6	30	34	1.12	13.25	816	18	2	1	4
6061	JG-34	43	82	102	20	128	46	32.7	3.1	4.6	27	32	1.16	12.98	610	23	2	1	3
6067	JG-39	54	76	95	19	126	50	32.1	2.6	3.7	18	23	1.22	12.89	540	29	3	1	3
6650	NEC-748	54	62	85	23	105	43	30.4	2.8	3.9	35	39	1.12	16.13	1166	7	2	1	3
6877	NEC-1086	42	74	98	24	129	55	45.3	2.3	2.6	13	13	1.00	35.02	299	56	3	1	5
7012	NEC-1269	39	71	93	22	129	58	40.0	2.3	2.5	21	31	1.45	12.16	393	44	3	1	4
7093	NEC-1376	33	73	96	23	130	57	42.1	2.6	3.0	27	36	1.30	13.30	445	42	4	1	4

Contd....13.8.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/ plant	Seed number/ plant	Seeds/pod	Weight of 100 seeds (g)	Seed yield kg/ha	Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.
7398	T-19	41	60	88	28	121	61	36.7	2.8	4.2	28	37	1.37	17.12	795	19	1	1	3
7900	NEC-1969	29	72	94	22	132	60	40.9	2.0	2.3	11	13	1.18	28.11	282	57	4	1	4
8145	NEC-2291	40	69	90	21	133	64	39.7	3.3	3.7	13	13	1.01	33.39	305	54	2	1	5
8294	Sel.601/BG-203	62	73	94	21	115	42	34.0	2.2	4.4	28	36	1.28	11.31	890	16	2	1	4
8764	NEC-2610	31	85	110	25	137	52	42.0	2.5	3.0	14	17	1.25	20.38	210	63	5	1	4
8822	NEC-2672	27	76	101	25	135	59	46.0	2.9	0.8	19	21	1.10	16.33	225	61	4	1	4
9696	NEC-2661-1	36	68	91	23	122	54	38.8	2.5	3.1	22	23	1.05	17.17	381	46	5	1	3
9732	NEC-2730-1	37	69	91	22	129	60	40.8	2.5	2.1	20	22	1.08	16.76	331	50	4	1	4
9799	NEC-2556-2	28	69	88	19	125	56	41.5	2.6	2.8	22	25	1.12	17.79	390	45	5	1	4
9918	RPSP-9	47	85	107	22	134	49	36.2	2.3	3.6	15	18	1.20	12.82	465	39	2	5	3
10137	Pant G-115	63	72	89	17	114	42	33.9	3.0	3.9	31	38	1.20	12.34	1111	10	2	1	3
10340	Registration no.56	43	65	86	21	124	59	39.5	2.0	2.3	9	8	0.95	36.93	327	51	3	1	5
10347	Registration no.67	37	67	88	21	138	70	38.3	2.2	3.1	13	12	0.93	35.79	313	53	3	1	5
10558	RPSP-289	48	77	106	30	131	54	29.3	2.7	4.0	19	25	1.30	12.79	505	32	2	5	3
10563	RPSP-294	36	69	92	23	112	43	26.4	2.8	4.1	35	40	1.13	13.24	467	38	2	8	3
10755	35168	42	65	84	19	127	62	38.1	2.7	1.7	10	11	1.02	36.46	321	52	3	1	5
10775	37386	44	80	90	18	131	51	38.0	1.7	1.5	10	10	1.00	36.19	272	60	2	1	4
10787	38005	41	73	93	20	129	56	40.3	2.7	3.0	8	9	1.04	34.45	277	58	2	1	5
10880	CPI-56315	40	65	89	24	112	47	37.2	3.3	4.3	46	66	1.42	10.57	503	33	4	1	4
10890	P-10664	36	72	94	22	127	55	48.8	2.4	3.3	28	34	1.22	11.47	418	43	4	1	4
11073	ANM-825	44	72	94	22	115	43	29.4	2.9	4.9	43	63	1.48	13.19	867	17	2	4	3
11112	ANM-696	46	86	115	29	132	46	27.4	3.3	2.4	22	25	1.18	11.52	489	37	1	3	4
11195	LJR-133	52	67	87	20	114	47	34.5	2.7	3.7	31	30	0.98	18.19	684	22	2	1	3
11427	PR-4440	50	86	109	23	136	50	32.4	2.6	2.8	15	21	1.37	11.75	603	25	2	3	4
11442	PR-4455	48	100	119	19	143	43	32.8	3.1	2.8	13	15	1.14	11.13	301	55	1	4	4
4918	Annigeri	62	46	65	19	83	37	26.5	2.4	3.4	27	35	1.29	19.41	1124	9	2	1	4
4948	G-130	44	90	115	25	137	47	37.8	3.2	4.8	22	25	1.15	13.41	490	36	2	3	3
	Mean	45	70	92	22	119	50	35.8	2.8	3.5	25	30	1.17	17.58	632		2.7	1.8	4.0
	CD at 5%	12.5	6.0	4.9	6.7	6.6	8.2	4.31	0.72	1.47	11.6	14.8	0.200	2.19	257.0				
	CV%	17.4	5.4	3.3	18.9	3.5	10.4	7.5	16.2	26.2	29.1	31.3	10.7	7.8	25.4				

Table 13.9. Characteristics of entries in Early Sown Screening Trial-4 at Hyderabad, 1980/81.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/plant	Seed number/plant	Seeds/pod	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.
103	P-80	54	66	85	19	104	38	30.8	3.2	5.2	58	70	1.24	11.80	1118	7	1	8	4
880	P-698-1	42	90	114	24	139	49	36.7	2.4	3.8	27	29	1.06	18.77	904	9	1	3	4
1376	P-1231	48	58	78	20	100	42	34.0	3.8	4.7	34	41	1.15	24.12	1290	3	2	1	5
1426	P-1257	57	52	73	21	87	35	31.8	3.0	3.7	49	69	1.37	14.69	1252	4	3	1	4
1428	P-1258	56	69	90	21	115	46	36.2	3.2	3.4	51	52	1.01	13.43	1237	5	2	1	3
1429	P-1259	56	53	74	21	90	37	31.2	3.0	4.7	42	59	1.33	14.16	1230	6	2	1	4
1566	P-1329-1	55	75	102	27	127	52	32.5	3.0	4.5	46	41	1.14	13.17	841	11	1	4	3
1573	P-1333	49	76	102	26	123	47	36.0	2.7	4.1	32	41	1.19	11.91	674	13	2	3	3
1868	P-1501-4	43	81	114	33	139	58	38.4	2.6	3.4	25	31	1.30	12.52	685	12	2	2	3
1874	P-1503	46	64	84	20	102	38	28.2	2.7	4.5	52	54	1.11	14.49	973	8	2	7	3
1875	P-1504	52	86	109	23	137	51	30.5	2.4	3.7	19	22	1.13	11.07	404	34	2	7	3
1962	P-1587-1	38	103	123	20	143	40	40.3	2.5	3.5	28	33	1.13	12.40	306	42	3	3	4
2025	P-1633	44	85	107	22	133	48	36.2	2.6	3.7	28	33	1.23	13.73	506	24	2	2	3
2053	P-1655	40	87	109	22	143	56	36.0	2.3	4.1	33	45	1.34	15.61	413	32	2	5	3
2097	P-1693	40	85	109	24	138	53	36.1	2.5	4.0	15	16	1.12	13.43	301	43	3	1	4
2130	P-1710-1	48	93	115	22	136	43	40.7	2.4	3.2	25	32	1.22	13.18	646	14	2	2	3
2137	P-1716	32	92	112	20	144	52	45.8	1.8	2.5	12	14	1.24	20.40	287	44	3	1	5
2155	P-1730	37	86	108	22	141	55	38.8	2.2	2.5	11	14	1.39	19.91	276	45	3	1	4
2202	P-1772-2	28	97	117	20	144	47	39.9	1.8	2.6	18	21	1.24	17.96	206	50	4	1	3
2315	P-1985-2	27	83	106	23	137	54	38.6	1.9	2.4	24	28	1.13	12.15	327	38	2	1	4
3110	P-3623-1	43	97	119	22	142	45	41.0	2.2	3.5	23	32	1.32	12.43	566	19	1	4	3
3912	P-4593	26	78	112	34	137	59	37.4	2.4	2.8	25	33	1.26	9.18	325	39	4	1	4
3959	P-4658-1	41	82	101	19	136	54	46.5	2.4	1.8	9	8	0.93	28.63	274	46	2	1	5
4684	P-6272	53	94	111	17	137	43	38.3	2.4	3.8	22	27	1.15	14.56	564	21	2	3	3
4938	EC-12409	51	93	115	22	137	44	32.2	2.2	3.0	15	21	1.35	12.07	481	27	2	4	4
5001	USA-613	43	94	116	22	139	45	39.8	2.4	3.0	23	28	1.21	14.55	606	17	3	1	4
5059	C-401	38	94	113	19	139	45	37.3	2.2	2.8	18	20	1.21	12.74	400	35	2	5	3
5140	F-235	45	89	108	19	142	53	37.4	2.6	3.5	24	29	1.17	13.23	314	41	2	6	4
5144	F-293	51	92	112	20	138	46	35.8	2.5	3.5	23	28	1.25	12.84	462	29	2	4	3
5146	F-300	53	86	108	22	137	51	31.6	2.4	3.4	23	25	1.12	12.99	490	26	2	6	3
5178	G-18	30	97	120	23	142	45	40.0	2.6	2.8	20	20	0.99	13.18	498	25	3	3	4
5327	M-12	26	104	122	18	143	39	45.1	2.0	2.4	16	20	1.29	18.72	175	52	3	3	3
5330	Matter x 63-1	35	100	120	20	144	44	38.2	2.6	2.6	17	23	1.28	12.20	257	47	3	4	4
5341	No.477	32	95	114	19	138	43	41.5	2.4	2.4	14	15	1.01	27.48	400	35	3	1	3
5386	NP-62	19	98	119	21	145	47	32.4	2.1	2.9	26	29	1.02	12.88	154	54	3	9	4
5413	PB-12	48	99	117	18	142	43	37.8	2.7	3.4	20	22	1.17	12.58	420	31	2	4	4

Contd....Table 13.9.

ICC Number	Pedigree	Final plant stand	Days to 50% flowering	Days to end of flowering	Flowering duration	Days to maturity	Reproductive period	Plant height (cm)	Primary branches/plant	Secondary branches/plant	Pod number/ plant	Seed number/ plant	Seeds/pod	Weight of 100 seeds (g)	Seed Yield kg/ha	Seed Yield Rank	*Fusarium* wilt score	Iron chlorosis score	Vigor score 19 Oct.
5425	Pusa-20	57	83	109	26	134	51	32.6	3.8	4.1	26	31	1.16	13.01	984	10	1	4	3
5527	V-80	14	93	110	17	140	47	41.3	2.2	1.8	14	20	1.41	15.52	127	55	3	1	3
5596	Y-28	41	95	116	21	141	46	35.2	2.5	3.6	27	29	1.05	12.34	535	22	3	3	3
5603	5603-7/143	39	99	115	16	139	40	37.0	2.2	2.4	21	26	1.19	13.78	374	36	2	4	3
6058	JG-30	32	90	112	22	141	51	38.6	2.6	3.0	24	28	1.07	12.37	349	37	3	3	3
6117	JG-108	38	89	110	21	136	47	35.4	2.1	3.0	22	31	1.38	11.78	441	30	2	4	3
6638	NEC-734	49	83	107	24	136	53	38.2	2.6	3.9	30	37	1.18	13.02	642	15	1	4	4
6792	NEC-957	51	98	119	21	141	43	45.6	2.2	1.4	8	11	1.31	28.22	408	33	1	1	5
6859	NEC-1055	31	86	111	25	142	56	48.2	2.0	2.3	13	16	1.41	18.02	159	53	5	1	3
7355	1917	33	87	108	21	138	51	36.1	2.4	3.1	20	23	1.05	17.99	473	28	3	1	3
8024	NEC-2147	15	93	115	22	137	44	43.8	1.8	1.6	11	13	1.19	18.83	84	59	5	1	5
8197	NEC-2351	12	97	119	22	142	45	45.8	2.3	2.3	10	12	0.96	30.68	121	56	4	1	4
8227	NEC-2388	24	85	108	23	144	59	44.4	1.8	2.1	12	16	1.17	21.39	225	49	2	1	4
9363	NEC-1899	11	89	109	20	141	52	41.0	2.0	2.0	12	12	0.98	22.59	103	57	2	1	4
9400	NEC-1950	16	98	120	22	141	43	43.1	1.8	2.4	15	15	1.17	16.52	86	58	3	1	4
9488	NEC-2323	35	98	118	20	139	41	37.6	2.3	3.0	19	24	1.12	14.41	324	40	2	4	5
9656	NEC-2586-1	16	87	107	20	139	52	46.5	2.2	1.9	15	14	1.12	22.22	235	48	3	1	4
9913	RPSP-4	40	98	120	22	142	44	38.5	2.4	2.8	22	28	1.31	11.97	535	23	3	4	4
10085	P-4109	21	90	112	22	140	50	47.7	2.1	2.4	15	19	1.22	17.96	176	51	5	1	4
341	P-225	51	54	74	20	93	39	30.8	2.9	4.2	43	51	1.17	15.93	1469	1	2	4	4
693	P-542	52	86	109	23	139	53	36.8	2.7	3.8	26	30	1.22	14.01	627	16	2	6	3
893	P-708-1	50	97	118	21	138	41	35.9	2.6	3.2	22	30	1.38	11.92	600	18	2	4	4
4918	Annigeri	59	46	67	21	81	35	28.4	2.9	5.2	34	48	1.43	18.86	1376	2	2	1	4
4948	G-130	38	89	114	25	139	50	37.0	2.7	3.7	29	34	1.25	13.65	562	20	2	3	3
	Mean	39	86	108	21	133	45	38.0	2.4	3.2	24	27	1.19	15.78	519		2.5	2.8	3.7
	CD at 5%	15.1	6.4	6.8	5.8	4.1	6.7	5.41	.66	1.24	11.2	13.8	0.290	2.51	274.0				
	CV%	23.8	4.6	3.9	16.8	1.9	8.9	8.8	16.6	24.0	28.8	31.8	15.9	9.9	32.7				

Table 13.10. Correlation coefficients between seed yield and other characters in Early vs. Normal and Screening Trials at Hyderabad, 1980/81.

Character	Early vs. Normal Planting	Screening Trials
	Early	
Plant stand	.45**	.62**
Days to 50% flowering	-.65**	-.57**
Plant height(cm)	-.27*	-.45**
Pod number/plant	.29	.58**
Seeds/pod	-.13**	.20**
Weight of 100 seeds(g)	.35**	-.19**
Reproductive period	-.36*	-.52**
Fusarium wilt score	-.16**	-.36
Iron chlorosis score	-.28**	.04**
Vigor score	.46	.22

Table 13.11. Seed yields (kg/ha) of high yielding lines, early sown during three years (1978/79 to 1980/81) at Hyderabad.

ICC/ IC No.	Pedigree	1980/81		1979/80			1978/79		
		Yield	Rank	Yield	Rank	Trial No.	Yield	Rank	Trial No.
1565	P-1329	1461	1	1635	1	2	-	-	-
1156	P-1067-1	1282	2	1696	2	3	1008	2	5
867	P-690	1239	3	1136	14	1	829	3	4
638	P-500	1220	4	1294	30	2	1062	4	5
5676	K-4-1	1156	5	1177	8	1	933	7	3
6121	JG-112	1138	6	1134	15	1	989	2	3
73162	JG-62 x F-370	1126	7	1412	12	2	890	8	2
3405	P-4089-1	1057	8	1559	2	2	1137	1	5
25	P-18	1053	9	1519	4	2	870	1	4
915	P-726-1	1048	10	1147	12	1	771	9	4
7343	H-208 x USA-613	1042	11	1460	7	2	1007	3	2
8932	N-31	1040	12	1105	18	1	981	3	3
73129	JG-62 x Radhey	1017	13	1239	3	1	933	7	3
1896	P-1515-3	1011	14	1534	3	2	974	6	5
7389	K-850 x F-378	1011	15	1148	9	1	1158	1	2
6001	T-120	952	16	1005	36	1	1039	1	3
	Annigeri	924	19	953[a]	-	-	631[b]	-	-
	G-130	489	41	1203[a]	-	-	639[b]	-	-

[a]Means of five trials

[b]Means of seven trials.

The early x normal sowing trial will be repeated and new germplasm accessions will be examined together with superior genotypes from the early sown screening trials.

PROJECT 14: STUDIES OF DESI-KABULI INTROGRESSION

OBJECTIVES:

1. The introgression of desirable characters from desi types to kabuli types and vice-versa,
2. the study of variability in desi x desi, desi x kabuli and kabuli x kabuli crosses, and
3. the provision of bulks after each cyle of introgression to breeders in local programs for selection for adaptability.

Considerable progress has been reported by intercrossing diverse groups in wheat, barley and maize. Desi and kabuli chickpeas are considered distinct sub groups within *Cicer arietinum*. The present project was initiated to examine the utility of introgression between these two sub groups.

Three desi (CPS-1, BG-203 and Pant G-114) and three kabulis (C-104, K-4 and P-9800) were crossed in diallel combination in 1979/80. The 15 F_1s were multiplied in the off-season of 1980 and the F_2s were evaluated during the 1980/81 season to assess the variability generated in desi x desi, desi x kabuli and kabuli x kabuli crosses.

The F_2s were sown together with two parents, CPS-1 and K-4, in a randomized complete block design with three replications. The F_2s were in plots of 20 rows and the parents 2 rows, 60 cm apart with 20 cm between plants within the rows.

Plant height; number of primary and secondary branches and pods per plant; number of seeds per pod; seed weight and yield per plant were recorded on 50 random plants from each plot for the F_2s and 10 plants for each parent.

The parental and F_2 means are given in Table 14.1, and their variances in Table 14.2. The data were extremely variable due to differences in stand and other factors, so that the variances for the two parents, were in may cases greater than the variances of the F_2 populations. The D x D F_2s had more pods per plant and seeds per pod than the K x K combinations, which showed higher values for the other characteristics. The D x K F_2s tended to be intermediate and therefore offer the possibility of recombining the characters of the two sub groups.

Table 14.1. Means of F_2s and parents in D x K introgression trial at Hyderabad in 1980-81.

Crosses	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ pod	Seed Yield/ Plant (g)	Weight of 100 seeds (g)
Desi x Desi							
CPS-1 x Pant G-114	38.3	2.69	6.05	136	1.21	21.4	13.2
CPS-1 x BG-203	36.7	3.06	6.58	141	1.28	24.4	13.6
BG-203 x Pant G-114	36.0	3.27	7.20	144	1.46	23.7	11.5
Kabuli x Kabuli							
K-4 x P-9800	46.9	3.28	7.76	101	1.09	28.4	26.6
K-4 x C-104	44.8	3.56	8.27	102	1.14	25.3	21.7
P-9800 x C-104	47.4	3.45	8.01	102	1.04	27.6	26.4
Desi x Kabuli							
CPS-1 x K-4	39.6	3.24	6.45	123	1.26	25.9	17.3
CPS-1 x P-9800	43.9	2.64	5.94	99	1.07	25.2	24.2
CPS-1 x C-104	44.2	3.09	7.67	128	1.13	27.8	19.8
Pant G-114 x K-4	37.5	3.10	6.10	102	1.36	19.5	14.4
Pant G-114 x P-9800	42.4	3.15	6.94	121	1.23	24.4	17.7
Pant G-114 x C-104	41.7	3.17	7.89	119	1.20	23.2	16.4
BG-203 x K-4	38.8	3.17	6.87	111	1.37	22.5	15.1
BG-203 x P-9800	42.0	3.13	7.67	132	1.19	29.6	19.4
BG-203 x C-104	42.1	3.67	7.19	136	1.21	26.3	16.2
Parents							
CPS-1	32.9	2.30	4.13	87	1.10	17.8	18.5
K-4	40.2	3.63	9.30	111	1.28	28.9	19.7

Table 14.2. Variance estimates for F_2s and parents in D x K introgression trial at Hyderabad in 1980-81.

	Plant height (cm)	Primary branches	Secondary branches	Pods/ plant	Seeds/ pod	Seed yield/ plant	Weight of 100 seeds
Desi x Desi							
CPS-1 x Pant G-114	25.46	1.107	4.01	3207.8	0.032	86.81	4.93
CPS-1 x BG-203	22.16	1.327	6.93	4386.7	0.033	153.28	6.13
BG-203 x Pant G-114	14.92	1.368	6.44	3050.8	0.030	76.62	0.89
Kabuli x Kabuli							
K-4 x P-9800	35.16	1.451	9.84	2240.5	0.010	164.97	29.46
K-4 x C-104	20.05	1.361	9.73	2017.1	0.014	148.78	8.46
P-9800 x C-104	21.31	1.618	9.40	3357.7	0.002	284.06	26.96
Desi x Kabuli							
CPS-1 x K-4	27.28	1.002	4.33	2554.7	0.023	100.98	9.28
CPS-1 x P-9800	56.89	0.704	5.13	2451.0	0.008	156.87	15.97
CPS-1 x C-104	36.56	1.059	11.07	3639.8	0.018	175.90	19.04
Pant G-114 x K-4	21.99	1.030	4.69	1732.8	0.029	72.83	7.49
Pant G-114 x P-9800	35.94	0.965	9.26	4064.6	0.041	131.77	28.14
Pant G-114 x C-104	22.52	1.044	11.48	5443.0	0.026	215.38	6.45
BG-203 x K-4	23.00	1.079	4.65	2304.8	0.033	88.44	4.81
BG-203 x P-9800	27.03	0.962	6.30	3751.6	0.035	228.18	24.79
BG-203 x C-104	19.60	1.846	4.76	3098.8	0.021	130.56	7.37
Parents							
CPS-1	29.65	0.769	6.05	2063.3	0.009	86.03	10.83
K-4	35.04	2.033	18.91	3949.5	0.008	348.26	4.27

The magnitudes of the variances tended to be more related to parental divergence than to sub group combinations. For example, among the D x D populations, variation was lower in BG-203 x Pant G-114, the parents of which are similar in character, than in those crosses involving CPS-1. Among the K x K combinations P-9800 appeared to contribute increased variation. There were no consistent patterns among the D x K populations. However, the parent K-4 showed greater variances than most F_2s for all characters except seeds/pod and seed size, reflecting the high experimental error and the greater heritability of these characters.

Among D x K F_2s, there were higher proportions of plants with desi and lower with intermediate type seeds where K-4 was a parent; and lower proportions of desi and higher intermediate seed types in the combinations involving C-104 (Table 14.3) The proportions of plants of kabuli and near kabuli seed were less variable but appeared higher where CPS-1 was involved. It may thus be possible to select parents for D x K crosses depending on the seed type required.

Table 14.3. Parentages of desi, kabuli and intermediate seed type plants in F_2 populations of desi x kabuli crosses in D x K introgression trial at Hyderabad, in 1980-81.

Cross	Total plants	% in seed type classes		
		Desi	Intermediate	Kabuli & near kabuli
CPS-1 x K-4	810	71.9	9.9	18.2
CPS-1 x P-9800	684	50.0	26.5	23.5
CPS-1 x C-104	724	30.8	51.9	17.3
Pant G-114 x K-4	779	63.8	19.8	16.4
Pant G-114 x P-9800	734	61.1	26.4	12.5
Pant G-114 x C-104	720	25.0	57.5	17.5
BG-203 x K-4	856	75.1	9.9	15.0
BG-203 x P-9800	713	58.5	25.8	15.7
BG-203 x C-104	743	32.3	49.7	18.0

Plants of the 9 D x K crosses have been separated into the three major seed types and it is intended to evaluate the bulks and single plant progenies at Patancheru, Hissar and Aleppo (Syria) in 1981-82 to identify high yielding bulks for the next crossing cycle.

PROJECT 16 : BREEDING FOR DISEASE RESISTANCE

OBJECTIVE : To breed high yielding disease resistant chickpea desi and kabuli lines by incorporating resistance to one or more diseases.

INTRODUCTION

A large number of crosses has been made to date involving the sources of wilt resistance identified by the Pulse Pathology Subprogram and adapted, high yielding desi and kabuli genotypes. The segregating materials arising from the crosses have been screened in collaboration with the pathologists in wilt sick plots at Hyderabad and from this season, also at Hissar. At Hissar field variability and other disease problems hampered selection for resistance to wilt. Advanced lines were tested in replicated trials at Hyderabad and Hissar and are being incorporated in the ICRRWN. These included kabuli types with good resistance, which were not identified in the germplasm and have been developed for the first time.

Breeding for resistance to stunt has been expanded and a large number of crosses have been made for *Ascochyta* blight resistance. Populations combining resistance to stunt and wilt have also been advanced.

FUSARIUM WILT

Hybridisation

Twenty crosses were made between wilt resistant and high yielding parents, including short and long duration desi and kabuli genotypes (Table 16.1). In addition, many of the parents used in the general breeding projects have resistance to wilt, and other crosses were made for inheritance studies (Project 12).

Table 16.1. Crosses made for *Fusarium* wilt resistance, 1980/81.

IC No.	Pedigree	IC No.	Pedigree
800540	ICCC-10 x ICCC-4	800550	[BG-203 x (BG-203 x WR-315) x BG-203] X BG-203
800541	ICCC-10 x Pant G-114		
800542	ICCC-10 x BG-209	800577	BG-209 x WR-315
800543	ICCC-10 x H-76-49	800578	H-76-49 x WR-315
800544	ICCC-10 x ICCC-24	800579	BG-209 x JG-74
800545	ICCC-10 x ICCC-25	800580	H-76-49 x JG-74
800546	ICCC-10 x ICCC-26	800581	Harigantas x WR-315
800547	ICCL-80002 x K-4	800582	Harigantas x JG-74
800548	ICCL-80004 x L-550	800583	WR-315 x P-386
800549	[(WR-315 x L-550) x L-550] X L-550	800584	JG-74 x P-386
		800729	JG-62 x WR-315

F_2 Populations

Eight F_2 populations of three-way crosses made in 1978/79 were grown in the wilt-sick plot at Hyderabad (Table 16.2). We sowed 500 seeds of each with JG-62 as the susceptible check every two test rows. Eighty-five single plants combining wilt resistance with good plant type were selected for further testing.

Table 16.2. Parentage of F_2s of three-way crosses involving wilt-resistant parents screened in the wilt-sick plot at Hyderabad, 1980/81.

IC Number	Parents
78377	WR-315 x (P-436 x H-223)
78391	Annigeri x (P-36 x WR-315)
78392	JG-62 x (P-36 x WR-315)
78393	IC-7389-20-3 x (P-36 x WR-315)
78398	PP-1 x (Caina x PRR-1)
78399	JG-74 x (JG-62 x P-345-1)
78400	CPS-1 x (JG-62 x P-345-1)
78424	IC-7385-17-2 x (P-36 x WR-315)

Thirty-nine F_2 populations of the F_1s multiplied in Kashmir were sown in the wilt sick plot at Hissar. We sowed 400 seeds per population with JG-62 every third row as an indicator. One hundred and twenty-six plants showing resistance were selected for further tests.

F_3 Populations

We sowed 34 F_3 populations in the wilt sick plot at Hissar using the same plot size and layout as the F_2s and selected 73 resistant single plants.

F_3 And more advanced progeny rows and bulks

Off-season nursery: We sowed a total of 374 long duration F_3 to F_7 and backcross progenies and 207 F_4 to F_9 bulks. The numbers are shown in Table 16.3. The list of bulks and their parentage can be found in Report of Work 1979/80, Table 1.65.

Hyderabad: A total of 5191 F_3 and F_4 single plant progenies were sown as single rows and 118 F_5 family bulks in four row plots in the wilt sick plot at Hyderabad. Promising resistant single plants and rows were harvested. The numbers in the D x D, D x K and K x K categories and of single plants and bulks harvested are shown in Table 16.4.

Table 16.3. Numbers of progenies and bulks of wilt-resistant crosses multiplied in Kashmir, in 1980.

Generation	Progenies	Bulks
F_3	199	
F_4	76	11
F_5	45	107
F_6	18	33
F_7	3	29
F_8	-	16
F_9	-	11
BC	33	-
Total	374	207

Table 16.4. Numbers of D x D, D x K and K x K F_3 and more advanced progenies and bulks sown and single plants and bulks selected in wilt sick plot at Hyderabad, 1980/81.

Generation	Number sown				Number selected						
					Single plants			Bulks			
	D x D	D x K	K x K	Total	D	K	I	D	K	DK	DI
F_3 progenies	3924	681	7	4612	1598	15	17	142	4	7	-
F_4 progenies	456	123	-	579	94	-	4	198	-	1	2
F_5 bulks	94	24	-	118	76	1	-	120	-	1	1
BC_2 F_5	19	-	-	19	6	-	-	-	-	-	-
BC_2 F_4	106	12	-	118	121	-	-	3	-	-	-

We also selected 127 single plants and 3 bulks from F_4 and F_5 progenies of second backcrosses involving WR-315.

Hissar: Five hundred and eighty seven F_4 and more advanced later maturing single plants selected for wilt resistance at Hyderabad were sown as single row plots in the wilt-sick plot at Hissar. Thirty resistant single plants and five resistant bulks were selected for further tests. In addition, 1315 progenies from the desi and kabuli projects were sown in the wilt-sick plot and 185 plants and 20 lines were selected.

Thirty-three second backcross progenies of WR-315 to BG-203 were also sown and two single plants were selected.

Replicated trials

Advanced materials and germplasm accessions selected for resistance to *Fusarium* wilt were tested in replicated trials in wilt-sick or normal fields at Hyderabad and Hissar.

Preliminary Trial - Hyderabad: Seventy-eight early maturing F_7 and more advanced lines, bulked in the wilt-sick plot in 1979-80 were compared with Annigeri, WR-315 and CPS-1 in the wilt-sick plot at Hyderabad.

The trial was a 9 x 9 triple lattice with 3 replications and a plot size of 4 rows of 4 m length with 60 cm between rows. The numbers of days to flowering and to maturity, seed weight and seed yield and the percent mortality due to wilt and other root rots were recorded and the adjusted means are shown in Table 16.5.

There were significant differences among entries for all characters. Emergence was somewhat variable but final stands were reasonable. Mortality due to wilt and root rots was generally low and several advanced lines showed incidences similar to those of the resistant checks, CPS-1 and WR-315. Annigeri showed greater mortality than the other checks and IC-741196-1P-1P-BP-BP was highly susceptible with 75% incidence. There was wide variation in days to flowering with most of the entries being later than the three checks. Two of the advanced lines gave significantly higher yields than WR-315, which was the highest yielding of the checks.

Those entries combining good yields with low mortality will be promoted to advanced trials at either Hyderabad or Hissar, according to their duration, in the coming season.

Advanced trial - Hyderabad: Forty six wilt resistant breeding lines which had given good performance in replicated trials in the wilt-sick plot at Hyderabad in 1979-80 (see ROW, 1979-80, Tables 1.66 to 1.68) were compared with Annigeri, CPS-1 and WR-315 in a 7 x 7 simple lattice trial with two replications

Table 16.5. Characteristics of entries in Preliminary Yield Trial of wilt resistant lines at Hyderabad, 1980/81.

IC number	Pedigree	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank	% Plant mortality
741568-3P-4P-1P-BP	K-850 x P-2774	63	124	30	16.9	749	41	13.9
741579-1P-2P-1P-BP	F-378 x WR-315	64	125	30	17.2	699	50	28.3
7547-1P-1P-1P-BP	G-130 x WR-315	56	119	29	12.8	794	34	12.7
7552-1P-1P-1P-BP	K-4 x WR-315	55	117	28	16.6	889	20	5.0
75278-1P-2P-1P-BP	(NEC-240 x NEC-1639) x (Chafa x P-427)	48	126	18	11.8	521	74	19.6
75286-3P-1P-1P-BP	(NEC-1640 x P-493) x (K-850 x NEC-249)	53	128	31	17.3	521	74	23.7
75286-3P-2P-1P-BP	(NEC-1640 x P-493) x (K-850 x NEC-249)	53	127	28	19.2	432	79	19.3
75419-3P-1P-1P-BP	(P-99 x NEC-108) x Radhey	55	125	29	19.6	667	55	20.7
75419-4P-1P-1P-BP	(P-99 x NEC-108) x Radhey	52	123	34	14.4	946	15	12.7
75419-6P-1P-1P-BP	(P-99 x NEC-108) x Radhey	50	122	35	15.3	883	21	11.7
75419-7P-2P-1P-BP	(P-99 x NEC-108) x Radhey	58	124	32	13.2	1041	6	6.5
75419-7P-3P-1P-BP	(P-99 x NEC-108) x Radhey	64	120	33	15.1	864	25	5.0
75419-11P-2P-1P-BP	(P-99 x NEC-108) x Radhey	50	125	35	22.6	781	38	12.6
75419-11P-3P-1P-BP	(P-99 x NEC-108) x Radhey	50	127	30	22.5	603	68	25.9
75889-3P-2P-1P-BP	P-1100 x WR-315	59	121	29	16.0	1010	7	8.0
75886-1P-2P-BP-BP	PRR-1 x P-1265	48	126	24	13.1	438	78	17.5
75889-2P-3P-BP-BP	P-1100 x WR-315	56	126	26	12.2	788	37	12.6
752296-5P-1P-BP-BP	$[F_3$(K-850 x BG-1) x K-4$]$ X $[F_3$(F-404 x L-550) x GW-5/7$]$	45	127	29	20.8	546	73	22.4
752296-6P-1P-BP-BP	$[F_3$(K-850 x BG-1) x K-4$]$ X $[F_3$(F-404 x L-550) x GW-5/7$]$	48	126	28	16.4	845	28	8.8
752296-7P-BP-BP-BP	$[F_3$(K-850 x BG-1) x K-4$]$ X $[F_3$(F-404 x L-550) x GW-5/7$]$	59	121	36	25.9	940	16	12.5
752296-7P-3P-BP-BP	$[F_3$(K-850 x BG-1) x K-4$]$ X $[F_3$(F-404 x L-550) x GW-5/7$]$	61	122	37	24.8	794	34	9.2
7447-1P-1P-BP-BP	F_4(JG-62 x F-496) X (K-850 x Radhey)	58	120	26	13.1	794	34	8.5
75419-11P-2P-BP-BP	(P-99 x NEC-108) x Radhey	53	125	36	22.6	654	62	17.4
741196-1P-1P-BP-BP	P-3090 x G-130	54	118	26	13.7	197	81	75.2
741533-4P-1P-BP-BP	P-5409 x K-850	59	122	28	18.8	489	77	28.3
741533-5P-1P-BP-BP	P-5409 x K-850	65	124	32	19.1	508	76	29.8
741533-5P-4P-BP-BP	P-5409 x K-850	62	122	32	19.5	718	46	21.3
741568-3P-1P-BP-BP	K-850 x P-2774	60	122	25	17.9	641	65	9.1
741568-3P-2P-BP-BP	K-850 x P-2774	59	124	28	17.6	724	45	9.6

)ntd....Table 16.5.

C number	Pedigree	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank	% Plant mortality
'552-3P-2P-BP-BP	K-4 x WR-315	56	126	25	13.1	660	58	4.9
75278-1P-2P-BP-BP	(NEC-1640 x NEC-1639) x (Chafa x P-472)	47	123	24	12.6	406	80	11.3
74349-5P-1P-4P-1P-BP	F_2(P-1786 x C-214) X F_2(F-496 x L-550)	64	124	30	14.4	730	44	8.5
74349-6P-1P-2P-1P-BP	F_2(P-1786 x C-214) X F_2(F-496 x L-550)	56	122	25	13.8	616	67	11.5
74356-3P-1P-3P-1P-BP	F_2(P-1786 x C-214) x F_2(C-104 x L-550)	65	124	28	10.6	870	23	6.2
74513-3P-1P-2P-1P-BP	F_2(L-550 x T-3) x F_2(G-130 x JG-24)	79	126	31	13.2	1092	3	16.0
74524-3P-1P-1P-1P-BP	F_2(K-850 x GW-5/7) X F_2(H-208 x Annigeri)	54	125	29	23.3	667	55	13.0
74527-4P-1P-1P-1P-BP	F_2(G-130 x B-108) X F_2(NP-34 x GW-5/7)	48	124	25	17.9	660	58	15.1
74527-4P-1P-3P-1P-BP	F_2(G-130 x B-108) X F_2(NP-34 x GW-5/7)	51	123	21	17.7	718	46	16.9
74540-21H-1P-1P-1P-BP	F_2(K-850 x T-3) X F_2(JG-62 x BEG-482)	63	126	33	19.5	673	53	8.3
74540-21H-1P-3P-1P-BP	F_2(K-850 x T-3) X F_2(JG-62 x BEG-482)	62	125	35	19.2	781	38	9.4
74514-22H-1P-1P-1P-BP	F_2(BG-2 x P-1480) x F_2(GW-5/7 x H-233)	63	126	33	19.5	870	23	3.6
74632-5P-1P-2P-1P-BP	(H-355 x BEG-482) X (JG-62 x P-1387)	70	124	36	11.7	699	50	6.5
74518-6P-1P-BP-1P-BP	F_2(G-130 x P-5409) X F_2(Radhey x L-550)	68	127	32	12.6	692	52	3.8
74606-5P-1P-BP-1P-BP	(G-130 x JG-221) X (E-100 x H-355)	70	123	35	13.6	1080	4	10.6
74729-2P-1P-BP-1P-BP	NEC-240 X (H-355 x K-850)	66	122	36	19.6	965	10	8.1
74729-2P-1P-3P-1P-BP	NEC-240 X (H-355 x K-850)	66	124	36	18.5	673	53	6.4
74731-5P-1P-1P-BP-BP	F_2(K-850 x BEG-482) X F_2(JG-62 x JG-221)	66	125	31	15.9	902	19	10.6
74524-3P-1P-3P-BP-BP	F_2(K-850 x GW-5/7) X F_2(H-208 x Annigeri)	55	124	25	24.2	959	12	5.9
74540-21H-1P-1P-BP-BP	F_2(K-850 x T-3) X F_2(JG-62 x BEG-482)	63	126	29	17.9	743	42	8.9
74527-4P-1P-3P-BP-BP	F_2(G-130 x B-108) x F_2(NP-34 x GW-5/7)	47	125	21	17.0	654	62	11.1
74540-22H-1P-1P-BP-BP	F_2(K-850 x T-3) X F_2(JG-62 x BEG-482)	61	125	34	19.7	794	34	8.6
74594-23H-1P-2P-BP-BP	(G-130 x K-4) X (RS-11 x No.-42)	80	128	35	14.6	654	62	22.2
74729-2P-1P-1P-BP-BP	NEC-240 X (H-355 x K-850)	66	124	30	19.8	1251	1	7.3
74729-2P-1P-2P-BP-BP	NEC-240 X (H-355 x K-850)	59	123	33	18.5	743	42	16.9
74540-21H-1P-BP-BP-BP	F_2(K-850 x T-3) X F_2(JG-62 x BEG-482)	62	125	34	19.3	876	22	6.0
74540-21H-1P-BP-BP-BP	F_2(K-850 x T-3) X F_2(JG-62 x BEG-482)	63	126	32	19.01	794	34	6.8
74190-B-2P-1P-2P-1P-BP	F-61 x F-378	53	124	28	17.9	572	70	8.1

Contd....Table 16.5.

IC number	Pedigree	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank	% Plant mortality
741663-3-3P-BH-3P-1P-BP	(H-208 x RS-11) x (JG-221 x L-550)	61	125	32	17.4	940	16	11.1
741663-3-3P-BH-3P-1P-BP	(H-208 x RS-11) x (JG-221 x L-550)	62	122	27	13.4	553	72	4.5
74223-B-4H-1P-BP-BP-BP	No.42 x H-223	57	122	32	18.8	927	18	13.4
74273-B-9H-1P-BP-BP-BP	(K-850 x H-223) x P-82	58	126	36	19.9	711	48	8.9
74132-B-4H-1H-1P-BP-BP	G-130 x BG-1	75	123	31	10.5	997	9	12.2
73190-B-2P-1P-1P-BP-BP	F-378 x Chafa	54	124	31	18.0	775	40	8.4
73190-B-2P-1P-3P-BP-BP	F-378 x Chafa	54	123	54	17.2	629	66	18.7
74632-1P-4P-BH-2P-BP-BP	(H-355 x BEG-482) x (JG-62 x P-1387)	64	123	29	12.6	832	30	10.1
74632-1P-LB-BH-BP-BP-BP	(H-355 x BEG-482) x (JG-62 x P-1387)	63	121	31	13.0	959	12	6.4
741663-2-1P-1P-1P-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	63	121	33	18.0	864	25	8.6
741663-2-1P-1P-2P-BP-BP	(H-208 x RS-11) x (JG-62 x L-550)	65	125	35	17.2	953	14	11.0
741663-3-1P-1P-2P-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	63	125	29	18.1	1003	8	12.7
741663-1-3P-BH-1P-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	63	126	34	14.9	1073	5	3.4
741663-6-1P-1P-2P-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	65	123	32	14.0	591	69	27.6
74798-2P-LB-1H-BP-BP-BP	P-2974 x (P-2974 x C-235)	75	126	33	12.4	660	58	13.5
7339-1-8-1-1P-BH-1P-BP	H-208 x E-100	68	121	38	21.0	959	12	4.6
73105-14-2-1P-1P-2P-BP-BP	K-850 x B-108	65	125	36	18.2	845	28	18.6
7334-8-3-1P-1P-1P-BP-BP	H-208 x No.56	51	125	26	13.9	654	62	13.2
73105-14-2-2P-1P-1P-BP-BP	K-850 x B-108	60	127	36	18.6	1194	2	7.4
73105-14-2-2P-1P-2P-BP-BP	K-850 x B-108	61	122	32	18.2	705	49	16.1
73166-9-3-1H-BH-1P-BP-BP	JG-62 x Pant G-104	62	120	32	22.9	826	31	9.7
	Annigeri	50	121	20	18.9	565	71	16.6
	CPS-1	56	126	30	16.4	654	62	3.4
	WR-315	55	123	29	12.6	845	28	6.5
Mean		59	124	30	17.0	765		12.9
CD (.05)		3.0	3.3	5.8	1.3	319.0		10.5
CV%		3.1	1.7	11.9	4.6	25.9		50.5

at Hyderabad. The plots were 8 rows of 4m length and 60 cm apart. The numbers of days to flowering and maturity, plant height, seed size and seed yields were recorded and adjusted means are shown in Table 16.6.

There were significant differences among entries for all characteristics. Collar rot caused initial plant mortality but final stands were reasonable in most plots. As in the Preliminary Trial most entries flowered later than the checks. The highest yield was obtained from Annigeri, although not significantly more than several of the advanced lines. The best performers will be included in further tests at Hyderabad and Hissar and in international nurseries and trials in 1981-82

Hissar: Long duration lines from the wilt sick plot at Hyderabad in 1979-80 were evaluated in replicated trials at Hissar. They included two preliminary trials, the second of which was sown in the wilt sick plot, and one trial of advanced lines. All were triple lattices with three replications and plots of 4 rows, 4m long. The rows were 60 cm apart in the trial in the wilt-sick plot and 30 cm in the others. In common with other materials at Hissar, *Botrytis* and *Ascochyta* caused considerable damage. Forty two badly affected entries were omitted from the analysis of Preliminary Trial-1 but C.Vs were high in all the trials. Days to flowering, seed size and seed yield data are summarised in Tables 16.7 to 16.9. The best entries have been selected for further tests in 1981-82.

STUNT (Pea leaf roll virus)

Eight crosses were made of the stunt resistant, Col1-327, on to high yielding desi and kabuli cultivars (Table 16.10).

The parents, F_1 and F_2 generations and F_3 progenies of the cross P-4353-1 x WR-315 and F_2 populations (8-10 rows each) of P-992 x K-468, NEC-240 x BC-203, P-2202-2 x Pant G-114 and P-992 x Rabat were evaluated for stunt resistance at Hissar. There was considerable mortality due to wilt, the stunt incidence was variable and the entries were bulked for further tests in 1981-82.

Table 16.6. Characteristics of entries in Advanced Trial of wilt resistant lines at Hyderabad in 1980/81.

IC / ICCL number	Pedigree	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
75866-1P-2P-BP-BT-BP-BP	PRR-1 x P-1265	48	114	34	13.8	1089	39
752296-5P-1P-BP-BT-BP-BP	[F_3(K-850 x BG-1) x K-4]X[F_3(F-404 x L-550) x GW-5/7]	46	113	35	23.5	1041	41
75419-5P-2P-BP-BT-BP-BP	P-99 x (NEC-108 x Radhey)	60	116	36	20.5	1529	7
741533-5P-3P-BP-BT-BP-BP	P-5409 x K-850	61	114	32	19.1	1523	8
75419-2P-3P-BP-BT-BP-BP	(P-99 x NEC-108) x Radhey	62	118	35	18.9	1113	37
741529-1P-2P-BP-BT-BP-BP	K-850 x P-2003	62	121	34	18.2	1226	29
741533-5P-4P-BP-BT-BP-BP	P-5409 x K-850	62	116	33	20.3	1386	17
80032[a]	(NEC-249 x NEC-1639) X (Chafa x P-472)	42	109	29	13.9	994	44
80031[a]	G-130 x WR-315	57	112	34	13.4	1446	11
75266-6P-1P-BP-BT-BP-BP	(NEC-1639 x NEC-1604) X (F-61 x P-10)	59	112	37	19.0	1131	36
80001[a]	(P-99 x NEC-108) x Radhey	54	113	32	16.7	1363	20
752424-7P-1P-BP-BT-BP-BP	F_4(JG-62 x F-496) X F_4(K-850 x Radhey)	54	112	38	18.6	1589	5
75889-2P-3P-BP-BT-BP-BP	P-1100 x WR-315	48	110	34	13.0	1380	19
741568-3P-2P-BP-BT-BP-BP	K-850 x P-2774	55	114	32	20.4	1428	13
752296-6P-1P-BP-BT-BP-BP	[F_3(K-850 x BG-1) x K-4]X[F_3(F-404 x L-550) x GW-5/7]	47	119	29	20.0	1083	40
75419-5P-3P-BP-BT-BP-BP	(P-99 x NEC-108) x Radhey	53	111	34	18.3	1339	23
80002[a]	K-4 x WR-315	55	119	33	15.1	1131	35
80003[a]	K-4 x WR-315	54	112	34	15.1	1446	11
752296-7P-BP-BP-BT-BP-BP	[F_3(K-850 x BG-1) x K-4]X[F_3(F-404 x L-550) x GW-5/7]	61	116	37	28.1	1410	14
75889-2P-2P-BP-BT-BP-BP	P-1100 x WR-315	49	111	32	12.4	1399	15
74632-1P-LB-BH-BP-BP-BT-BP-BP	(H-355 x BEG-482) x (JG-62 x P-1387)	57	111	34	13.9	1690	3
74273- B -9H-1P-BP-BP-BT-BP-BP	P-82 x (K-850 x H-223)	59	117	40	19.5	982	46
74371-5P-1P-1P-BP-BT-BP-BP	(K-850 x BEG-482) x (JG-62 x JG-221)	65	121	32	18.3	1113	37
73190-B-2P-1P-1P-BP-BT-BP-BP	E-378 x Chafa	53	108	35	23.4	1875	2
74632-1P-LB-BH-2P-BP-BT-BP-BP	(H-355 x BEG-482) x (JG-62 x P-1387)	60	112	34	13.9	1386	17
741663-6P-1P-1P-2P-BP-BT-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	61	120	36	16.1	798	49
741663-2P-1P-1P-1P-BP-BT-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	63	117	36	19.4	1041	42
741663-3P-1P-1P-2P-BP-BT-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	59	119	31	17.6	1303	25
80034[a]	F_2(K-850 x T-3) x (JG-62 x BEG-482)	58	114	39	17.9	1178	32

Contd....Table 16.6.

IC / ICCL number	Pedigree	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
74729-2P-1P-1P-BP-BT-BP-BP	(H-355 x K-850) x NEC-240	61	116	38	19.2	863	48
74540-22H-1P-BP-BP-BT-BP-BP	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)	58	115	41	20.2	1196	31
74729-2P-1P-2P-BP-BT-BP-BP	(H-355 x K-850) x NEC-240	54	113	37	19.5	1012	43
80033[a]	F_2(K-850 x T-3) x (JG-62 x BEG-482)	59	113	36	17.1	1351	21
741663-2-1P-1P-2P-BP-BT-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	62	117	38	19.8	1618	4
741663-3P-3P-BH-1P-BP-BT-BP-BP	(H-208 x RS-11) x (JG-221 x L-550)	60	124	33	16.9	1285	26
74540-21H-1P-1P-BP-BT-BP-BP	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)	61	116	35	17.9	1166	33
73190-B-2P-1P-3P-BP-BT-BP-BP	F-378 x Chafa	52	110	34	20.6	1154	36
74524-3P-1P-3P-BP-BT-BP-BP	(K-850 x GW-5/7) x (H-208 x Annigeri)	53	108	33	24.0	1351	21
74132-B-4H-1H-1P-BP-BT-BP-BP	G-130 x BG-1	71	123	36	11.1	1214	30
74527-4P-1P-1P-BP-BT-BP-BP	(G-130 x B-108) x (NP-34 x GW-5/7)	47	107	27	18.0	1565	6
73105-14-2-2P-1P-1P-BP-BT-BP-BP	K-850 x B-108	62	120	35	18.0	988	45
73105-14-2-2P-1P-2P-BP-BT-BP-BP	K-850 x B-108	61	118	38	20.0	1482	9
73166-9-3-1H-BH-1P-BP-BT-BP-BP	JG-62 x Pant G-104	60	115	35	20.4	1232	28
7353-2-3-1P-1P-1P-BP-BT-BP-BP	L-550 x BEG-482	59	118	34	13.7	1166	33
80004[a]	L-550 x USA-613	52	121	28	17.0	1244	27
76105-37P-BP-BP-BT-BP-BP	NEC-1604 x (PRR-1 x P-1488)	64	123	44	17.5	917	47
4918	Annigeri	49	112	25	19.9	1964	1
8933	WR-315	49	110	30	13.1	1446	11
10130	CPS-1	53	113	28	16.4	1309	24
Mean		57	115	34	17.9	1284	
CD (.05)		2.3	4.4	5.3	2.3	557.8	
CV%		2.0	1.9	7.7	6.4	21.3	

[a] ICCL-80001 = IC-75419-7P-2P-BP-BT-BP
ICCL-80002 = IC-7552-3P-2P-BP-BT-BP
ICCL-80003 = IC-7552-3P-2P-BP-BT-BP
ICCL-80004 = IC-7369-2-2-1P-1P-1P-BP-BT-BP
ICCL-80031 = IC-7547-1P-1P-BP-BT-BP
ICCL-80032 = IC-75278-1P-2P-BP-BT-BP
ICCL-80033 = IC-74540-21H-1P-BP-BP-BT-BP
ICCL-80034 = IC-74540-21H-1P-3P-BP-BT-BP

Table 16.7. Characteristics of wilt resistant entries in Preliminary Trial at Hissar, 1980/81.

Name/IC-number	Days to 50% flowering	Weight of 100 seeds (g)	Disease score	Seed yield (kg/ha)	Rank
75888-2P-2P-1P-BT	87	19.5	4.5	1317	20
7668-15P-1P-1P-BT	88	14.1	4.5	1968	8
7688-27P-1P-1P-BT	86	16.6	6.5	1684	14
7668-29-P-1P-1P-BT	84	16.5	3.0	1734	12
76105-22P-3P-1P-BT	85	22.7	5.0	1401	19
752760-11P-1P-1P-BT	82	18.3	4.5	1701	13
75877-9P-BP-2P-BT	83	15.9	4.5	1534	15
75877-10P-BP-1P-BT	82	19.0	4.5	1534	15
752463-29P-BP-1P-BT	85	17.2	2.5	2368	3
75419-1P-1P-1P-1P-BT	85	16.0	4.0	700	22
75419-2P-3P-1P-4P-BT	90	18.0	3.0	934	21
752296-7P-1P-BP-2P-BT	87	29.4	3.0	1417	18
742424-7P-1P-BP-1P-BT	86	22.4	4.0	1818	10
742424-7P-1P-BP-2P-BT	87	23.1	2.0	1734	11
741196-1P-1P-BP-1P-BT	84	17.1	3.0	2501	2
741196-1P-2P-BP-1P-BT	84	19.3	3.5	1501	17
741533-5P-3P-BP-1P-BT	86	21.0	2.5	2201	6
75419-5P-2P-BP-1P-BT	86	21.3	5.0	2268	5
WR-315	88	14.1	3.5	1901	9
H-208	88	13.9	2.0	2851	1
Pant G-114	87	15.5	2.5	2335	4
G-130	90	14.6	7.0	2168	7
Mean	86	18.4	3.8	1798	
CD(.05)	5.9	4.70	3.14	1246.8	
CV%	3.3	12.3	39.6	33.3	

Table 16.8. Characteristics of entries in Preliminary Trial-2 in wilt sick plot in Hissar in 1980/81.

IC/ICCL number	Pedigree	Days to 50% flowering	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
75866-1P-2P-BP	PRR-1 x P-1265	87	14.8	1317	14
752296-5P-1P-BP	[F_3(K-850 x BG-1) x K-4]x[F_3(F-404 x L-550) x GW-5/7]	89	22.0	169	49
75419-5P-2P-BP	(P-99 x NEC-108) x Radhey	88	17.8	1140	22
741533-5P-3P-BP	P-5409 x K-850	94	19.4	1460	9
75419-2P-3P-BP	(P-99 x NEC-108) x Radhey	94	15.7	228	48
741579-1P-2P-BP	K-850 x P-2003	91	16.0	1723	5
741533-5P-4P-BP	P-5409 x K-850	97	17.6	1182	20
75278-1P-2P-BP	(NEC-249 x NEC-1639) x (Chafa x P-472)	89	13.7	373	47
7547-1P-1P-BP	G-130 x WR-315	92	13.9	1402	11
75266-6P-1P-BP	(NEC-1639 x NEC-1604) x (F-61 x P-10)	94	17.0	1370	12
75419-7P-2P-BP	P-99 x (NEC-108 x Radhey)	91	13.7	1121	23
752424-7P-1P-BP	F_4(JG-62 x F-496) x F_4(K-850 x Radhey)	92	13.7	1048	25
75889-2P-3P-BP	P-1100 x WR-315	89	11.5	1301	15
741568-3P-2P-BP	K-850 x P-2774	95	17.9	1253	18
752296-6P-1P-BP	[F_3(K-850 x BG-1) x K-4]x[F_3(F-404 x L-550) x GW-5/7]	85	17.9	832	32
75419-5P-3P-BP	(P-99 x NEC-108) x Radhey	88	18.4	1344	13
ICCL-80002[a]	K-4 x WR-315	92	13.9	918	31
ICCL-80003[a]	K-4 x WR-315	91	14.6	1255	17
752296-7P-BP-BP	[F_3(K-850 x BG-1) x K-4]x[F_3(F-404 x L-550) x GW-5/7]	102	22.9	787	33
75889-2P-2P-BP	P-1100 x WR-315	90	12.4	962	29
74632-1P-LB-BH-BP-BP	(H-355 x BEG-482) x (JG-62 x P-1387)	88	13.3	494	43
74273-B-9H-1P-BP-BP	P-82 x (K-850 x H-223)	92	17.1	1404	10
74371-5P-1P-1P-BP	(K-850 x BEG-482) x (JG-62 x JG-221)	90	17.5	585	41
73190-B-2P-1P-1P-BP	F-378 x Chafa	91	19.4	701	36
74632-1P-LB-BH-2P-BP	(H-355 x BEG-482) x (JG-62 x P-1387)	88	13.5	1823	4
741663-6P-1P-1P-2P-BP	(H-208 x RS-11) x (JG-221 x L-550)	89	14.9	1827	3
741663-2P-1P-1P-1P-BP	(H-208 x RS-11) x (JG-221 x L-550)	90	19.1	1072	24
741663-3P-1P-1P-2P-BP	(H-208 x RS-11) x (JG-221 x L-550)	90	20.5	1949	1
ICCL-80034[a]	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)	92	17.6	1717	6
74729-2P-1P-1P-BP	(H-355 x K-850) x NEC-240	93	20.8	1241	19
74540-22H-1P-BP-BP	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)	92	18.6	1490	8
74729-2P-1P-2P-BP	(H-355 x K-850) x NEC-240	91	18.5	591	40

Contd....Table 16.8.

IC/ICCL number	Pedigree	Days to 50% flowering	Weight of 100 seeds (g)	Seed yield kg/ha	Seed yield Rank
74540-21H-1P-BP-BP	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)	94	17.5	952	30
741663-2-1P-1P-2P-BP	(H-208 x RS-11) x (JG-221 x L-550)	90	15.1	716	35
741663-3P-3P-BH-1P-BP	(H-208 x RS-11) x (JG-221 x L-550)	94	15.2	549	42
74540-21H-1P-1P-BP	F_2(K-850 x T-3) x F_2(JG-62 x BEG-482)	96	13.6	591	39
73190-B-2P-1P-3P-BP	F-378 x Chafa	92	19.4	464	45
74524-3P-1P-3P-BP	(K-850 x GW-5/7) x (H-208 x Annigeri)	89	20.6	989	28
74132-B-4H-1H-1P-BP	G-130 x BG-1	97	15.6	1882	2
74527-4P-1P-1P-BP	(G-130 x B-108) x (NP-34 x GW-5/7)	90	17.5	1300	16
73105-14-2-2P-1P-1P-BP	K-850 x B-108	92	18.5	1044	26
73105-14-2-2P-1P-2P-BP	K-850 x B-108	89	18.1	1596	7
73166-9-3-1H-BH-1P-BP	JG-62 x Pant G-104	90	20.1	1171	21
7353-2-3-1P-1P-1P-BP	L-550 x BEG-482	108	15.7	1023	27
ICCL-80004[a]	L-550 x USA-613	85	16.6	740	34
76105-37P	NEC-1604 x (PRR-1 x P-1488)	95	17.8	645	38
G-130		94	13.3	450	46
WR-315		91	13.6	653	37
CPS-1		92	15.2	484	44
Mean		92	16.7	1047	
CD (.05)		5.3	2.8	723.8	
CV%		3.6	10.2	42.6	

[a] ICCL-80002 = 7552-3P-29-BP
ICCL-80003 = 7552-3P-2P-BP-BT-BP
ICCL-80004 = 7369-2-2-1P-1P-1P-BP
ICCL-80034 = 74540-21H-1P-3P-BP

Table 16.9. Characteristics of wilt resistant lines in Advanced Trial at Hissar, 1980/81.

IC number	Pedigree	Days to 50% flowering	Days to maturity	Weight of 100 seeds (g)	Seed yield kg/ha	Rank
74190-B-2P-1P-2P-1P-BP-BT	F-61 x F-378	87	154	14.1	1462	8
74223-B-4H-1P-BP-BT	No.42 x H-223	86	152	17.4	1760	2
74132-B-4H-1H-1P-BP-BT	G-130 x BG-1	87	156	15.7	1574	6
73190-B-2P-1P-1P-BP-BT	F-378 x Chafa	93	159	10.6	1291	13
73190-B-2P-1P-3P-BP-BT	F-378 x Chafa	86	154	17.1	1259	14
74632-LB-BH-2P-BP-BT	(H-355 x BEG-482) x (JG-62 x P-1367)	89	159	12.3	1085	19
74632-LB-BH-BP-BP-BT	(H-355 x BEG-482) x (JG-62 x P-1367)	90	142	9.1	1152	16
741663-2-1P-1P-1P-BP-BT	(H-208 x RS-11) x (JG-221 x L-550)	91	156	13.6	1378	10
741663-2-1P-1P-2P-BP-BT	(H-208 x RS-11) x (JG-221 x L-550)	94	159	13.9	926	23
741663-2-3P-1P-1P-2P-BP-BT	(H-208 x RS-11) x (JG-221 x L-550)	87	152	14.7	1680	3
741663-1-3P-BH-1P-BP-BT	(H-208 x RS-11) x (JG-221 x L-550)	89	157	13.6	808	25
741663-6-1P-1P-2P-BP-BT	(H-208 x RS-11) x (JG-221 x L-550)	88	154	11.3	842	24
74798-2P-LB-1H-BP-BT	P-2974 x (P-2974 x C-235)	94	156	8.6	1620	5
7385-12-2-1H-1H-BP-1P-BT	L-550 x L-2 (Early)	90	157	16.6	1164	15
7385-12-2-1H-1H-BP-1P-BT	L-550 x L-2(Late)	88	157	15.3	1661	4
7339-1-8-1-1P-BH-1P-BP-BT	H-208 x E-100	94	158	21.8	1513	7
73105-14-2-1P-1P-2P-BP-BT	K-850 x B-108	86	153	15.9	1244	21
7334-8-3-1P-1P-1P-BP-BT	H-208 x No.56	85	156	11.5	1347	11
73105-14-2-2P-1P-1P-BP-BT	K-850 x B-108	85	153	16.0	1049	20
73105-14-2-2P-2P-3P-BP-BT	K-850 x B-108	86	153	16.3	1146	17
73166-9-3-1H-BH-1P-BP-BT	JG-62 x Pant G-104	90	155	17.4	2032	1
7370-15-3-1P-1P-1P-BP-BT	L-550 x GW-5/7	89	157	23.3	953	22
7353-2-3-1P-1P-1P-BP-BT	L-550 x BEG-482	87	159	12.0	1382	9
WR-315		92	157	12.4	1346	12
H-208		95	155	8.9	1089	18
Mean		89	155	14.4	1303	
CD(.05)		3.1	10.7	3.7	781	
CV%		2.1	4.1	15.6	36.5	

Table 16.10. Crosses made for stunt resistance 1980/81.

IC number	Cross
800717	Coll-327 x L-550
800718	Coll-327 x Pant G-114
800719	Coll-327 x BG-209
800720	Coll-327 x ICCC-24
800721	Coll-327 x ICCC-25
800722	Coll-327 x ICCC-26
800723	Coll-327 x ICCC-27
800724	Coll-327 x WR-315

ASCOCHYTA BLIGHT

We made 81 crosses of L-550, Pant G-114 and BG-209 on to 31 desi germplasm lines found resistant at ICARDA in 1979-80 (Table 16.11). The 31 desi lines were simultaneously evaluated at Islamabad in Pakistan in order to identify those resistant to *Ascochyta* in areas of the Indian subcontinent where the disease is endemic. We also made 39 crosses involving *Ascochyta* blight resistant kabuli and intermediate seed types identified at ICARDA, mainly with L-550 and Pant G-114 (Table 16.12).

Four F_2s of crosses made in 1979-80 and F_1s advanced in Kashmir involving genotypes found resistant to *Ascochyta* in the plant propagator at Hyderabad were sown at Hissar and harvested as bulks for further tests.

COMBINED RESISTANCE

We advanced 10 F_1s made to combine wilt and stunt resistance and 4 for *Ascochyta* and stunt resistance in the off-season nursery in Kashmir.

These were sown in non replicated plots of 20 to 40 rows each at Hissar and bulk harvested.

Table 16.11. Crosses of *Ascochyta* blight resistant desi types on to L-550, Pant G-114 and BG-209 in 1980/81.

Cross No.		Cross No.	
800585	L-550 x P-60-1	800633	Pant G-114 x P-1279-2
800586	L-550 x P-74	800634	Pant G-114 x P-1308
800587	L-550 x P-221	800635	Pant G-114 x P-1343-1
800588	L-550 x P-228	800636	Pant G-114 x P-1441
800589	L-550 x P-358-1	800637	Pant G-114 x P-1443-3
800590	L-550 x P-479	800638	Pant G-114 x P-1469-1
800591	L-550 x P-502-1	800639	Pant G-114 x P-1496-1
800592	L-550 x P-601	800640	Pant G-114 x P-1506-3
800593	L-550 x P-630-2	800641	Pant G-114 x P-1588
800594	L-550 x P-631	800642	Pant G-114 x P-1596
800595	L-550 x P-633	800643	Pant G-114 x P-1605
800596	L-550 x P-906	800644	Pant G-114 x P-1714-1
800597	L-550 x P-1004	800645	Pant G-114 x NEC-130
800598	L-550 x P-1034	800646	Pant G-114 x NEC-1431
800599	L-550 x P-1098	800647	BG-209 x P-60-1
800600	L-550 x P-1252-1	800648	BG-209 x P-74
800601	L-550 x P-1279-1	800649	BG-209 x P-221
800602	L-550 x P-1279-2	800650	BG-209 x P-228
800603	L-550 x P-1308	800651	BG-209 x P-358-1
800604	L-550 x P-1343-1	800652	BG-209 x P-479
800605	L-550 x P-1441	800653	BG-209 x P-502-1
800606	L-550 x P-1443-3	800654	BG-209 x P-601
800607	L-550 x P-1469-1	800655	BG-209 x P-630-2
800608	L-550 x P-1496-1	800656	BG-209 x P-631
800609	L-550 x P-1506-3	800657	BG-209 x P-633
800610	L-550 x P-1588	800658	BG-209 x P-906
800611	L-550 x P-1596	800659	BG-209 x P-1004
800612	L-550 x P-1605	800660	BG-209 x P-1034
800613	L-550 x P-1741-1	800661	BG-209 x P-1098
800614	L-550 x NEC-130	800662	BG-209 x P-1252-1
800615	L-550 x NEC-1431	800663	BG-209 x P-1279-1
800616	Pant G-114 x P-60-1	800664	BG-209 x P-1279-2
800617	Pant G-114 x P-74	800665	BG-209 x P-1308
800618	Pant G-114 x P-221	800666	BG-209 x P-1343-1
800619	Pant G-114 x P-228	800667	BG-209 x P-1441
800620	Pant G-114 x P-358-1	800668	BG-209 x P-1443-3
800621	Pant G-114 x P-479	800669	BG-209 x P-1469-1
800622	Pant G-114 x P-502-1	800670	BG-209 x P-1496-1
800623	Pant G-114 x P-601	800671	BG-209 x P-1506-3
800624	Pant G-114 x P-630-2	800672	BG-209 x P-1588
800625	Pant G-114 x P-631	800673	BG-209 x P-1596
800626	Pant G-114 x P-633	800674	BG-209 x P-1605
800627	Pant G-114 x P-906	800675	BG-209 x P-1741-1
800628	Pant G-114 x P-1004	800676	BG-209 x NEC-130
800629	Pant G-114 x P-1034	800677	BG-209 x NEC-1431
800630	Pant G-114 x P-1098		
800631	Pant G-114 x P-1252-1		
800632	Pant G-114 x P-1279-1		

Table 16.12. Crosses made in 1980/81 involving *Ascochyta* resistant kabuli and intermediate seed type.

Cross No.	
800678	Pant G-114 x ILC-191
800679	Pant G-114 x ILC-194
800680	Pant G-114 x ILC-220
800681	Pant G-114 x ILC-249
800682	Pant G-114 x ILC-76
800683	Pant G-114 x ILC-1695
800684	Pant G-114 x ILC-1617
800685	Pant G-114 x ILC-1675
800686	Pant G-114 x ILC-1619
800687	Pant G-114 x ILC-482
800688	Pant G-114 x ILC-484
800689	Pant G-114 x ILC-404
800690	Pant G-114 x ILC-1407
800691	Pant G-114 x ILC-236
800692	Pant G-114 x ILC-1284
800693	Pant G-114 x ILC-1287
800694	Pant G-114 x ILC-1305
800695	Pant G-114 x ILC-1276
800696	Pant G-114 x ILC-1331
800697	Pant G-114 x ILC-202
800698	L-550 x ILC-194
800699	L-550 x ILC-210
800700	L-550 x ILC-249
800701	L-550 x ILC-1695
800702	L-550 x ILC-1617
800703	L-550 x ILC-1675
800704	L-550 x ILC-1619
800705	L-550 x ILC-482
800706	L-550 x ILC-484
800707	L-550 x ILC-404
800708	L-550 x ILC-1407
800709	L-550 x ILC-236
800710	L-550 x ILC-1254
800711	L-550 x ILC-1287
800712	L-550 x ILC-1305
800713	L-550 x ILC-1276
800714	L-550 x ILC-1331
800715	L-550 x ILC-202
800716	PRR-1 x ILC-16430

PROJECT 17 : BREEDING FOR REDUCED SUSCEPTIBILITY TO *HELIOTHIS*

OBJECTIVE : To incorporate resistance to *Heliothis* into improved agronomic backgrounds of desi and kabuli types.

INTRODUCTION

Breeding for reduced susceptibility to *Heliothis* pod borer continued mainly at Hyderabad, where damage by the pest is more severe. The project proceeds in close cooperation between the breeders and entomologists. New sources of resistance identified by the entomologist and others in which reduced damage have been confirmed were incorporated in the breeding program, and F_1 to F_3 generations of earlier crosses were screened against pod borer. Studies of the contribution of pod borer to genotype x environment interactions were initiated. In subsequent descriptions, lines exhibiting reduced susceptibility will be referred to as 'low borer' lines.

HYBRIDISATION

The parents used and crosses made in breeding for reduced susceptibility to *Heliothis* are shown in Tables 17.1 to 17.3. They included a 6 x 6 diallel among low borer desi lines to improve existing levels of resistance (Table 17.1); a 4 x 4 diallel among low borer kabuli lines (Table 17.2); and 18 further crosses between adapted and low borer lines (Table 17.3).

Table 17.1. Parents used in 6 x 6 desi diallel to combine sources of *Heliothis* resistance, and their pedigrees.

ICC/IC No.	Pedigree
ICC-3474-EB4	P-4160
ICC-5880-EB4	GRAM-21
ICC-10619-EB3	G-130
IC-738-8-1-1P-BP-EB3	H-208 x BEG-482
IC-7320-11-2-1H-B-EB3	H-208 x RS-11
IC-73213-9-1-3H-B-EB3	GW-5/7 x H-223

F_1 GENERATION

Crosses made in 1979/80 involving low borer lines were multiplied in the off-season in Kashmir or under rain shelters at Hyderabad. They included 6 crosses among low and high borer selections, 13 between low borer and adapted lines and 5 three-way crosses involving disease resistant parents (Table 17.4).

Table 17.2. Parents used in 4x4 kabuli diallel to combine sources of *Heliothis* resistance, and their pedigrees.

Accession number	Pedigree
ICC-2696-EB3	P-2774-1
ICC-5264-EB4	GL-645
ICC-7966-EB4	NEC-2059
IC-7375-15-1-B-BP-EB2	L-550 x CP-66

Table 17.3. Crosses to incorporate *Heliothis* resistance into adapted backgrounds.

Adapted parent	*Heliothis* resistant lines	
	ICC/IC No.	Pedigree
BDN-9-3	ICC-6663-EB4	NEC-764
BG-203	ICC-5634-EB4	LUDHIANA-3
BG-209	ICC-3474-EB4	P-4160
F-378	C-235-EB3	
G-130	IC-7320-11-2-1H-B-EB3	H-208 x RS-11
H-76-49	ICC-4662-EB4	P-6254
H-208	ICC-1477-EB4	P-1283
ICCC-4	ICC-506-EB4	P-386
ICCC-9	ICC-11099-EB3	JG-1254
ICCC-10	ICC-1381-EB4	P-1234-1
ICCC-13	IC-738-8-1-1P-BP-EB4	H-208 x BEG-482
JG-74	IC-73213-9-1-3H-B-EB3	GW-5/7 x H-223
K-850	ICC-506-EB4	P-386
P-324	ICC-5800-EB4	GRAM-21
P-326	IC-73179-24-1-1H-B-EB3	G-130 x P-5409
Pant G-114	IC-731-9-2-1H-B-EB3	H-208 x F-61
Phule G-1	ICC-1381-EB4	P-1234-1
Phule G-4	ICC-8334-EB4	F-3
C-104	ICC-2996-EB3	P-3466-1
GL-622	ICC-2446-EB3	P-2224-2
K-4	ICC-7510-EB4	12-071-10025 JAM
Kourosh	IC-730075-15-1-B-BP-EB2	L-550 x CP-66
L-534	ICC-7579-EB4	P-9704
L-550	ICC-2966-EB4	P-3425
NEC-10	ICC-5462-EB4	V-1
NEC-175	ICC-7510-EB4	12-071-10025 JAM
NEC-1640	ICC-730075-15-1-B-BP-EB2	L-550 x CP-66
No.501	ICC-10761-EB3	CRIC-35380
Rabat	ICC-5264-EB4	GL-645

Table 17.4. Numbers and pedigrees of crosses involving low borer lines made in 1979/80.

IC No.	Pedigree
79191	ICC-7770-EB-EB x C-235-EB-EB
79192	ICC-7770-EB-EB x ICC-4767-EB-EB
79193	ICC-7770-EB-EB x ICC-1981-EB-EB
79194	C-235-EB-EB x ICC-4767-EB-EB
79195	C-235-EB-EB x ICC-1981-EB-EB
79196	ICC-4767-EB-EB x ICC-1981-EB-EB
79197	ICCC-4 x ICC-506-EB-EB
79198	ICCC-6 x ICC-1381-EB-EB
79199	ICCC-8 x ICC-3340-EB-EB
79200	Phule G-3 x ICC-2793-EB-EB
79201	Pant G-114 x ICC-3316-EB-EB
79202	P-324 x ICC-7770-EB-EB
79203	P-326 x G-130-EB-EB
79204	ICCC-17 x IC-7339-3-3-1H-B-EB
79205	ICCC-18 x IC-731-9-2-B-EB
79208	P-9847 x ICC-5264-EB-EB
79209	NEC-34 x ICC-5264-EB-EB
79210	L-534 x ICC-5264-EB-EB
79211	P-9800 x ICC-5264-EB-EB
79212	(ICC-506-EB-EB x ICC-1381-EB-EB) x WR-315
79213	(ICC-506-EB-EB x ICC-3316-EB-EB) x P-1353
79214	(ICC-1381-EB-EB x ICC-3316-EB-EB) x CPS-1
79215	(ICC-3316-EB-EB x ICC-7770-EB-EB) x T-3 Gwalior
79216	(ICC-506-EB-EB x ICC-7770-EB-EB) x T-3 Gwalior

Six F_1s of a 4 x 4 diallel among low and high borer lines made in 1979/80 were sown in insecticide-free conditions in the main season at Hyderabad in a randomised block design with three replicates. The plot size was 1 row 4 m long and 60 cm apart. The percentage of pods damaged by pod borer and the weight of seed were determined for each plant. The data are summarised in Tables 17.5 to 17.7.

There were significant differences among entries for all characters (Table 17.5). The two low borer parents, IC-7770-EB-EB and C-235-EB2, showed significantly lower pod damage than IC-4767-EB2 and IC-1981-EB-EB (Table 17.6).

Both GCA and SCA effects were significant for all characters. For total pods and seed yield, SCA effects were similar to or greater than GCA effects but for percentage damage GCA effects were greater, indicating a predominance of additive genetic variance for this character. Both the low borer parents were good combiners for reduced pod damage (Table 17.7) and C-235-EB2 for improved

Table 17.5. Mean squares from the analysis of variance and for GCA and SCA effects in 4 x 4 diallel trial at Hyderabad, 1980/81.

		Total pods	% damaged pods	Seed yield g/plot
Replicates	2	1535**	39.3**	50.1**
Entries	9	4068	149.4	168.0
Error	18	400	14.1	17.7
GCA	3	1349**	117.2**	26.0*
SCA	6	1359**	16.1*	71.0**
Error	18	133	4.7	5.9
GCA/SCA				

Table 17.6. Total number and % damaged pods and seed yield in parents and F_1s of 4 x 4 diallel at Hyderabad, 1980/81.

F_1s/parents	Total pods	% damaged pods	Seed yield g/plot
IC-7770-EB-EB x C-235-EB2	144	15.6	23.7
IC-7770-EB-EB x IC-4767-EB2	104	22.6	18.9
IC-7770-EB-EB x IC-1981-EB-EB	111	13.6	19.4
C-235-EB2 x IC-4767-EB2	138	22.6	26.8
C-235-EB2 x IC-1981-EB-EB	127	15.6	19.8
IC-4767-EB2 x IC-1981-EB-EB	171	17.9	33.6
IC-7770-EB-EB	87	16.3	13.3
C-235-EB2	153	12.8	23.7
IC-4767-EB2	54	36.9	7.9
IC-1981-EB-EB	77	21.5	12.5
Mean	117	19.6	20.0
C.D.	34.3	6.44	7.22
C.V.	17.2	19.2	21.2

Table 17.7. GCA and SCA effects for total number and % damaged pods and seed yield for parents and F_1s of 4 x 4 diallel at Hyderabad, 1980/81.

F_1s/Parents	Total pods	% damaged pods	Seed yield (g/plot)
IC-7770-EB-EB x C-235-EB2	13.7	1.27	2.64
x IC-4767-EB2	6.4	-1.25	1.58
x IC-1981-EB-EB	6.4	-2.43	1.60
C-235-EB2 x IC-4767-EB2	10.1	-0.41	4.60*
x IC-1981-EB-EB	- 7.9	0.41	- 2.81
IC-4767-EB2 x IC-1981-EB-EB	67.9**	-6.88**	14.72**
IC-7770-EB-EB	- 8.4*	-2.21**	- 1.85*
C-235-EB2	22.1**	-3.05**	2.97**
IC-4767-EB2	-10.3*	6.54**	- 0.78
IC-1981-EB-EB	- 3.4	-1.28	- 0.33
S.E. GCA	4.08	0.77	0.86
S.E. SCA	9.89	1.86	2.08

seed yield. The cross, IC-4767-EB2 x IC-1981-EB-EB, showed good specific combining ability for total pods and seed yield and for reduced borer damage. Other sca effects did not differ significantly from zero.

F_2 GENERATION

F_2 generations of crosses involving low borer lines made in 1978/79 and 1979/80 were sown as non-replicated plots under insecticide-free conditions at Hyderabad. Six of these were diallel combinations of 4 low borer parents made in 1978/79 (Table 17.8) and these were also sown protected with insecticide to compare selection in the two situations. The others were mainly crosses among low borer or between low borer and adapted lines made in 1978/79 and 1979/80 (Tables 17.9 and 17.3), the latter group having been multiplied in the off-season.

In the unprotected diallel set, percentage borer damage and seed yield were recorded for 25 single plants selected visually for low and 10 selected for high borer damage, from each population. Those selected visually for low damage had significantly lower percentage of damaged pods than those selected for high damage (Table 17.10) indicating the effectiveness

Table 17.8. Numbers and pedigrees of F_2s of a 4 x 4 diallel cross of low borer lines made in 1978/79.

IC No.	Pedigree
78286	IC-506-EB-EB x IC-1381-EB-EB
78287	IC-506-EB-EB x IC-3316-EB-EB
78288	IC-506-EB-EB x IC-7770-EB-EB
78289	IC-1381-EB-EB x IC-3316-EB-EB
78290	IC-1381-EB-EB x IC-7770-EB-EB
78291	IC-3316-EB-EB x IC-7770-EB-EB

Table 17.9. Numbers and pedigrees of crosses involving low borer lines made in 1978/79.

IC No.	Pedigree
78292	ICC-7770-EB-EB x ICC-4767-EB-EB
78293	IC-7339-3-3-1H-B-EB x ICC-1981-EB-EB
78294	ICC-3928-EB-EB x G-130-EB-EB
78295	ICC-4767-EB-EB x G-130-EB-EB
78296	BG-203 x ICC-3340-EB-EB
78297	H-208 x ICC-3340-EB-EB
78298	ICC-3340-EB-EB x ICCC-4
78301	ICC-5264-EB-EB x K-4
78302	BG-203 x IC-731-9-2-B-EB
78304	Annigeri x IC-731-9-2-B-EB
78305	H-208 x IC-731-9-2-B-EB
78306	IC-731-9-2-B-EB x ICCC-4
78307	IC-731-9-2-B-EB x ICCC-1
78308	Pant G-118 x IC-7559-EB-EB
78311	Chafa x IC-731-9-2-B-EB

Table 17.10. Mean percentage borer damage and seed yields and their standard errors of plants selected for low (LB) and high (HB) borer damage under insecticide-free conditions from F_2 populations of a 4 x 4 diallel series of low borer parents, 1980/81.

IC No.	% borer damage				Seed yield/plant (g)			
	LB		HB		LB		HB	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
78286	2.9	3.58	15.4	4.04	25.6	5.37	22.9	5.96
78287	4.0	3.01	12.3	3.90	33.2	17.46	26.5	5.83
78288	4.9	3.52	13.5	3.68	28.5	12.61	22.3	5.69
78289	5.1	3.75	17.5	6.64	29.6	16.34	25.0	8.84
78290	7.7	5.48	21.5	7.51	24.3	11.51	23.6	9.85
78291	6.2	3.64	16.4	8.20	25.9	11.70	25.8	7.06
Mean	5.1		16.1		27.8		24.4	

of the visual selection. There was much greater variation among those selected for low borer damage and there were many single plants with none or very few damaged pods. Seed yields did not differ significantly though they were always slightly higher among plants selected for low borer damage. The progenies will be subjected to further screening in 1981/82.

In the protected set, *Fusarium* wilt caused considerable plant mortality and surviving plants were bulk harvested for further selection in 1981/82.

In the other F_2s percentage borer damage and seed yield were recorded for single plants selected visually for low and 7 to 8 selected for high borer damage in each population in insecticide-free conditions. As with the diallel set there was significantly lower percentage borer damage among plants selected visually for low damage than among those selected for high damage (Table 17.11) confirming the effectiveness of visual selection. In general, percentage borer damage was higher than in the diallel perhaps reflecting the use of only one low borer parent in each cross combination, the other being adapted but selected principally under protected conditions. Again the low borer selections were usually higher yielding than those selected for high damage but the differences were small and non-significant. The progenies will be grown under insecticide-free conditions in 1981/82 for further selection.

F_3 GENERATION

One hundred and twentyone F_3 progenies of 7 of the crosses made in 1978/79 and selected from F_2 populations in 1979/80 were sown in insecticide-free conditions at Hyderabad. Eight were selected for high borer and 113 for low borer damage. The plot size was 2 rows, 4 m long and 60 cm apart and Annigeri was sown after every 10 progenies as a susceptible check. Percentage borer damage and weight of seed were estimated from 10 plants in each plot.

Mean percentage pod damage in Annigeri ranged from 14.1 to 21.2 with an overall mean of 17.29 $\pm$ 2.79 (Table 17.12). For the progenies the range was 2.6 to 33.8%. The correlation between pod borer damage in the F_2 plants selected in 1979/80 and the F_3 progenies was low but positive and significant ($r = 0.26$, $P < 0.01$) suggesting at least some degree of relationship between the two years.

There was no correlation between seed yields in the two years. Seed yields were much lower in 1980/81 than in 1979/80, probably due to the low moisture conditions in 1980/81, in which year there was a reasonably high positive correlation ($r = 0.471$, $P < 0.001$) between seed yield and maturity score, showing that the earlier maturing lines gave higher yields. There was no correlation between borer damage and seed yield in either year and no correlation between borer damage and maturity score in 1980/81. Selected lines will be sown in 1981/82 for further selection.

Table 17.11. Mean % borer damage and seed yields and their standard errors of plants selected for low (LB) and high (HB) borer damage under insecticide-free conditions from F_2 populations of crosses involving low borer lines, 1980/81.

IC No.	% borer damage					Seed yield/plant (g)			
	LB			HB		LB		HB	
	No.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
78292	11	13.9	10.5	24.5	12.2	28.1	21.7	18.1	7.1
78293	16	7.7	4.6	20.2	6.7	20.5	5.5	14.9	4.3
78294	12	11.3	5.1	20.9	9.2	24.6	19.1	13.5	6.8
78295	16	10.4	8.5	33.0	13.5	25.3	11.9	15.2	8.7
78296	18	5.5	4.9	20.3	7.0	19.9	13.7	14.3	7.3
78297	15	5.6	2.8	12.4	5.0	20.1	5.8	14.3	4.5
78298	18	2.9	3.8	17.7	8.3	13.2	7.6	12.3	4.2
78301	14	5.5	4.3	14.3	10.1	17.5	9.7	11.5	2.6
78302	41	4.5	4.1	22.9	5.4	20.4	7.5	21.8	8.1
78304	14	14.9	8.7	27.3	9.7	17.2	9.8	21.1	13.7
78305	30	3.1	2.2	14.7	8.3	30.7	14.5	22.1	10.3
78306	20	4.4	5.6	18.9	11.2	27.9	13.5	20.3	6.2
78307	14	4.9	3.7	31.5	10.0	17.6	6.6	15.3	8.8
78308	14	3.7	3.9	20.3	9.0	16.1	8.1	23.2	11.0
78311	18	5.7	5.0	20.5	10.9	20.4	7.3	22.2	9.6
79191	26	5.0	4.6	19.2	10.2	16.8	6.8	13.2	4.5
79192	15	10.9	8.5	30.7	9.7	25.7	16.3	18.2	7.7
79193	17	7.1	6.4	26.6	4.8	18.8	11.6	12.1	4.4
79194	15	9.9	4.2	32.3	11.0	19.2	8.7	20.9	9.4
79195	28	4.4	3.7	17.7	5.0	17.6	6.5	17.0	10.2
79196	12	9.0	6.9	23.4	4.7	19.7	11.0	14.8	5.1
79197	46	4.0	4.3	19.2	10.0	18.0	6.5	20.1	14.0
79198	48	4.6	4.8	16.8	7.2	18.7	7.9	24.9	11.9
79199	34	7.0	4.1	16.1	6.3	22.3	9.4	23.2	6.2
79200	40	6.7	5.0	20.8	4.7	21.5	8.1	23.5	6.2
79201	33	4.0	3.4	17.2	4.7	18.5	7.9	18.5	3.6
79202	27	4.0	4.6	23.0	5.4	14.7	7.4	19.0	8.0
79203	68	4.3	5.3	17.5	6.1	15.9	7.4	18.8	8.1
79204	80	4.9	4.2	21.7	6.9	19.6	8.6	18.0	7.0
79205	37	6.4	4.7	20.5	8.4	15.6	6.8	24.6	15.9
79208	14	5.3	4.1	20.1	13.0	19.7	9.5	18.0	8.7
79209	16	5.9	4.2	25.2	6.2	24.1	12.7	19.3	9.9
79210	22	4.1	3.5	16.8	4.8	16.9	5.8	20.2	7.2
79211	28	6.5	5.6	27.1	8.6	12.4	5.3	11.3	2.4
79212	51	4.2	3.9	22.5	7.3	14.5	6.9	13.0	4.2
79213	28	6.0	5.5	19.6	4.8	17.1	6.8	13.7	5.3
Mean		6.3		21.5		19.6		17.8	
S.D. of mean		2.9		5.1		4.2		4.0	

Table 17.12. Mean percentage borer damage and seed yields of F_2 single plants in 1979/80 and their F_3 progenies in 1980/81.

IC No.	1979/80		1980/81		
	% borer damage	Seed yield (g/plant)	% borer damage	Seed yield (g/plant)	Maturity score*
78287-1PE	1.5	65.5	5.6	18.6	4.0
78287-2PE	1.4	31.1	8.8	23.9	3.0
78287-3PE	1.9	34.1	9.3	21.2	4.0
78287-4PE	3.8	58.2	11.5	19.1	3.0
78294-2PE	14.9	63.7	11.0	18.8	3.0
78294-3PE	14.2	98.3	13.7	9.7	2.0
78294-4PE	6.4	82.0	13.0	24.0	2.0
78294-5PE	7.8	81.7	14.4	16.4	3.0
78294-6PE	4.9	85.3	10.8	15.4	2.0
78294-8PE	9.9	66.3	7.7	18.3	3.0
78294-17PE	12.1	78.7	12.5	9.8	2.0
78294-22PE	6.3	83.5	12.1	14.4	2.0
78294-24PE	29.2	16.9	16.7	13.9	2.0
78294-28PE	6.8	60.0	15.0	19.3	2.0
78294-31PE	6.5	57.4	13.3	14.0	2.0
78294-32PE	13.4	63.9	17.7	10.9	2.0
78294-34PE	2.8	61.2	12.1	17.6	2.0
78294-36PE	7.8	82.0	11.1	17.4	2.0
78294-38PE	5.0	93.3	14.9	16.7	3.0
78294-41PE	5.9	78.6	13.5	12.1	2.0
78294-46PE	29.3	68.0	19.0	11.1	2.0
78294-47PE	18.2	64.3	11.2	10.8	1.5
78294-48PE	38.3	12.6	12.8	15.1	1.5
78294-50PE	5.7	63.5	5.2	10.4	1.5
78295-1PE	10.0	103.4	18.7	10.7	1.0
78295-2PE	14.4	78.4	21.9	11.9	3.0
78295-6PE	27.5	93.3	29.3	11.9	3.0
78295-7PE	23.9	106.5	16.3	10.2	2.0
78295-8PE	21.8	78.4	12.3	10.5	1.5
78295-11PE	10.7	107.8	19.0	9.8	1.0
78295-13PE	19.9	116.0	15.7	12.7	1.5
78295-14PE	10.6	109.4	33.0	7.5	2.0
78295-15PE	15.6	78.7	17.2	12.8	2.0
78295-16PE	7.7	72.2	4.7	13.1	3.0
78295-18PE	21.8	87.2	21.9	10.3	2.0
78297-4PE	13.1	40.5	11.6	10.7	2.0
78297-11PE	14.9	40.0	8.3	10.6	2.0
78297-12PE	25.0	17.3	8.6	10.9	2.5
78297-13PE	24.1	13.0	8.2	11.7	1.5
78297-15PE	5.4	39.6	13.4	12.6	2.0
78297-18PE	7.1	29.7	6.3	14.8	2.0
78297-19PE	8.5	44.0	15.0	9.4	2.0
78297-23PE	5.5	49.9	8.7	12.1	2.0

Contd....Table 17.12.

IC No.	1979/80		1980/81		
	% borer damage	Seed yield (g/plant)	% borer damage	Seed yield (g/plant)	Maturity score*
78297-27PE	12.5	50.1	11.2	11.1	2.0
78297-31PE	11.0	52.8	8.1	9.4	2.0
78297-33PE	6.2	56.3	8.2	10.9	2.0
78297-37PE	6.1	56.2	8.8	8.5	2.0
78297-38PE	10.3	56.6	16.6	6.2	1.5
78297-39PE	4.3	42.7	7.3	9.7	2.0
78297-41PE	3.4	37.5	9.6	7.3	1.5
78297-48PE	0.8	40.6	33.8	11.8	2.0
78297-50PE	0.7	42.5	4.3	10.2	2.0
78297-57PE	7.7	41.0	8.8	15.0	2.5
78297-58PE	3.3	37.9	12.3	8.2	1.5
78297-59PE	4.7	49.2	9.1	9.3	2.0
78297-61PE	4.8	49.5	9.0	13.9	1.5
78297-62PE	8.5	65.1	10.3	12.8	3.0
78297-64PE	7.3	39.6	15.4	10.1	2.0
78297-71PE	6.1	36.4	15.6	9.2	2.0
78297-72PE	2.8	33.6	7.6	5.2	1.5
78297-74PE	4.6	43.7	12.5	7.8	2.0
78297-75PE	5.5	40.5	5.4	9.6	2.0
78297-80PE	5.6	48.3	10.1	10.5	2.0
78297-81PE	9.3	40.4	7.4	8.5	1.5
78297-82PE	1.2	34.5	12.4	17.4	1.5
78297-83PE	16.6	40.6	9.8	14.1	2.5
78297-86PE	11.0	42.4	21.6	8.9	2.0
78297-87PE	8.4	67.5	3.6	12.5	2.0
78297-88PE	11.5	56.9	12.4	9.0	2.0
78297-98PE	5.2	40.8	7.9	12.6	2.0
78302-2PE	8.4	29.0	8.0	15.9	1.5
78302-3PE	17.8	24.0	8.5	14.4	2.0
78302-4PE	8.9	29.4	14.0	10.0	1.0
78302-5PE	3.9	29.2	2.6	20.3	2.0
78302-7PE	4.7	25.3	8.3	14.0	2.0
78302-8PE	19.3	32.0	11.7	16.4	2.5
78302-12PE	4.7	25.4	4.0	14.0	2.0
78302-13PE	3.2	26.0	5.7	14.5	1.5
78302-14PE	20.1	19.0	7.2	11.6	2.0
78302-15PE	6.9	25.7	8.2	13.6	1.5
78302-16PE	10.4	38.3	9.2	10.4	1.0
78302-18PE	6.2	24.8	12.0	17.5	1.5
78302-21PE	7.3	33.1	9.4	13.1	2.0
78302-22PE	12.8	42.8	3.5	12.9	2.0
78302-24PE	6.9	26.3	7.1	18.1	1.5
78308-1PE	9.7	47.6	11.6	13.8	3.0
78308-2PE	0.7	36.6	20.5	19.4	4.0
78308-4PE	11.1	44.9	8.9	13.1	4.0
78308-6PE	8.4	70.6	12.0	14.6	3.0

Contd....Table 17.12.

IC No.	1979/80		1980/81		
	% borer damage	Seed yield (g/plant)	% borer damage	Seed yield (g/plant)	Maturity score*
78308-7PE	6.9	65.9	7.3	18.6	2.0
78308-8PE	6.5	66.7	5.3	11.7	2.5
78308-9PE	4.7	48.8	20.4	12.4	3.0
78308-11PE	10.1	86.7	12.2	21.2	3.0
78308-12PE	9.4	86.6	12.2	10.8	1.5
78308-13PE	0.0	49.3	9.8	17.8	3.0
78308-14PE	9.7	54.7	10.6	14.3	2.0
78308-15PE	5.4	56.5	9.1	11.0	2.0
78308-17PE	12.2	57.1	4.4	15.1	2.0
78308-18PE	8.3	48.8	8.6	14.1	2.5
78308-19PE	6.8	79.5	6.6	20.1	3.0
78308-20PE	14.9	91.9	14.1	12.4	3.0
78308-21PE	26.8	54.3	7.3	16.9	2.5
78308-22PE	18.6	42.2	18.6	14.4	2.0
78308-24PE	16.7	45.6	8.7	14.3	2.5
78308-25PE	9.3	72.0	11.7	12.6	2.5
78308-26PE	8.1	76.4	14.6	12.8	3.0
78308-27PE	1.6	43.1	5.7	16.5	3.0
78308-28PE	7.9	69.2	6.6	13.0	2.0
78308-29PE	4.6	56.3	7.4	11.5	3.0
78308-30PE	1.7	47.7	9.1	11.8	2.5
78308-33PE	15.3	24.5	18.4	11.2	3.0
78308-34PE	4.8	52.6	14.3	13.6	3.0
78308-35PE	10.5	75.1	4.7	12.1	2.5
78308-36PE	3.5	58.4	13.1	12.1	3.0
78308-37PE	21.7	53.5	29.6	15.8	5.0
78308-39PE	11.2	62.7	14.7	15.3	4.0
78308-41PE	9.6	74.1	8.1	14.0	2.5
78308-42PE	6.5	74.2	14.7	14.6	3.5
78308-43PE	10.7	48.5	22.3	4.9	1.0
78310-1PE	14.2	70.4	17.6	12.6	4.0
78310-2PE	12.2	108.1	12.1	7.8	1.0
Annigeri Mean			17.29	20.7	5.08
Annigeri Range			13.1-21.2	14.7-26.8	4.5-6.0
Annigeri S.D.			2.79	3.65	0.47

On scale of 1 to 6 where 1 indicates preflowering stage and 6,maturity.

REPLICATED TRIALS

Three trials of eight entries and Annigeri as a susceptible check were grown in insecticide-free and protected conditions in order to investigate the interactions between genotypes and insecticide. The entries were separated according to maturity and each trial included 4 low borer and 4 high yielding lines from the breeding program, selected under insecticide protection. The early and medium duration trials were sown at Hyderabad as balanced lattice squares with 4 replicates and plots of 6 rows 4 m long and 60 cm apart; and the long duration trials at Hissar with the same design and plot sizes except that due to space limitations the insecticide-free trial was a randomised block.

In the trials at Hyderabad percentage pod borer damage was estimated from 6 plants from each plot and records were taken of days to flowering, days to maturity and seed yields.

In the protected short duration trial two of the low borer entries ICC-506-EB4 and IC-738-8-1-1P-BP-2EB suffered severe plant mortality due to wilt and were excluded from the analysis. The results are summarised in Tables 17.13 to 17.15.

At Hyderabad, in both duration groups, seed yields were lower in the protected than in the unprotected trials (Tables 17.13 and 17.14), but this was unrelated to borer damage which was much lower and highly variable under protected conditions. In the short duration, unprotected trial there was a significant negative correlation between seed yield and percent borer damage ($r = -0.56$, $P < 0.01$) but not in the other trials.

Table 17.13. Performance of entries in short duration trials at Hyderabad, 1980/81.

Cultivar	DFF	DM	Seed yield (kg/ha)		% Borer	
	Prot.	Prot.	Unprot.	Prot.	Unprot.	Prot.
ICC-506-EB4	-	-	2001	-	5.1	-
IC-7394-18-2-1P-BP-2EB	54.0	105.3	2223	1345	14.6	0.1
IC-738-8-1-1P-BP-2EB	-	-	1963	-	9.9	-
IC-73103-10-2-2B-BP-2EB	46.5	96.0	1900	1318	14.9	0.1
ICCC-1	54.3	105.2	1297	1254	28.0	0.4
ICCC-6	48.0	96.0	1726	1322	17.8	1.0
ICCC-8	48.3	96.8	1685	1406	18.0	1.1
ICCC-9	47.3	96.4	1876	1588	14.9	0.2
Annigeri	48.0	97.1	1828	1650	20.0	0.8
Mean	49.5	98.9	1833	1412	15.9	0.5
S.E.	0.65	0.69	47.0	73.7	1.70	0.4
C.V.	2.6	1.4	5.1	10.4	21.4	165.5

Table 17.14. Performance of entries in medium duration trials at Hyderabad, 1980/81.

Cultivar	DFF	DM	Seed yield (kg/ha)		% Borer	
	Prot.	Prot.	Unprot.	Prot.	Unprot.	Prot.
ICC-1477-EB4	69.3	114.5	1466	982	15.4	0.2
IC-7341-8-1-1-BP-2BB	67.5	115.3	1720	920	12.1	0.9
IC-73185-2-4-1H-2EB	70.3	115.3	1740	980	14.2	1.5
IC-73213-9-1-3H-B-2EB	67.5	117.8	1744	840	12.9	1.7
ICCC-4	67.3	115.3	1490	838	14.4	2.0
ICCC-13	66.0	111.0	1626	960	13.1	4.4
ICCC-14	66.0	110.5	1610	946	17.4	1.7
ICCC-15	70.3	114.5	1505	998	18.2	4.0
Annigeri	48.0	98.0	1839	1308	17.8	0.1
Mean	65.8	112.4	1638	975	15.0	1.84
C.D.	1.60	1.59	34.8	135.6	1.62	2.58
C.V.	1.7	1.0	4.2	9.5	21.6	86.0

For both duration groups there were significant interactions between genotypes and insecticide protection for seed yields and, in the short duration group, for borer damage (Table 17.15). Among both duration groups, in unprotected conditions the highest yields were obtained from the "low borer" lines and those which had been developed under insecticide protection, indicating the importance of selection under unsprayed conditions for the, largely unprotected, farmer's crop. Annigeri gave the highest yields in both protected trials and in the medium duration, unprotected trial where its shorter duration gave it a marked advantage over medium duration genotypes in this relatively dry season but in the short duration, unprotected trial it was only similar yielding to the breeders' materials.

The trials at Hissar were badly damaged by *Ascochyta* blight and *Botrytis* gray mold and reliable yield and pod damage data were not obtained.

Table 17.15. Mean squares from combined analysis of variance of high and low input trials in short and medium duration groups at Hyderabad, 1980/81.

	Short duration			Medium duration		
	df	MS		df	MS	
		Seed yield	Borer damage		Seed yield	Borer damage
Inputs	1	2004120**	4425.09**	1	7911310**	3136.32**
Error (a)	6	73132	28.78	6	22205	6.72
Entries	6	270745**	47.32**	8	102100**	12.35
Inputs x Entries	6	163791**	42.76**	8	55491**	12.46
Error (b)	36	20188	6.61	48	15366	5.89

LIST OF PUBLICATIONS/REPORTS

1. Report of the Fourth International Chickpea Trials and Nurseries 1978-79. Progress Report-5. pp.162.

2. Details of Chickpea Materials Distributed to Cooperators June 1979-May 1980. Chickpea Breeding Progress Report-6. pp.60.

3. Report of the Fifth International Chickpea Trials and Nurseries 1979-80. Progress Report-7. pp.164.

4. Chickpea Breeding Report of Work (June 1979-May 1980). Progress Report-8. pp.253.

5. A brief report of the Sixth International Chickpea Trials and Nurseries conducted in India. Presented at the Rabi Pulses Workshop, University of Udaipur, Udaipur, Rajasthan, 16-19 September 1980. pp.36.

6. Proceedings of the International Workshop on Chickpea Improvement. ICRISAT, Hyderabad, 28 Feb-2 Mar 1979, India. pp.298.

7. International Chickpea Newsletter No. 2. June 1980. pp.27.

8. International Chickpea Newsletter No. 3. December 1980. pp.27.

9. Singh, K.B., Hawtin, G.C., Nene, Y.L., and Reddy, M.V. 1981. Resistance in chickpea to Ascochyta rabiei. Plant Disease 65:586-587.

10. Hawtin, G.C., and Singh, K.B. 1981. Prospects and potential of winter sowing of chickpea in the Mediterranean region. Presented at the Workshop on Ascochyta Blight and Winter Sowing of Chickpeas, ICARDA, 4-7 May 1981, Aleppo, Syria.

11. Singh, K.B., Gridley, H.E., and Hawtin, G.C. 1981. Strategy for breeding Ascochyta blight resistant cultivars. Presented at the Workshop on Ascochyta Blight and Winter Sowing of Chickpeas, ICARDA, 4-7 May 1981, Aleppo, Syria.

12. Reddy, M.V., Singh, K.B., and Nene, Y.L. 1981. Screening techniques for Ascochyta blight. Presented at the Workshop on Ascochyta Blight and Winter Sowing of Chickpeas, ICARDA, 4-7 May 1981, Aleppo, Syria.

13. Singh, K.B., Nene, Y.L., and Reddy, M.V. 1981. International screening for resistance to Ascochyta blight. Presented at the Workshop on Ascochyta Blight and Winter Sowing of Chickpeas, ICARDA, 4-7 May 1981, Aleppo, Syria.

14. Singh, K.B., Saxena, M.C., and Gridley, H.E. 1981. Screening for cold and frost tolerance. Presented at the Workshop on Ascochyta Blight and Winter Sowing of Chickpeas, ICARDA, 4-7 May 1981, Aleppo, Syria.

15. Sethi, S.C., Byth, D.E., Gowda, C.L.L., and Green, J.M. 1981. Photoperiodic response and accelerated generation turnover in chickpea. Field Crops Research 4:215-225.