Chickpea Breeding
Progress Report-20

CHICKPEA BREEDING

REPORT OF WORK

June 1982-May 1983

PROJECTS CP-brd/path-16 and CP-brd/ent-17
Breeding for disease and insect resistance

ICRISAT

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FOREWORD

As stated in our Foreword to Progress Report No.18 the activities of the Chickpea Breeding sub-program for 1982-83 are reported in three parts. The subject of this report (No.20) include: Breeding for disease and insect resistance - Projects CP-brd/path-16 and CP-brd/ent-17 - carried out in collaboration with the Pulse Pathology and Pulse Entomology sub-programs in 1982-83.

The work described involves the diseases, Fusarium wilt, root rots, Ascochyta blight, Botrytis gray mold, and stunt, the pest is Heliothis armigera. The pedigree method of breeding is in use for all. Breeding for resistance to wilt and root rots is most advanced compared to Heliothis and other diseases.

As with our other Reports of Work, it is intended to be a plete record of our activities. We present all the data we collected from tests at Hyderabad, Gwalior and Hissar in 1982-83, without at this stage embarking on detailed analysis or interpretation of the data will be or have already been reported elsewhere. Some is extremely variable and much will get no further than this report.

To reduce repetition, all field tests were sown in rows 4 m long. Trials of F_2 and more advanced materials were at a spacing of 10 cm in rows 30 cm apart and other materials at 20 x 60 cm unless otherwise stated. The symbols * and ** indicate significance at the 0.05 and 0.01 levels of probability, respectively.

Climatological data for Hyderabad and Hissar, where most of the work was conducted, and a brief description of growing conditions were given in Progress Report No.18. A list of the staff involved is here on page i. The projects and the scientists responsible are listed on page ii and full contents on pages iii and iv. As always, we recognize the participation of all our cooperators both within and without ICRISAT and gratefully acknowledge their assistance and contributions.

CHICKPEA BREEDING SUBPROGRAM 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
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
Mr. D.M. Pawar	Senior Supervisor (Hissar)
Mr. M.D. Gupta	Senior Research Associate (Pigeonpea Breeding, Gwalior)
Mr. J.B. Miranda	Research Associate II
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Mr. Arvind Shukla@	Research Associate I
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Mr. Ramkishore	Field Assistant (Hissar)
Mr. S.C. Saxena	Field Assistant
Mr. K.J. Reddy	Field Assistant II
Mr. Sube Singh	Field Assistant (Hissar)
Mr. K. Shivraj	Field Assistant II
Mr. K. Shankeriah	Field Assistant II
Mr. Easwaraiah	Field Assistant
Mr. A.J. Rama Rao	Sr. Secretary I
Mr. Meva Singh	Clerk/Typist (Hissar)
Miss Gyaneswari Shukla+	Clerk/Typist
Mr. Syed Liaqatullah	Sr. Driver/General Assistant
Mr. Zamashah Khan	Driver/General Assistant
Mr. Phul Singh	Driver/General Assistant (Hissar)
Mr. Kashi Ram	Security Guard II (Hissar)
Mr. Asifuddin@@	Field Attendant
Mr. S.	Field Attendant

\+ Transferred to Pulse program office during the year
@ Left the program during the year
@@ Joined the program during the year

CHICKPEA BREEDING

List of Approved Projects

No.	Title	Project Scientist	Cooperators
CP-brd-1	Development of desi cultivars and superior breeding lines	S.C. Sethi C.L.L. Gowda Onkar Singh	
CP-brd-2	Development of kabuli cultivars and superior breeding material	J. Kumar S.C. Sethi	
CP-brd-5	Breeding for adaptation to late sowing	S.C. Sethi	M.P. Saxena
CP-brd-6	Development of high protein breeding lines	J. Kumar	U. Singh
CP-brd-7	Breeding for new plant types	Onkar Singh C.L.L. Gowda	M.P. Saxena
CP-brd-9	Comparison of breeding methods	Onkar Singh S.C. Sethi	-
CP-brd-11	International cooperation	J.B. Smithson J. Kumar	C.L.L. Gowda Onkar Singh S.C. Sethi
CP-brd-12	Genetic studies of qualitative and quantitative characters	S.C. Sethi J. Kumar C.L.L. Gowda Onkar singh	-
CP-brd-13	Breeding chickpeas for early sowing	Onkar Singh	M.P. Saxena
CP-brd-14	Studies of desi-kabuli introgression	C.L.L.Gowda	S.C. Sethi
CP-brd/ path-16	Breeding for disease resistance	J. Kurar M.P. Haware M.V. Reddy S.P.S.Beniwal	S.C. Sethi
CP-brd/ ent-17	Breeding for reduced susceptibility to Heliothis	C.L.L. Gowda S.S. Lateef	S.C. Sethi

CONTENTS

SUMMARY

CP-brd-16. Breeding for disease resistance

1. We made 74 single and 138 multiple or back crosses to transfer wilt, Ascochyta, Botrytis and stunt resistance to improved desi and kabuli backgrounds.

2. Seventy-seven F_1s of crosses made earlier were advanced in the off-season at Tapperwaripora in Kashmir.

3. We screened 97 bulks and 893 progenies of F_2 to F_4 generations of crosses for wilt resistance in wilt-sick plot at Hyderabad.

4. We evaluated 1086 F_4 to F_5 progenies in normal fields and selected 715 rows and 79 plants for further yield tests.

5. Forty-three wilt resistant kabuli and 9 wilt resistant double-podded lines developed through breeding were also evaluated for yield and other agronomic traits.

6. At Hissar, we screened 177 bulks and 2171 progenies from F_2 to F_3 generations in a wilt-sick plot and selected 84 bulks, 408 rows and 747 single plants.

7. At Hissar, 749 F_4 to F_5 progenies were evaluated for yield in the normal fields, and 417 rows and 27 plants were selected.

8. Eighty-eight and 90 advanced breeding lines were evaluated in four trials each at Hyderabad and Hissar, respectively. None gave significantly heavier seed yields than the check cultivar. However 5 best yielding lines were selected for ICSN-DS and 49 were retained for further testing.

9. We tested 46 and 47 entries in advanced yield trails at Hyderabad and Hissar respectively. Of these 34 lines will be retested in 1983-84 and 6 will be promoted to ICSN-DS.

10. We screened 28 F_2 populations for Ascochyta blight resistance in collaboration with HAU at Hissar.

11. We screened 60 F_2 and 49 F_3 populations for resistance to Botrytis gray mold in collaboration with GBPUAT at Pantnagar.

12. We screened 50 F_2 populations and 299 F_3 to F_5 progenies in the stunt nursery at Hissar, selected 332 single plants, and bulked 54 progenies for yield testing in 1983-84.

13. F_2s and F_3s of crosses for combining Ascochyta and wilt resistance, Ascochyta and Botrytis, and wilt and root rots were advanced to F_3 and F_4 generations.

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

1. We made diallel crosses among 6 short duration desi and 5 kabuli low and high borer lines. Four low borer lines were also crossed to four wilt resistant parents.

2. Trials at Hydrabad of F_1 diallels of desi short and medium duration low and high borer lines indicated that variation for borer damage and other characters was mainly additive.

3. We screened 110 F_2 populations in unsprayed conditions at Hyderabad and selected 241 low borer, 40 high borer, and 354 plants with good seed yields for F_3 progeny tests in 1983-84.

4. We screened 738 F_3 to F_4 progenies at Hydrabad and 736 F_4/F_5 progenies at Hissar in unsprayed conditions and selected 917 and 822 single plants for further testing.

PROJECT 16: BREEDING FOR DISEASE RESISTANCE

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

INTRODUCTION

We attempted more crosses to incorporate resistance to fusarium wilt, ascochyta blight, botrytis gray mold and ascochyta blight and stunt into adapted desi and kabuli backgrounds. Screening of segregating material was done in collaboration with Pulse Pathology section. Material for ascochyta blight was screened in collaboration with HAU, Hissar and for botrytis gray mold with GBPUA&T, Pantnagar.

FUSARIUM WILT

Hybridisation

Crosses involving new wilt resistant kabuli types and high yielding kabuli cultivars and a good combiner L-2 and Surutato 77 were attempted (Table 16.1). We did not make any crosses involving desi types as enough material has already been generated.

F_1 generation

We advanced 31 F_1's of single crosses made in 1981-82 for short duration desi types (Chickpea Breeding Progress Report No.15, Table 16.1) in the off-season nursery at Tapperwaripora in Jammu and Kashmir State. Similarly 32 crosses involving long duration desi types and 14 involving kabuli types (Chickpea Breeding Progress Report 15, Tables 16.2, 16.3, respectively) were planted in the off-season nursery.

F_2 to F_4 generations

Hyderabad: In the wilt-sick plot, 97 F_2 popoulations each with 20 rows, 831 F progenies each with one row and 62 F_4 progenies with one row each were screened (Table 16.2). Two rows were sown on ridges 75cm apart and every third ridge was occupied by a single row of JG-62, as a susceptible indicator. JG-62 was killed by 4 weeks after planting. The bulks and progenies were rated for earliness and appearance. Resistant single plants were selected in F generation and will undergo further screening in the wilt-sick plot in 1983-84. The performance of single plants and progenies selected in F_3 and F_4 generations will be evaluated in non-replicated rows in general fields.

Table 16.1 Crosses made in 1982 to incorporate disease resistance to desi and kabuli types.

ICCX No.	Parentage
Wilt Resistance-Kabuli.	
820587	ICCL-81001 x L-2
820588	ICCL-81001 x C-104
820589	ICCL-82001 x L-2
820590	ICCL-82001 x C-104
820591	ICCL-82001 x L-550
820710	ICCL-81001 x L-144
820711	ICCL-82001 x L-144
820579	L-550 x SURUTATO 77
Ascochyta Resistance-Desi	
820592	ILC-202 x C-235
820593	ILC-202 x G-543
820594	ILC-202 x GG-588
820595	ILC-202 x H 75-35
820596	ILC-202 x BG(M)-408
820597	ILC-202 x ICCC-23
820598	ILC-202 x GL-1002
820599	ILC-202 x GG-685
820600	ILC-202 x ICCC-29
820601	ILC-202 x H 77-51
820602	ILC-202 x GL-769
820603	ILC-202 x H-208
820604	ILC-3279 x C-235
820605	ILC-3279 x G-543
820606	ILC-3279 x GG-588
820607	ILC-3279 x H 75-35
820608	ILC-3279 x BG(M)-408
820609	ILC-3279 x ICCC-23
820610	ILC-3279 x GL-1002
820611	ILC-3279 x GG-685
820612	ILC-3279 x ICCC-29
820613	ILC-3279 x H 77-51
820614	ILC-3279 x GL-769
820615	ILC-3279 x H-208
820712	ILC-72 x GG-588
Ascochyta Resistance-Kabuli	
820616	ILC-3279 x ICCC-32

contd....Table 16.1

ICCX No	Parentage
Ascochyta and Stunt Resistance	
820617	ICC-2385 x ILC-3279
820618	ICC-2385 x ILC-202
820619	ICC-3718 x ILC-3279
820620	ICC-3718 x ILC-202
820621	ICC-6433 x ILC-3279
820622	ICC-6433 x ILC-202
820623	ICC-6934 x ILC-3279
820624	ICC-6934 x ILC-202
820625	ICC-10495 x ILC-3279
820626	ICC-10495 x ILC-202
Botrytis Resistance	
820627	ANNIGERI x ICC-6671
820628	ANNIGERI x ICC-1084
820629	ANNIGERI x ICC-1093
820630	ANNIGERI x ICC-4014
820631	ANNIGERI x ICC-4018
820632	ICCC-4 ICC-6671
820633	ICCC-4 ICC-1084
820634	ICCC-4 ICC-1093
820635	ICCC-4 ICC-4014
820636	ICCC-4 ICC-4018
820637	PANT G-114 x ICC-6671
820638	PANT G-114 x ICC-1084
820639	PANT G-114 x ICC-1093
820640	PANT G-114 x ICC-4014
820641	PANT G-114 x ICC-4018
820642	BG-209 ICC-6671
820643	BG-209 ICC-1084
820644	BG-209 ICC-1093
820645	BG-209 ICC-4014
820646	BG-209 ICC-4018
820647	GG-588 ICC-6671
820648	GG-588 ICC-1084
820649	GG-588 ICC-1093
820650	GG-588 ICC-4014
820651	GG-588 ICC-4018
820652	GL-769 ICC-6671
820653	GL-769 ICC-1084
820654	GL-769 ICC-1093
820655	GL-769 ICC-4014
820656	GL-769 ICC-4018

contd...Table 16.1

ICCX No.	Female parent	Male parent
Double crosses		
Wilt and Ascochyta		
811092	(WR-315 x GL-769)	(ILC-72 x PANT G-114)
811093	(WR-315 x H-75-35)	(ILC-72 x PANT G-114)
811094	(WR-315 x BG-209)	(ILC-72 x PANT G-114)
811095	(WR-315 x ICCC-23)	(ILC-72 x PANT G-114)
811096	(WR-315 x GL-769)	(ILC-72 x BG-209)
811097	(WR-315 x H-75-35)	(ILC-72 x BG-209)
811098	(WR-315 x BG-209)	(ILC-72 x BG-209)
811099	(WR-315 x ICCC-23)	(ILC-72 x BG-209)
811100	(WR-315 x GL-769)	(ILC-202 x PANT G-114)
811101	(WR-315 x H-75-35)	(ILC-202 x PANT G-114)
811102	(WR-315 x BG-209)	(ILC-202 x PANT G-114)
811103	(WR-315 x ICCC-23)	(ILC-202 x PANT G-114)
811104	(WR-315 x GL-769)	(ILC-202 x BG-209)
811105	(WR-315 x H-75-35)	(ILC-202 x BG-209
811106	(WR-315 x BG-209)	(ILC-202 x BG-209)
811107	(WR-315 x ICCC-23)	(ILC-202 x BG-209)
811108	(PPK-1 x GL-769)	(ILC-72 x PANT G-114)
811109	(PPK-1 x H-75-35)	(ILC-72 x PANT G-114)
811110	(PPK-1 x BG-209)	(ILC-72 x PANT G-114)
811111	(PPK-1 x ICCC-23)	(ILC-72 x PANT G-114)
811112	(PPK-1 x GL-769)	(ILC-72 x BG-209)
811113	(PPK-1 x H-75-35)	(ILC-72 x BG-209
811114	(PPK-1 x BG-209)	(ILC-72 x BG-209
811115	(PPK-1 x ICCC-23)	(ILC-72 x BG-209)
811116	(PPK-1 x GL-769)	(ILC-202 x PANT G-114)
811117	(PPK-1 x H-75-35)	(ILC-202 x PANT G-114)
811118	(PPK-1 x BG-209)	(ILC-202 x PANT G-114)
811119	(PPK-1 x ICCC-23)	(ILC-202 x PANT G-114)
811120	(PPK-1 x GL-769)	(ILC-202 x BG-209)
811121	(PPK-1 x H-75-35)	(ILC-202 x BG-209
811122	(PPK-1 x BG-209)	(ILC-202 x BG-209)
811123	(PPK-1 x ICCC-23)	(ILC-202 x BG-209)
Botrytis and Ascochyta		
811127	(GL-769 x P-9687)	(ILC-72 x PANT G-114)
811128	(GL-769 x NEC-2451)	(ILC-72 x PANT G-114)
811129	(GL-769 x P-919)	(ILC-72 x PANT G-114)
811130	(GL-769 x NEC-123)	(ILC-72 x PANT G-114)
811131	(GL-769 x P-9687)	(ILC-72 x BG-209)
811132	(GL-769 x NEC-2451)	(ILC-72 x BG-209)
811133	(GL-769 x P-919)	(ILC-72 x BG-209)
811134	(GL-769 x NEC-123)	(ILC-72 x BG-209)
811135	(GL-769 x P-9687)	(ILC-202 x PANT G-114)

contd...Table 16.1

ICCX No.	Female parent	Male parent
811136	(GL-769 NEC-2451)	(ILC-202 PANT G-114)
811137	(GL-769 P-919)	(ILC-202 PANT G-114)
811138	(GL-769 NEC-123)	(ILC-202 PANT G-114)
811139	(GL-769 P-9687)	(ILC-202 BG-209)
811140	(GL-769 NEC-2451)	(ILC-202 BG-209)
811141	(GL-769 P-919)	(ILC-202 BG-209)
811142	(GL-769 NEC-123)	(ILC-202 BG-209)
811143	(L-550 NEC-2451)	(ILC-72 PANT G-114)
811144	(L-550 P-919)	(ILC-72 PANT G-114)
811145	(L-550 NEC-123)	(ILC-72 PANT G-114)
811146	(L-550 NEC-2451)	(ILC-72 BG-209)
811147	(L-550 P-919)	(ILC-72 BG-209)
811148	(L-550 NEC-123)	(ILC-72 BG-209)
811149	(L-550 NEC-2451)	(ILC-202 PANT G-114)
811150	(L-550 P-919)	(ILC-202 PANT G-114)
811151	(L-550 NEC-123)	(ILC-202 PANT G-114)
811152	(L-550 NEC-2451)	(ILC-202 BG-209)
811153	(L-550 NEC-123)	(ILC-202 BG-209)
811154	(H 75-35 NEC-2451)	(ILC-72 PANT G-114)
811155	(H 75-35 NEC-123)	(ILC-72 PANT G-114)
811156	(H 75-35 NEC-2451)	(ILC-72 BG-209)
811157	(H 75-35 P-919)	(ILC-72 BG-209)
811158	(H 75-35 NEC-123)	(ILC-72 BG-209)
811159	(H 75-35 NEC-2451)	(ILC-202 PANT G-114)
811160	(H 75-35 P-919)	(ILC-202 PANT G-114)
811161	(H 75-35 NEC-123)	(ILC-202 PANT G-114)
811162	(H 75-35 NEC-2451)	(ILC-202 BG-209)
811163	(H 75-35 P-919)	(ILC-202 BG-209)
811164	(H 75-35 NEC-123)	(ILC-202 BG-209)
811165	(BG-209 x P-9687)	(ILC-72 PANT G-114)
811166	(BG-209 x NEC-2451)	(ILC-72 PANT G-114)
811167	(BG-209 P-919)	(ILC-72 PANT G-114)
811168	(BG-209 NEC-123)	(ILC-72 PANT G-114)
811169	(BG-209 P-9687)	(ILC-202 PANT G-114)
811170	(BG-209 NEC-2451)	(ILC-202 PANT G-114)
811171	(BG-209 P-919)	(ILC-202 PANT G-114)
811172	(BG-209 NEC-123)	(ILC-202 PANT G-114)
Stunt and Ascochyta		
811173	(BG-209 P-2151-1)	(ILC-72 x PANT G-114)
811174	(BG-209 P-4341-2)	(ILC-72 x PANT G-114)
811175	(BG-209 NEC-417)	(ILC-72 x PANT G-114)
811176	(BG-209 NEC-1174)	(ILC-72 x PANT G-114)
811177	(BG-209 RPSP-226)	(ILC-72 x PANT G-114)
811178	(BG-209 P-2151-1)	(ILC-202 x PANT G-114)
811179	(BG-209 P-4341-2)	(ILC-202 x PANT G-114)
811180	(BG-209 NEC-417)	(ILC-202 x PANT G-114)

contd...Table 16.1

ICCX No.	Female parent	Male parent
811181	(BG-209 x NEC-1174)	(ILC-202 x PANT G-114)
811182	(BG-209 x RPSP-226)	(ILC-202 x PANT G-114)
811183	(PANT G-114 x P-2151-1)	(ILC-72 x BG-209)
811184	(PANT G-114 x P-4341-2)	(ILC-72 x BG-209)
811185	(PANT G-114 x NEC-417)	(ILC-72 x BG-209)
811186	(PANT G-114 x NEC-1174)	(ILC-72 x BG-209)
811187	(PANT G-114 x RPSP-226)	(ILC-72 x BG-209)
811188	(PANT G-114 x P-2151-1)	(ILC-202 x BG-209)
811189	(PANT G-114 x P-4341-2)	(ILC-202 x BG-209)
811190	(PANT G-114 x NEC-417)	(ILC-202 x BG-209)
811191	(PANT G-114 x NEC-1174)	(ILC-202 x BG-209)
811192	(PANT G-114 x RPSP-226)	(ILC-202 x BG-209)
811193	(L-550 x P-2151-1)	(ILC-72 x L-550)
811194	(L-550 x P-4341-2)	(ILC-72 x L-550)
811195	(L-550 x NEC-417)	(ILC-72 x L-550)
811196	(L-550 x NEC-1174)	(ILC-72 x L-550)
811197	(L-550 x RPSP-226)	(ILC-72 x L-550)
811198	(L-550 x P-2151-1)	(ILC-202 x L-550)
811199	(L-550 x P-4341-2)	(ILC-202 x L-550)
811200	(L-550 x NEC-417)	(ILC-202 x L-550)
811201	(L-550 x NEC-1174)	(ILC-202 x L-550)
811202	(L-550 x RPSP-226)	(ILC-202 x L-550)
Three way crosses		
Wilt and Ascochyta		
811124	(WR-315 x H-75-35)	BG-209
811125	(WR-315 x H-75-35)	PANT G-114
811126	(WR-315 x H-75-35)	GL-769
Back crosses - Disease Resistance		
811072	(P-1329 x NEC-116)	P-1329
811073	(P-1067-1 x NEC-1166)	P-1067-1
811074	(P-4089-1 x NEC-1166)	P-4089-1
811075	(P-18 x NEC-1166)	P-18
811076	(JG-62 x P-436-2)	JG-62
811077	(2375 x P-436-2)	2375
811078	(ICCC-4 x P-436-2)	ICCC-4
811079	(ICCC-31 x P-436-2)	ICCC-31
811080	(ANNIGERI x P-436-2)	ANNIGERI
811081	(ANNIGERI x NEC-1166)	ANNIGERI
811082	(ILC-72 x PANT G-114)	PANT G-114
811083	(ILC-202 x PANT G-114)	PANT G-114
811084	(ILC-72 x BG-209)	BG-209
811085	(ILC-202 x BG-209)	BG-209
811086	(ICCL-81001 x L-550)	L-550
811087	(PANT G-114 x ILC-3279)	PANT G-114
811088	(ILC-3279 x BG-209)	BG-209

contd...Table 16.1

ICCX No.	Female parent	Male parent
811089	(L-550 x ILC-3279)	L-550
811090	(ILC-482 x ICCL-81001)	ILC-482
811091	(ILC-484 x ICCL-81001)	ILC-484
811203	(ICC-10619-EB x CPS-1)	ICC-10619-EB
811204	(ICC-10619-EB x WR-315)	ICC-10619-EB
811205	(ICC-10667-EB x P-436-2)	ICC-10667-EB
811206	(ICC-10667-EB x WR-315)	ICC-10667-EB
811207	(ICCX-730213-9-1-3H-B-EB x NEC-970)	ICCX-730213-9-1-3H-B-EB
811208	(ICC-506-EB x WR-315)	ICC-506-EB

Table 16.2. Numbers of populations/progenies grown in F_2 and more advanced generations and selections made in Hyderabad in 1982-83.

Generation	Grown		Selected	
	Populations	Progenies	Rows	Single plants
Wilt sick plot				
F_2	97	-	10	2837
F_3	-	831	456	
F_4	-	62	49	
Normal fields				
F_2	-	82	61	10
F_3 a	-	816	571	58
F_4 a	-	160	117	10
F_5 a	-	28	26	-
Kabuli WR lines	-	43	43	-
Double podded WR lines	-	9	7	-

a. Total for two plantings

F_5 and more advanced generation progenies were planted in plots of 2 rows and Annigeri and K-850 were sown after every 18 plots as checks. There were two plantings for these. The earliness and appearance of the progeny bulks were assessed. Those with seed yields exceeding the nearest checks advanced were for further testing in non-replicated rows or replicated trials in 1983-84.

Forty three wilt resistant kabuli and nine wilt resistant double podded lines developed through breeding were also evaluated for yield and other agronomic traits.

Hissar: F_3 desi, F_3 kabuli and F_4 bulks and F_4 to F_5 progenies were sown in the wilt-sick plot at Hissar (Table 16.3). Each bulk had 10-20 rows and each progeny one row. JG-62 and H-208 were planted as susceptible indicators alternately after two test rows.

Salinity affected the plot on one side. There was some damage by ascochyta blight but we made useful selections.

Preliminary trials

Eightyeight and 90 bulked entries which had shown resistance in the wilt-sick plot for atleast two seasons were evaluated in four trials each at Hyderabad and Hissar, respectively. All were 5 x 5 balanced lattice squares with three replications. The plot size was 4 rows and Annigeri, WR-315 and BDN-9-3/K-850 were included as checks at Hyderabad and Pant G-114, H-208 and WR-315 at Hissar.

We recorded days to 50% flowering and maturity, plant height, weight of 100 seeds and seed yield by plot.

Mean seed yields were high (around 2.5 t/ha) and coefficients of variation low at Hyderabad (Tables 16.4 to 16.7). None of the wilt resistant entries was higher yielding than Annigeri however, many were equal. The best yielding entries (indicated in the tabels) will be included in advanced trials in 1983-84.

The mean yields in the preliminary trials at Hissar varied from 579 kg/ha to 2667 kg/ha and coefficients of variation were high except in one case (Tables 16.8 to 16.11). The yield of the checks also varied much, however, two entries out yielded the generally highest yielding check Pant G-114. The best entries will be included in advanced trials in 1983-84.

Table 16.3. Numbers of bulks and progenies grown and selections made at Hissar in 1982-83.

Generation	Grown		Selected		
	Bulks/populations	Progenies	Bulks	Progenies	Single plants
Wilt sick plots					
F_2 Desi	63	42	39	53	180
F_2 Kabuli	41	-	11	-	60
F_3	73	48	34	14	225
F_4-F_5 (HR/WR)		672	-	64	46
F_4		56	-	7	-
F_5, F_6 (CP-Brd-1)		1028	-	193	148
F_6		218	-	63	63
F_7		107	-	8	5
Stunt Nursery					
F_2 STR	16	-	-	-	235
F_3 STR		155	-	19	32
F_4 STR		90	-	12	31
F_5 STR		154	-	23	33
Normal fields					
F_2 Ascochyta and Botrytis tolerant	71		70		74
F_4-F_8 (Desi Project)		749		417	27
F_6+Bulks (Kabuli project)		166		139	

Table 16.4 Characteristics of entries in Preliminary Yield Trial-1 of wilt resistant lines at ICRISAT center Patancheru, in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield (kg/ha)	Rank
1	760810-12P-2P-BP-BP[b]	46.8	98.3	36.4	18.3	2624	9
2	761471-7P-1P-BP-BP	48.2	98.3	30.5	14.5	2522	14
3	761543-17P-1P-BP-BP[b]	41.4	98.3	29.0	15.7	2701	5
4	761431-31P-1P-1P-BP[b,c]	49.1	98.5	32.8	16.7	3032	3
5	752760-1P-1P-BP-2P-BP	44.1	95.6	27.7	14.1	2500	17
6	780215-181T-2P-2P-BP[b]	49.6	98.9	30.1	12.6	2690	6
7	780215-304T-2P-2P-BP	48.7	98.5	30.6	12.7	2343	21
8	750886-6P-3P-BP-BP-BP	44.9	97.3	29.9	17.2	2278	23
9	750653-18P-1P-BP-BP-BP[b]	46.3	97.2	29.3	15.0	2610	11
10	750787-4P-1P-BP-BP-BP	46.4	98.5	29.7	16.3	2292	22
11	750794-11P-2P-BP-BP-BP	46.6	97.7	29.6	17.3	2577	12
12	752463-3P-1P-BP-BP-BP	48.0	99.5	36.9	22.9	2381	19
13	752792-13P-3P-BP-BP-BP[b]	41.3	95.3	26.8	23.3	2867	4
14	750657-4P-1P-BP-BP-BP	39.2	89.8	26.4	23.9	1992	25
15	760810-5P-2P-BP-BP	44.4	95.2	28.8	16.2	2510	16
16	760812-4P-1P-BP-BP	44.1	97.2	32.2	16.9	2560	13
17	760812-13P-1P-BP-BP[b]	50.2	100.3	31.7	19.8	2363	20
18	760812-15P-1P-BP-BP[b]	44.9	98.5	30.2	17.4	2675	7
19	761365-6P-1P-BP-BP	44.9	103.0	37.9	19.9	2456	18
20	761365-14P-2P-BP-BP	44.7	97.1	27.1	17.9	2520	15
21	761365-18P-1P-BP-BP[b,c]	45.2	98.9	29.0	19.8	3118	1
22	761370-4P-1P-BP-BP	44.6	101.1	32.9	21.6	2245	24
23	Annigeri	45.1	97.1	25.9	19.4	3034	2
24	WR-315	44.6	95.9	28.4	15.5	2661	8
25	BDN 9-3	41.8	96.3	26.6	14.7	2620	10
	Mean	45.4	97.7	30.3	17.6	2567	
	SE±	0.78	0.71	1.56	0.42	141.79	
	CV(%)	3.0	1.3	8.8	4.1	9.6	

b. nced yield trials in 1983-84.

c. Contributed to ICSN-DS in 1983-84.

Table 16.5 Characteristics of entries in Preliminary Yield Trial-2 of wilt resistant lines at ICRISAT center Patancheru, in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	770544-5P-2P-BP[b]	43.3	96.0	33.1	18.2	2574	10
2	770544-8P-2P-BP	47.9	98.7	28.8	14.6	2292	22
3	770549-5P-1P-BP	50.4	101.5	32.9	19.3	2075	25
4	770553-16P-1P-BP	43.2	98.1	29.3	22.7	2172	23
5	770553-33P-1P-BP	43.0	94.1	26.1	25.6	2310	21
6	770576-2P-1P-BP[b,c]	45.3	98.5	33.0	30.2	2779	4
7	780109-15P-1P-BP	48.7	98.3	27.9	14.9	2450	15
8	780110-31P-1P-BP	45.3	100.0	26.4	13.3	2342	19
9	780119-5P-1P-BP[b]	45.8	98.2	28.0	13.7	2754	5
10	780125-30P-3P-BP	42.2	98.1	25.2	16.1	2450	15
11	780125-36P-2P-BP[b]	39.6	97.6	27.6	16.3	2786	3
12	780125-56P-1P-BP[b]	39.2	98.3	28.2	15.6	2626	7
13	780126-10P-2P-BP[b,c]	47.3	99.3	27.6	14.5	2801	2
14	780128-3P-2P-BP	49.1	99.8	28.2	15.4	2338	20
15	780129-4P-2P-BP[b]	46.2	98.4	24.4	13.5	2623	8
16	780129-15P-1P-BP	47.3	107.4	27.5	14.5	2160	24
17	780129-23P-3P-BP[b]	41.0	96.2	23.4	14.1	2513	13
18	780129-46P-1P-BP	44.5	97.4	23.7	14.7	2373	18
19	780129-48P-2P-BP	45.0	100.1	24.6	14.0	2459	14
20	780129-55P-1P-BP[b]	44.3	98.2	23.9	14.1	2532	12
21	780129-57P-2P-BP	44.9	97.5	22.7	15.2	2437	17
22	770594-49P-1P-BP[b]	50.0	98.9	31.9	14.7	2598	9
23	Annigeri	46.0	98.1	24.8	18.3	2670	6
24	WR-315	44.4	97.4	30.4	15.0	2552	11
25	BDN 9-3	42.3	96.7	27.3	14.4	2870	1
	Mean	45.1	98.5	27.5	16.5	2501	
	SE±	0.73	0.67	1.47	0.53	119.62	
	CV(%)	2.8	1.2	9.2	5.5	8.3	

b. Retained for testing in advanced yield trials in 1983-84.
c. Contributed to ICSN-DS in 1983-84.

Table 16.6 Characteristics of entries in Preliminary Yield Trial-3 of wilt resistant lines at ICRISAT center Patancheru, in 1982-83.

Entry No.	ICCX No./	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	761471-10P-2P-BP-BP	48.4	99.3	26.4	14.1	2191	22
2	761471-16P-1P-BP-BP	44.6	99.5	26.0	17.1	2392	14
3	761471-35P-1P-BP-BP	45.3	99.1	30.8	16.7	2481	9
4	780129-16P-1P-BP	46.7	104.0	26.2	12.9	2274	19
5	780129-62P-2P-BP	50.9	99.1	29.3	12.1	2426	13
6	780129-66P-1P-BP	45.4	101.3	28.4	13.6	2345	16
7	780130-26P-1P-BP	52.1	104.0	27.9	12.5	2279	18
8	780130-29P-1P-BP	49.9	105.7	32.2	14.2	2470	10
9	780131-14P-1P-BP	55.5	105.2	31.1	13.3	1965	24
10	770594-88P-1P-BP	57.6	104.7	31.7	16.3	1845	25
11	780161-76P-1P-BP	49.3	101.0	30.0	17.1	2377	15
12	780161-76P-4P-BP	58.5	105.1	35.3	13.8	1977	23
13	760241-11P-3P-BP-BP	44.4	101.0	35.9	21.6	2502	8
14	760811-1P-1P-BP-BP[b,c]	44.3	97.4	29.7	16.9	2804	2
15	760811-18P-1P-BP-BP[b]	45.4	99.0	29.0	17.9	2595	7
16	760812-1P-1P-BP-BP[b]	44.5	96.6	27.8	16.8	2690	3
17	761471-2P-1P-BP-BP[b]	49.9	97.4	30.8	16.8	2677	4
18	761471-14P-1P-BP-BP[b]	46.2	98.7	30.2	14.7	2630	6
19	761471-40P-3P-BP-BP[b]	47.7	100.0	29.0	15.3	2662	5
20	752313-25P-1P-BP-BP-BP	44.5	101.6	29.3	21.7	2234	20
21	750873-7P-1P-BP-BP-BP	37.0	93.7	24.8	23.1	2219	21
22	752337-29P-1P-BP-BP-BP	44.6	95.7	27.3	13.9	2315	17
23	K-850	57.2	103.9	32.8	27.8	2444	12
24	WR-315	45.1	97.7	29.5	14.9	2457	11
25	Annigeri	46.9	98.0	26.7	19.4	2958	1
	Mean	48.1	100.4	29.5	16.6	2408	
	SE±	0.66	1.21	1.56	0.40	132.69	
	CV(%)	2.4	2.1	9.1	4.1	9.5	

b. Retained for testing in advanced yield trials in 1983-84.
c. Contributed to ICSN-08 in 1983-84.

Table 16.7 Characteristics of entries in Preliminary Yield Trial-4 of wilt resistant lines at ICRISAT center Patancheru, in 1982-83.

Entry No.	ICCX No./	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	752760-36P-1P-BP-2P-BP[b]	48.0	99.9	25.7	16.1	2698	3
2	760811-11P-2P-BP-BP	50.5	100.4	28.4	17.8	2519	8
3	760811-12P-1P-BP-BP	47.7	100.2	33.6	17.9	2639	5
4	761470-10P-1P-BP-BP	53.1	102.1	36.5	24.0	2407	11
5	761472-7P-1P-BP-BP[b]	49.6	101.3	34.3	17.8	2860	2
6	750884-23P-2P-BP-BP-BP	57.5	103.6	38.1	20.5	2175	19
7	750885-15P-1P-BP-BP-BP	51.3	102.7	34.8	13.8	2292	16
8	760285-7P-1P-BP-BP	59.1	104.3	32.7	15.7	1788	24
9	761216-3P-1P-BP-BP	59.0	103.2	32.9	12.5	1823	23
10	770536-2P-2P-BP	58.4	105.5	35.6	22.7	2167	20
11	770536-13P-1P-BP[b]	49.7	101.3	33.3	21.0	2677	4
12	770549-3P-4P-BP	57.0	106.3	32.7	17.3	1543	25
13	780107-55P-2P-BP	50.2	102.9	22.3	12.1	2043	22
14	780113-12P-1P-BP	47.4	100.2	32.5	17.9	2504	9
15	780113-16P-1P-BP	51.2	99.9	31.3	15.9	2393	12
16	780125-35P-2P-BP	53.0	101.1	32.0	15.3	2282	18
17	780125-54P-2P-BP	47.9	102.9	31.9	17.4	2128	21
18	780125-57P-1P-BP	50.9	105.2	34.7	16.8	2288	17
19	780128-37P-1P-BP	45.2	101.2	28.0	14.2	2320	15
20	761472-13P-1P-BP-BP	38.6	101.6	29.1	16.4	2417	10
21	750653-6P-1P-BP-BP-BP	47.6	99.1	28.5	12.5	2593	6
22	761374-9P-1P-BP-BP	49.4	100.8	27.6	16.3	2593	6
23	K-850	58.6	103.2	31.1	27.3	2391	13
24	WR-315	45.3	97.7	28.3	14.7	2322	14
25	Annigeri	46.2	98.4	26.1	18.9	3210	1
	Mean	50.9	101.8	31.3	17.3	2363	
	SE±	0.84	0.87	1.35	0.74	107.15	
	CV(%)	2.9	1.5	7.5	7.4	7.9	

b. Retained for testing in advanced yield trials in 1983-84.

Table 16.8. Characteristics of ıtries in Preliminary Yield Trial-1 of wilt resistant lin(at Hisar in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	770532-7P-BT-BH[b]	59.2	76.6	16.8	5.9	142	25
2	770532-22P-BT-BH[b]	78.8	144.7	35.6	9.7	732	6
3	760636-2P-3P-BT-BP	47.8	97.0	22.9	10.0	572	11
4	751679-50P-1P-2P-BT-BH	17.3	34.1	9.3	4.3	427	19
5	750963-5-1H-BH-BH-BH[a]	82.8	123.4	32.1	11.9	531	13
6	780214-9T-1P-BT-BH[a]	38.4	54.8	16.7	6.2	790	5
7	780214-132T-1P-BT-BH	54.3	68.2	16.5	5.6	186	24
8	780214-280T-1P-BT-BH	43.0	77.3	17.0	7.4	581	10
9	780214-298T-1P-BP-BH[a]	40.0	70.0	16.1	7.6	1092	2
10	750744-4H-BP-1H-BH	44.7	77.1	19.0	5.3	584	9
11	741167-1H-1H-BH-1H-BH[a]	51.0	93.0	24.9	11.0	489	15
12	752587-17H-1H-BH-1H-BH[a,b]	38.0	58.5	14.7	11.5	677	8
13	750370-28H-11P-BP-1H-BH[a]	57.7	87.0	17.8	10.1	839	4
14	750771-1H-1P-BP-1H-BH	58.6	48.7	12.3	4.3	357	22
15	752510-12H-1P-BP-1H-BH	65.2	77.1	18.2	7.6	409	20
16	752571-4H-1P-BP-1H-BH	14.5	34.1	9.6	9.1	434	18
17	752306-2P-1P-BP-1H-BH[b]	62.2	82.1	19.5	11.7	334	23
18	752596-9H-1H-BH-1H-BH[a]	71.4	120.1	30.9	14.0	1203*	1
19	752589-3H-1H-BH-1H-BH[b]	78.5	30.4	7.5	5.9	396	21
20	751679-12P-1P-1P-BT-BH[b]	28.2	55.5	15.7	11.4	566	12
21	751679-19P-1P-2P-BT-BH[b]	65.5	100.7	24.0	13.7	1024	3
22	751679-19P-1P-4P-BT-BH	53.4	100.6	21.7	10.5	439	17
23	HR-315	90.8	52.3	18.3	8.0	507	14
24	H-208	40.9	79.9	18.8	5.4	713	7
25	PANT G-114	45.2	84.9	17.9	7.8	448	16
	Mean	53.1	77.1	19.0	8.6	579	
	SE ±	18.76	25.30	6.25	3.24	248.35	
	CV(%)	61.2	56.8	57.1	65.0	74.3	

a. Repeated in preliminary yield trials in 1983-84.

b. Included in advanced yield trial in 1983-84.

*. Significantly higher yielding than Pant G-114 at 5% level of probability.

Table 16.9. Characteristics of entries in Preliminary Yield Trial-2 of wilt resistant lines at Hisar in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	752589-3H-1H-HH-1H-HH	96.5	154.0	47.2	13.3	1949	18
2	752243-4H-2H-HH-2H-HH[b]	97.6	154.5	47.6	12.6	2112	11
3	750463-5H-1H-HH-1H-HH[b]	97.2	152.9	50.7	12.6	2185	8
4	741229-7H-1H-HH-1H-HH[b]	93.8	154.1	45.7	13.1	2253	7
5	741229-7H-1H-HH-2H-HH	97.8	154.9	40.1	13.2	1793	22
6	752539-5P-1H-HH-1H-HH[a]	93.2	149.3	48.3	13.7	2092	13
7	750239-4P-1H-HH-1H-HH[b]	96.1	154.2	48.9	12.3	2561	3
8	750076-1P-1P-BP-1H-HH[b]	86.6	153.1	41.7	11.8	2497	5
9	740349-5H-2H-HH-1H-HH[b]	92.8	154.2	35.4	13.3	2111	12
10	740694-2H-1H-1P-HH-2H-HH[a]	93.3	154.2	42.5	12.6	2090	15
11	740366-1H-1H-1H-HH-1H-HH	98.5	154.1	47.5	12.6	1851	21
12	740170-B-4P-HH-1P-1P-1H-HH	80.8	152.3	45.9	11.1	1884	20
13	740842-4P-LB-3H-1P-1P-1H-HH[a]	97.9	151.3	48.2	14.0	2058	16
14	750744-3H-HH-1P-HH	87.7	150.9	45.4	11.8	1383	25
15	750736-15H-BP-1P-HH[b]	103.1	155.4	47.9	13.2	2531	4
16	750736-19H-BP-1P-HH[b]	102.2	155.1	42.8	12.3	2749*	1
17	751239-11H-BP-1P-HH[b]	95.9	156.7	45.3	14.9	2340	6
18	751907-9H-BP-1P-HH[b]	97.9	155.8	45.9	13.3	2130	9
19	750841-2P-BP-1P-HH	85.9	154.6	49.8	13.8	1929	19
20	750883-38P-2P-1P-BT-HH	95.5	167.3	54.8	15.1	1983	17
21	751260-3P-1P-1P-BT-HH	96.9	151.8	47.7	15.4	1786	23
22	751260-7P-1P-1P-BT-HH	98.0	154.8	52.3	17.6	1530	24
23	WR-315	93.3	155.7	48.6	12.6	2114	10
24	B-208	91.9	151.4	45.0	12.1	2606	2
25	PANT G-114	93.6	156.6	46.8	12.1	2091	14
	Mean	94.6	154.4	46.5	13.2	2104	
	SE±	3.85	1.82	3.11	0.51	198.55	
	CV(%)	7.0	2.0	11.6	6.7	16.3	

a. Repeated in preliminary yield trials in 1983-84.

b. Included in advanced yield trials in 1983-84.

*. Significantly high yielding than Pant G-114 at 5% level of probability.

Table 16.10. Characteristics of entries in Preliminary Yield Trial-3 of wilt resistant lines at Hisar in 1982-83.

Entry No.	ICCx No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	yield (kg/ha)	
1	751679-50P-1P-2P-BT-BH[b]	89.8	153.0	45.0	11.9	2376	4
2	760068-10P-1P-2P-BT-BH[b]	91.2	154.5	48.2	13.5	2058	7
3	760068-38P-1P-3P-BT-BH	90.5	153.4	41.0	14.5	1189	19
4	752226-12-2P-2P-BT-BH	98.6	155.5	40.3	14.9	1439	14
5	752463-3P-1P-1P-BT-BH	95.1	154.1	51.6	21.9	1663	10
6	752463-7P-1P-1P-BT-BH	94.4	152.0	42.5	20.6	1285	18
7	752305-20P-1P-1P-BT-BH[b]	87.4	159.3	40.3	15.3	2918	1
8	752307-12P-1P-1P-BT-BH	92.8	152.3	45.7	19.7	1436	15
9	760044-6P-1P-1P-BT-BH	92.1	153.3	43.6	18.4	1495	13
10	760105-8P-2P-1P-BT-BH	91.9	153.1	51.6	17.1	1388	17
11	760105-17P-1P-1P-BT-BH[b]	84.7	154.2	45.6	22.7	2091	6
12	760105-22P-3P-1P-BT-BH	89.8	151.6	44.8	20.4	1580	12
13	750877-9P-BP-2P-BT-BH	95.7	152.1	36.0	15.0	866	22
14	750286-3P-2P-1P-1P-BT-BH	93.7	152.8	36.4	16.7	355	25
15	750286-3P-2P-1P-2P-BT-BH[b]	86.2	153.9	38.9	13.6	2470	3
16	750286-3P-2P-1P-3P-BT-BH	84.6	152.0	34.1	15.8	1071	20
17	750419-1P-1P-1P-1P-BT-BH	100.3	158.4	50.4	11.6	1053	21
18	750419-2P-3P-1P-4P-BT-BH	102.0	157.3	45.4	12.3	701	23
19	752296-7P-1P-BP-2P-BT-BH	102.4	152.5	44.3	23.9	499	24
20	750419-11P-2P-BP-1P-BT-BH[a]	76.3	152.4	48.0	21.1	1786	9
21	741196-1P-1P-BP-1P-BT-BH	75.8	157.5	36.0	12.5	1392	16
22	741196-1P-2P-BP-2P-BT-BH	81.7	152.0	42.9	14.5	1625	11
23	741579-1P-2P-BP-1P-BT-BH	77.1	153.7	37.1	17.9	1789	8
24	H-208	90.4	153.6	44.5	12.0	2238	5
25	PANT G-114	95.6	154.3	35.4	15.2	2716	2
	Mean	90.4	153.9	42.8	16.5	1579	
	SE±	2.98	1.52	2.80	1.26	384.07	
	CV(%)	5.7	1.7	11.3	13.2	42.1	

a. Repeated in preliminary yield trials in 1983-84.

b. Included in advanced yield trials in 1983-84.

Table 16.11. Characteristics of entries in Preliminary Yield Trial-4 of wilt resistant lines at Niesar in 1982-83.

Entry	ICCX No./	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	741579-1P-2P-BP-2P-BT-BH	90.0	165.8	54.2	14.6	2510	16
2	750419-5P-2P-BP-3P-BT-BH	87.3	163.0	44.6	18.7	2315	20
3	771147-BP-3H-BH[b]	91.0	162.8	52.6	17.5	2918	9
4	780551-BP-1H-BH[a]	84.6	166.1	54.6	14.5	2761	10
5	750463-5-1H-BH-BH-BH	83.7	165.5	54.7	12.1	2511	15
6	760356-BH-BH-6H-BH	90.0	161.8	54.0	11.5	2443	17
7	761737-BH-BH-7H-BH	85.7	167.6	57.5	18.6	2099	23
8	760635-BH-BH-1H-BH[b]	85.7	163.1	48.3	16.3	2988	6
9	760635-BH-BH-3H-BH[a]	88.9	166.2	54.5	12.9	2697	12
10	760679-BH-BH-24H-BH[b]	85.0	163.6	41.6	12.7	2984	7
11	760361-BH-BH-3H-BH[b]	91.0	165.9	50.5	12.0	3020	5
12	761728-BH-BH-8H-BH[b]	87.5	167.6	40.4	19.8	3068	4
13	761879-BH-BH-4H-BH[b]	100.0	165.4	53.1	11.9	3385	3
14	761889-BH-BH-8H-BH	90.3	164.8	53.2	11.3	2934	8
15	761889-BH-BH-10H-BH[b]	88.3	163.0	50.4	11.5	3472	2
16	761981-BH-BH-1H-BH	45.5	162.3	41.8	13.4	1676	25
17	760852-BH-BH-3H-BH[a]	87.3	161.0	50.1	13.2	2745	11
18	750661-BH-BH-BH-3H-BH	84.7	166.0	45.5	13.0	2421	18
19	750661-BH-BH-BH-5H-BH	86.3	162.3	52.5	16.1	2305	21
20	760692-137P-3P-BH-BH	82.0	167.1	48.5	15.7	2119	22
21	750946-18H-1H-BH-BH-BH	90.3	162.2	45.8	16.4	2077	24
22	760692-55P-1P-BH-BH[a]	82.0	168.0	54.4	16.8	2524	14
23	761293-34H-2P-BH-BH	80.7	168.3	64.4	16.0	2420	19
24	H-208	90.0	164.1	49.5	12.2	2667	13
25	PANT G-114	89.2	162.6	42.6	11.4	3605	1
	Mean	85.9	164.6	50.4	14.4	2667	
	SE ±	6.96	1.14	4.89	0.64	342.92	
	CV(%)	14.0	1.2	16.8	7.7	22.3	

a. Repeated in preliminary yield trials in 1983-84.

b. Included in advanced yield trials in 1983-84.

Advanced Trials

Forty-six of the best yielding entries in the preliminary trials in 1981-82 were evaluated at Hyderabad and 47 at Hissar in two 5 x 5 balanced lattice square trials with three replicates. The plots were 8 rows (except for AYT-2 at Hissar 4 rows) and the same records were taken as for the preliminary trials.

The mean seed yields were high and coefficients of variation low at Hyderabad (Tables 16.12 and 16.13). None of the entries outyielded Annigeri. Nineteen lines (indicated in the tables) with better yields will be continued in advanced trials and six will be promoted to ICSN's in 1983-84.

The mean seed yields were moderate at Hissar (over 2 t/ha) and coefficients of variation were acceptable (Tables 16.14, 16.15). One line outyielded Pant G-114. Fifteen lines will be retained in the advanced trials.

ASCOCHYTA BLIGHT

Hybridisation

We made 25 crosses involving ascochyta blight resistant strains, ILC-202 and -3279 and high yielding desi genotypes. ILC-3279 was also crossed to a high yielding kabuli strain ICCC-32 (Table 16.1).

F_1 generation

Six F_1's of desi and 22 of kabuli and ascochyta blight resistant parents were advanced in the off-season nursery in 1982

F_2 and more advanced generations

In cooperation with Pulse Pathologists of HAU, we screened 22 populations involving kabuli and 6 involving desi parents for ascochyta blight resistance. Unfortunately enough disease pressure could not be created. The single plants harvested from the field were sent for multiplication in Kashmir. These materials were also supplied to our cooperators at the Pakistan Agricultural Research Council (PARC) at the National Agricultural Research Center (NARC) in Islamabad, Punjab Agricultural University (PAU) Ludhiana and H.P. Krishi Vishwa Vidyalaya (HPKVV) at Berthin. They have made useful selections.

BOTRYTIS GRAY MOLD

We obtained 30 cross combinations involving botrytis gray mold tolerant strains and high yielding desi types (Table 16.1)

Table 16.12 Characteristics of entries in Advanced Yield Trial-1 of wilt resistant lines at ICRISAT center Patancheru, in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	770526-18P-BP-BP	43.3	98.7	27.3	18.1	2404	23
2	780113-46P-BP-BP[b]	45.7	99.7	30.9	17.2	2846	6
3	780121-2P-BP-BP[b,c]	44.0	98.1	30.3	14.5	2675	13
4	780125-50P-BP-BP	39.3	100.0	28.6	16.4	2587	18
5	760810-2P-1P-BP-BP	44.0	96.1	30.1	17.1	2614	16
6	760810-11P-1P-BP-BP	44.7	96.6	31.3	17.4	2592	17
7	761365-8P-1P-BP-BP[b,c]	40.3	95.6	30.6	19.3	2687	11
8	761365-8P-3P-BP-BP	39.3	96.8	29.7	21.1	2451	21
9	761370-2P-1P-BP-BP	41.9	96.5	31.5	19.8	2707	10
10	761470-2P-1P-BP-BP[b,c]	39.4	100.4	31.2	15.3	2794	8
11	752760-22P-1P-BP-BP-BP[b]	44.3	96.1	24.8	16.8	2919	1
12	730190-B-2P-1P-1P-BP-BP	44.4	95.7	31.4	22.6	2509	19
13	740527-4P-1P-1P-BP-BP[b]	44.0	98.1	30.1	18.0	2883	5
14	750419-4P-1P-1P-BP-BP[b]	44.6	100.2	32.4	15.9	2639	15
15	750419-6P-1P-1P-BP-BP[b]	44.7	101.0	33.4	18.0	2492	20
16	752296-6P-1P-1P-BP-BP	43.3	98.7	32.7	21.1	2345	24
17	761374-9P-1P-BP-BP[b]	47.6	99.7	26.6	16.5	2923	2
18	761470-8P-1P-BP-BP[b]	38.7	99.9	31.9	15.6	2667	14
19	752337-8P-1P-BP-BP-BP	44.4	96.8	25.7	14.3	2417	22
20	752337-30P-2P-BP-BP-BP[b]	44.0	95.1	28.8	13.1	2685	12
21	752760-8P-1P-BP-BP-BP[b]	38.7	95.0	26.5	17.0	2912	3
22	752760-36P-1P-BP-BP-BP[b]	43.0	96.7	27.7	17.0	2714	9
23	741533-5P-4P-BP-BP-BP[b,c]	43.3	97.3	27.6	17.3	2905	4
24	K-850	58.0	105.2	34.9	27.6	3324	25
25	Annigeri	45.3	98.3	27.1	18.8	2846	6
	Mean	43.6	98.1	29.7	17.8	2662	
	SE±	0.72	0.96	1.39	0.81	93.86	
	CV(%)	2.8	1.7	8.1	7.9	6.1	

b. Retained for testing in advanced yield trials in 1983-84.
c. Contributed to ICSN-D8 in 1983-84.

Table 16.13 Characteristics of entries in Advanced Yield Trial-2 of wilt resistant lines at ICRISAT center Patancheru, in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds (g)	Seed yield (kg/ha)	Rank
1	761231-1P-1P-BP-BP	46.3	99.8	30.5	18.4	2539	19
2	761348-3P-1P-BP-BP	46.3	97.7	31.6	25.4	2706	9
3	761351-5P-1P-BP-BP[b]	44.7	97.7	32.3	21.2	2758	5
4	760285-5P-1P-BP-BP	52.3	106.4	35.4	16.2	2234	25
5	760810-10P-1P-BP-BP	45.3	96.6	30.2	18.0	2595	14
6	761373-4P-1P-BP-BP	50.0	102.7	30.1	18.9	2695	11
7	761471-4P-1P-BP-BP	45.0	98.1	26.6	16.7	2358	24
8	761471-23P-1P-BP-BP	44.7	98.2	26.6	16.6	2705	10
9	761666-11P-1P-BP-BP[b]	44.3	98.1	31.7	23.2	2757	6
10	761176-9P-BP-BP-BP	44.7	97.6	22.6	14.0	2681	12
11	750878-42P-2P-BP-BP-BP	48.3	97.7	29.0	14.7	2414	22
12	752760-1P-1P-BP-BP-BP	44.3	94.6	24.7	15.0	2577	17
13	752760-5P-1P-BP-BP-BP	40.0	95.6	25.6	14.6	2546	18
14	752760-40P-2P-BP-BP-BP	41.3	95.6	26.1	14.6	2631	13
15	750047-1P-1P-BP-BP	49.0	100.1	26.4	14.5	2526	20
16	740524-3P-1P-3P-BP-BP-BP	46.0	98.4	29.5	24.5	2965	2
17	740223-B-4B-1P-BP-BP-BP-	49.3	99.9	29.9	19.2	2871	3
18	760811-12P-2P-BP-BP[b,c]	45.0	98.5	31.6	19.1	2798	4
19	761472-15P-1P-BP-BP	45.7	100.0	34.0	18.2	2585	15
20	750679-9P-1P-BP-BP-BP	49.0	99.3	30.7	15.0	2721	8
21	760105-22P-2P-BP-BP-BP	46.7	99.7	36.3	20.9	2581	16
22	750760-16P-BP-BP-BP-BP	46.6	98.7	30.7	17.3	2463	21
23	780125-50P-BP-BP[b,c]	40.3	99.8	30.8	16.6	2727	7
24	E-850	50.0	102.3	35.1	29.2	2372	23
25	Annigeri	46.4	97.9	28.0	17.7	3023	1
	Mean	46.4	98.8	29.8	18.3	2633	
	SE±	0.58	1.11	1.17	0.39	120.00	
	CV(%)	2.2	1.9	6.8	3.7	7.9	

b. Retained for testing in advanced yield trials in 1983-84.
c. Contributed to ICSN-DS in 1983-84.

Table 16.14. Characteristics of entries in Advanced Yield Trial-1 of wilt resistant lines at Hissar in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	752587-17H-1H-HH-1H-HH	88.0	156.1	44.2	11.4	2170	10
2	740798-2P-LH-1H-HP-HT-HH[b]	85.7	153.0	44.8	10.0	1734	20
3	730166-9-3-1H-HH-1P-HP-HT-HH[b]	75.0	158.0	48.7	22.4	2277	8
4	750866-1P-2P-HP-HH	84.6	150.5	44.0	16.0	1674	23
5	760068-15P-1P-1P-HT-HH	87.5	153.0	36.3	13.7	1515	25
6	760068-29P-1P-1P-HT-HH[b]	78.1	153.3	45.6	14.5	2349	5
7	760280-3P-HT-HH	78.0	152.2	42.9	11.5	1842	19
8	760953-HH-HH-4H-HH[b]	78.8	153.1	52.4	13.3	2315	7
9	760939-HH-HH-13H-HH	102.7	155.7	49.5	13.0	1709	21
10	760679-HH-HH-19H-HH	92.1	152.8	47.8	13.2	1866	18
11	761728-HH-HH-1H-HH	94.6	155.3	46.0	17.0	2016	14
12	761879-HH-HH-7H-HH	90.1	154.4	46.3	12.3	1881	17
13	761889-HH-HH-1H-HH[b]	86.7	150.7	45.9	11.2	2518	3
14	761889-HH-HH-5H-HH[b]	88.2	157.5	47.7	12.4	2572	2
15	750749-HH-HH-HH-1H-HH	95.1	152.6	53.7	11.5	1887	16
16	750782-HH-HH-HH-15H-HH	102.9	156.3	46.8	12.5	1598	24
17	751242-HH-HH-HH-10H-HH	82.6	151.3	40.6	12.3	2150	11
18	780182-HP-HH-HH[b]	76.7	156.8	46.7	14.1	2368	4
19	780213-HP-HH-HH	83.0	153.0	44.8	14.3	1914	15
20	740939-3H-1P-HP-1H-1H-HH[b]	83.4	158.4	47.6	13.4	3343**	1
21	750736-4H-1P-HP-1H-1H-HH[b]	88.8	156.1	51.2	12.8	2338	6
22	752122-1H-HH-1H-1H-HH	89.5	156.2	49.0	18.1	1676	22
23	750946-9H-HP-1P-1H-HH	101.2	154.3	44.4	13.8	2133	12
24	H-208	80.3	154.4	46.6	13.9	2031	13
25	PANT G-114	83.3	154.3	47.3	11.6	2193	9
		87.1	154.4	46.4	13.6	2083	
	SE ±	2.33	1.70	4.06	0.98	256.09	
	CV(%)	4.6	1.9	15.2	12.4	21.3	

b. Retained for testing in advanced yield trials in 1983-84.

** Significantly high yielding than Pant G-114 at 1% level of probability.

Table 16.15. Characteristics of entries in Advanced Yield Trial-2 of wilt resistant lines at Hisar in 1982-83.

Entry No.	ICCX No./ Name	Days to 50% flowering	Days to maturity	Plant height (cm)	Weight of 100 seeds(g)	Seed yield (kg/ha)	Rank
1	740190-B-2P-1P-2P-1P-BP-BT-BH	78.3	167.0	48.1	21.8	1320	25
2	730039-1-8-1-1P-BH-1P-BP-BT-BH	88.0	168.7	56.4	22.9	1868	18
3	741533-5P-3P-BP-BH	83.0	168.4	47.3	20.3	1465	23
4	741533-5P-4P-BP-BH	86.7	167.9	58.9	22.3	2050	13
5	750047-1P-1P-BP-BH[b]	90.0	166.1	45.4	12.8	2274	9
6	750266-6P-1P-BP-BH	86.3	168.4	57.8	17.2	1876	17
7	740273-B-9H-1P-BP-BP-BH	86.0	166.5	63.9	17.9	1576	22
8	740632-1P-LB-BH-2P-BP-BH[b]	85.0	165.1	52.2	13.9	2469	6
9	740540-21H-1P-3P-BP-BH	84.7	167.1	57.6	15.7	2199	10
10	740540-22H-1P-BP-BP-BH[b]	88.0	165.7	57.0	19.7	2960	2
11	740132-B-4H-1B-1P-BP-BH[b]	88.0	166.0	44.8	12.6	2698	4
12	730105-14-2-2P-1P-2P-BP-BH	80.0	165.2	50.6	19.6	1970	15
13	751679-28P-1P-1P-BT-BH	99.7	164.9	48.2	15.8	1974	14
14	752463-29P-BP-1P-BT-BH[b]	90.2	166.7	54.0	14.2	2775	3
15	752424-7P-1P-BP-1P-BT-BH	92.3	165.3	56.7	20.8	1811	19
16	752424-7P-1P-BP-2P-BT-BH	97.3	167.7	55.3	20.9	2061	12
17	741196-1P-1P-BP-1P-BT-BH	72.0	166.9	46.8	14.0	1948	16
18	741533-5P-3P-BP-1P-BT-BH	87.3	166.6	54.5	20.4	2101	11
19	750419-5P-2P-BP-1P-BT-BH	89.3	168.1	53.3	18.3	1445	24
20	761707-BP-BT-BH[b]	73.0	168.1	61.7	19.5	1793	20
21	761139-BP-BT-BH[b]	93.0	166.4	48.7	14.0	2282	8
22	761122-6P-BT-BH	75.3	165.2	48.6	19.9	1625	21
23	761372-BP-BT-BH	84.3	166.0	55.7	14.1	2298	7
24	761273-BP-BT-BH	101.0	164.2	47.2	14.4	2597	5
25	PANT G-114	90.0	166.9	50.0	12.2	3207	1
	Mean	86.8	166.6	52.8	17.4	2106	
	SE:	2.46	0.90	3.27	0.86	257.55	
	CV(%)	4.9	0.9	10.7	8.0	21.2	

b. Retained for testing in advanced yield trials in 1983-84.

F_1 generation

Sixty single crosses were advanced to F_1 generation in the off-season nursery in 1982 (Table 16.16).

F_2 and more advanced generations

In cooperation with the pulse pathologists of GBPUA&T at Pantnagar, we planted 60 F_2 and 49 F_3 populations involving botrytis gray mold tolerant parents. This material was also supplied to the breeder at Rajendra Agricultural University at Dholi. Unfortunately the disease did not appear at Pantnagar. We will repeat the screening process in F_2 and F_3 generations in 1983-84.

STUNT

No new crosses were made for stunt resistance in 1982-83. We advanced 15 F_2 crosses (ROW 1981-82, Table 16.23). These were screened in the main season in stunt nursery at Hissar. We also screened 155 F_2, 90 F_3 and 154 F_4 progenies which were earlier selected for stunt resistance (Table 16.3). A total 235 single plants were selected in the F_2 and 96 in F_3 to F_4 generations. In addition we bulked 54 good progenies in these generations. After selecting for seed characteristics the best ones will be yield tested in 1983-84.

COMBINED RESISTANCE

We made 10 crosses to combine ascochyta blight and stunt resistance (Table 16.1). In addition 110 double crosses were made in 1982 off-season nursery to combine high yield, ascochyta blight and wilt resistance.

Twenty six back crosses attempted in off-season nursery in 1982 involving wilt and ascochyta resistant parents were advanced.

Seventy one crosses involving ascochyta and botrytis tolerant parents and high yielding strains were also advanced to F_2 generation and the F_2 populations grown in normal fields were bulk harvested and 13 single pod bulks were harvested.

Crosses involving fusarium wilt and dry root rot resistant parents were also advanced to F_2 generation (Progress Report 15, 1981-82).

Table 16.16 Percentages of F_1's of botrytis gray mold tolerant crosses grown in off-season nursery at Kashmir in 1982.

ICCX No.	Female parent	Male parent
810716	Pant G-114	P-9687
810717	GL-769	P-9687
810718	BG-209	P-9687
810719/20a	L-550	P-9687
810721/22a	H 75-35	P-9687
810722	H 75-35	P-9687
810723	ICCC-4	P-9687
810724	ICCC-32	P-9687
810725	ICCC-33	P-9687
810726	ICCC-34	P-9687
810727	Pant G-114	NEC-2451
810728	GL-769	NEC-2451
810729	BG-209	NEC-2451
810730	L-550	NEC-2451
810731	H 75-35	NEC-2451
810732	ICCC-4	NEC-2451
810733	ICCC-32	NEC-2451
810734	ICCC-33	NEC-2451
810735	ICCC-34	NEC-2451
810736	Pant G-114	P-919
810737	GL-769	P-919
810738	BG-209	P-919
810739	L-550	P-919
810740	H 75-35	P-919
810741	ICCC-4	P-919
810742	ICCC-32	P-919
810743	ICCC-33	P-919
810744	ICCC-34	P-919
810745	Pant G-114	NEC-123
810746	GL-769	NEC-123
810747	BG-209	NEC-123
810748	L-550	NEC-123
810749	ICCC-4	NEC-123
810750	ICCC-32	NEC-123
810751	ICCC-33	NEC-123
810752	ICCC-34	NEC-123
810753	BG-209	JM-593
810754	ICCC-4	JM-593
810755	BG-209	JM-595
810756	ICCC-4	P-479
810757	L-550	P-479
810758	P-479	BDN-9-3
810759	K-56567	Phule G-5
810760	K-56567	2375
810761	K-56567	ICCL-80074
810762	K-56567	GG-588

contd....Table 16.16

ICCX No.	Female parent	Male parent
810763	K-56567	GL-769
810764	K-56567	H 76-49
810765	K-56567	GL-920
810766	K-56567	BG-254
810767	P-9847	Phule G-5
810768	P-9847	2375
810769	P-9847	ICCL-80074
810770	P-9847	GG-588
810771	P-9847	GL-769
810772	P-9847	H 76-49
810773	P-9847	GL-920
810774	P-9847	BG-254
810775	MKC-123	H 75-35

Indicates reciprocal cross, also.

PROJECT 17 : BREEDING FOR REDUCED SUSCEPTIBILITY TO HELIOTHIS

OBJECTIVE To incorporate resistance to Heliothis into improved agronomic backgrounds of desi and kabuli type.

INTRODUCTION

Breeding for reduced susceptibility to Heliothis continued in collaboration with the entomologists. We made further crosses to recombine different sources of reduced susceptibility to Heliothis in desi and kabuli types and to incorporate wilt resistance. F_2 populations and F_3 progenies were grown at Hyderabad but progenies of F_4 and more advanced generations were grown at Hyderabad (short duration) or Hissar (long duration). The genotype x spraying trials were continued. For ease of reference reduced susceptibility to Heliothis will be described as "low borer" and the damage which is recorded as the percentage of pods bored by Heliothis (other borers are very rare at ICRISAT Center) as "borer damage".

HYBRIDIZATION

We repeated, the 6 x 6 diallel cross of short duration desi cultivars made in 1981-82 omitting IC-7394-18-2-1P-BP-EB, one of the low borer parents (ROW 1981-82, Table 17.1). New diallel sets were made in the desi short duration (Table 17.1) and kabuli (Table 17.2) groups.

Table 17.1. Parents of 6 x 6 diallel of low borer desi short duration cultivars made in 1982-83.

Number	Parentage/name	Borer reaction
ICCX-730094-18-2-1P-BP-EB	K-850 x N-59	Resistant
ICC-1381-EB	P-1234-1	Resistant
ICC-6663-EB	NEC-764	Resistant
ICCX-730041-12-1-B-EB	H-208 x N-59	Resistant
ICC-4918	Annigeri	Susceptible
ICCX-730266-3-4-1P-EB	H-208 x RS-11	Susceptible

In addition, three low borer desi lines were crossed on to P-436-2 and WR-315 and one kabuli line on to ICCL-81001 and -82001 to incorporate wilt resistance (Table 17.3).

Table 17.2. Parents of 5 x 5 diallel of low borer kabuli cultivars made in 1982-83.

Number	Name	Borer reaction
ICC-7510-EB	12-071-10025 JAM	Resistant
ICC-10870-EB	JM-2575	Resistant
ICC-7559-EB	P-9625	Resistant
ICC-10761-EB	CRIC-35380	Resistant
ICC-8835-EB	NEC-2685	Susceptible

Table 17.3. Crosses made to combine borer and wilt resistance in 1982-83.

ICCX number	Parentage
820689	ICC-1381-EB x P-436-2
820690	ICC-1381-EB x WR-315
820691	ICCX-730008-8-1-1P-BP-EB x P-436-2
820692	ICCX-730008-8-1-1P-BP-EB x WR-315
820693	ICCX-730020-11-1-1H-B-EB x P-436-2
820694	ICCX-730020-11-1-1H-B-EB x WR-315
820695	ICCX-730244-17-2-2H-EB x ICCL-81001
820696	ICCX-730244-17-2-2H-EB x ICCL-82001

F_1 GENERATION

F_1 diallel trials

The 15 F_1s and 6 parents of two 6 x 6 diallel sets of short (Table 17.4 and ROW 1981-82, Table 17.1) and medium (Table 17.5 and ROW 1981-82, Table 17.2) duration desi parents, made in 1981-82 to combine sources of borer resistance and to study its inheritance, were evaluated in randomised block trials with three replicates in unprotected conditions at Hyderabad.

Days to first flower and to maturity; plant height; the numbers of primary and secondary branches and pods per plant; percentage of pods damaged by borer; and seed yields per plant, were recorded on five random plants per plot. Plot means were used for combining ability analysis, according to Griffing's (1956) Method 2, Model I.

Table 17.4. Parentage of F_1s in 6 x 6 short duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

ICCX number	Parents	
	Female	Male
810997	ICC-506-EB	ICC-10619-EB
810998	ICC-506-EB	ICC-10667-EB
810999	ICC-506-EB	ICCX-730094-18-2-1P-BP-EB
811000	ICC-506-EB	Annigeri
811001	ICC-506-EB	ICCX-730266-3-4-1P-EB
811002	ICC-10619-EB	ICC-10667-EB
811003	ICC-10619-EB	ICCX-730094-18-2-1P-BP-EB
811004	ICC-10619-EB	Annigeri
811005	ICC-10619-EB	ICCX-730266-3-4-1P-EB
811006	ICC-10667-EB	ICCX-730094-18-2-1P-BP-EB
811007	ICC-10667-EB	Annigeri
811008	ICC-10667-EB	ICCX-730266-3-4-1P-EB
811009	IC-730094-18-2-1P-BP-EB	Annigeri
811010	IC-730094-18-2-1P-BP-EB	ICCX-730266-3-4-1P-EB
811011	Annigeri	ICCX-730266-3-4-1P-EB

Table 17.5. Parentages of F_1s in 6 x 6 medium duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

ICCX number	Parents	
	Female	Male
811012	ICC-6663-EB	ICCX-730213-9-1-3H-BP-EB
811013	ICC-6663-EB	ICC-3137-EB
811014	ICC-6663-EB	ICCX-730020-11-1-1H-B-EB
811015	ICC-6663-EB	ICC-5003
811016	ICC-6663-EB	ICCC-4
811017	ICCX-730213-9-1-3H-BP-EB	ICCC-3137-EB
811018	ICCX-730213-9-1-3H-BP-EB	ICCX-730020-11-1-1H-B-EB
811019	ICCX-730213-9-1-3H-BP-EB	ICC-5003
811020	ICCX-730213-9-1-3H-BP-EB	ICCC-4
811021	ICC-3137-EB	ICCX-730020-11-1-1H-B-EB
811022	ICC-3137-EB	ICC-5003
811023	ICC-3137-EB	ICCC-4
811024	ICCX-730020-11-1-1H-B-EB	ICC-5003
811025	ICCX-730020-11-1-1H-B-EB	ICCC-4
811026	ICC-5003	ICCC-4

There were significant differences among entries in both trials for all characters except primary and secondary branches per plant in the short duration trial and primary branches per plant in the medium duration trial (Tables 17.6 and 17.7). In the trial of short duration materials, ICC-10667-EB and the high borer checks (Annigeri and ICCX-730266-3-4-1P-EB) produced fewer pods and less seed yield per plant than the other parents. The two susceptibles exhibited greater pod damage than the low borer parents and, among the latter, ICC-506-EB and -10619-EB had the least pod damage.

In the trial of medium duration materials the low borer parents, ICCX-730213-9-1-3H-BP-EB and -730020-11-1-1H-B-EB, were significantly later flowering and maturing than the other parents and fell closer to the long duration category. ICC-3137-EB,(susceptible to pod borer), exhibited much greater pod damage than the other parents, which did not differ significantly from each other though ICCC-4 and ICC-5003 are not regarded as resistant. ICC-6663-EB and -5003 were the heaviest yielding parents and ICC-3137-EB produced the smallest yields.

In both trials the GCA variances for days to flowering and maturity, percent borer damage and seed yields and the SCA variances for days to flowering and maturity, plant height and pods per plant were significantly greater than zero (Tables 17.8 and 17.9). The GCA variances for pods per plant in the short duration group and plant height and secondary branches in the medium duration trial and SCA variances for secondary branches and seed yield per plant and percent borer damage in the medium duration trial were also significantly greater than zero. The preponderance of SCA for borer damage in the medium duration group conflicts with other data and indicates that nonadditive genetic variation may be important in some sources of resistance.

ICC-506-EB and -10619-EB, among the short duration parents, and ICCX-730020-11-1-1H-1-B-EB were good general combiners in respect of reduced borer damage, the first two parents also combining well for increased pod number (Tables 17.10 and 17.11). Annigeri and ICCX-730266-3-4-1P-EB, (short duration) and ICC-3137-EB (medium duration) were poor in respect of both these characters. In both groups, there were parents with good GCA for earliness or lateness and ICC-5003 (medium duration) expressed good GCA for seed yield.

SCA effects were generally small and not significantly different from zero except for days to flowering and maturity and (in the short duration group) pods per plant (Tables 17.12 and 17.13). Two combinations, ICC-6663-EB x ICCC-3137-EB and ICC-3137-EB x ICCX-730020-11-1-1H-B-EB (medium duration), exhibited significant negative SCA effects for borer damage and ICC-10667-EB x Annigeri (short duration) and ICC-3137-EB x ICCC-4 (medium duration), good SCA for seed yield.

In both trials, there were significant positive correlations among plant height and branches, pods and seed yield per plant (Table 17.14) and percent borer damage was negatively correlated with days to flowering and maturity. Other correlations were small or inconsistent. In the short duration trial, plants with least pod borer damage produced most pods and seed yield and those which

Table 17.6. Characteristics of entries in F_3 6x6 short duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

ICCX number/ Name	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
F_3 Generation								
810v97	52	02	42	47	67	81		28
810v98	63	15	44	28	56	28		27
810v99	56	09	44	80	47	50		26
811000	52	06	39	56	78	04		22
811001	49	00	41	20	73	01		18
811002	64	16	43	27	87	28		24
811003	65	20	44	65	00	41		20
811004	56	11	42	80	25	12		21
811005	51	04	41	78	06	24		21
811006	59	16	40	27	87	20		24
811007	50	00	42	73	13	35		26
811008	49	01	44	73	47	22		21
811009	54	07	41	60	13	18	--	25
811010	51	02	41	00	00	98	25	17
811011	48	00	41	67	33	04	26	20
Parents								
ICC-506-EB	50.5	101.2	40.1	2.67	5.07	143	8.9	23.8
ICC-1061y-EB	52.4	102.8	41.0	2.33	3.53	172	8.6	23.6
ICC-10667-EB	50.5	103.3	38.2	2.67	4.07	81	20.9	17.5
ICCX-730094	53.9	108.4	39.5	3.00	5.00	138	17.4	24.4
Annigeri	49.9	102.8	38.9	2.73	3.00	86	30.4	16.5
ICCX-730266	48.8	100.1	40.7	2.33	4.00	90	32.0	15.6
Mean	53.9	106.5	41.6	2.74	4.47	122	17.9	22.2
SE $\pm$	2.15	1.88	1.18	0.24	0.49	14.21	2.80	2.41
CV(%)	6.9	3.1	4.9	15.3	18.9	20.2	27.0	18.8

Table 17.7. Characteristics of entries in F_1 6x6 medium duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
F_1 generation								
811012	76.4	131	47.1	3.20	5.13	104.3	10.1	18.9
811013	75.3	129	43.1	3.07	4.13	118.0	6.6	19.8
811014	87.2	134	41.1	3.07	4.87	84.1	11.0	12.0
811015	59.1	116	46.6	3.33	4.67	97.9	15.6	22.1
811016	74.7	130	40.1	3.07	4.20	80.5	7.8	13.3
811017	76.5	130	44.4	3.07	5.40	110.9	9.5	18.8
811018	85.2	134	41.1	3.40	4.47	100.7	3.3	15.4
811019	63.5	120	46.3	3.13	5.07	102.7	12.7	23.1
811020	74.5	127	44.1	3.60	4.73	100.6	9.7	17.4
811021	80.5	130	42.7	2.87	3.87	92.8	4.5	14.0
811022	55.8	120	46.6	2.78	4.10	71.0	19.2	16.7
811023	61.7	120	47.1	3.20	4.60	110.7	17.5	21.3
811024	67.3	121	46.4	3.33	5.33	101.3	12.0	20.7
811025	76.7	129	39.7	2.67	4.13	88.3	13.3	13.5
811026	59.8	118	43.5	3.13	4.47	86.9	17.0	20.1
Parents								
ICC-6663-EB	65.3	118	44.5	3.07	3.67	117.5	10.7	18.4
ICCX-730213-9-1-3B-BP-EB	77.6	134	41.3	2.80	4.80	73.8	9.2	12.6
ICC-3137-EB	63.5	123	45.3	2.40	2.40	42.3	34.7	7.9
ICCX-730020-11-1-1B-B-EB	84.3	135	37.3	2.80	3.60	81.8	6.4	10.5
ICC-5003	62.6	123	41.8	2.87	4.47	64.5	12.8	17.8
ICCC-4	67.1	129	38.1	3.07	5.13	96.8	10.6	15.8
Mean	71.2	126	43.2	3.05	4.44	91.7	11.6	16.6
SE ±	2.20	1.5	1.74	0.27	0.36	12.66	2.95	2.56
CV(%)	5.4	2.1	7.8	15.4	14.1	23.9	43.9	26.7

Table 17.8. Estimates of GCA and SCA mean squares and variances from F_1 6x6 short duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

	df	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
Mean squares									
GCA	5	45.81**	68.55**	1.90	0.134	0.472	1744**	150.2**	28.92**
SCA	15	21.25**	30.65**	3.82*	0.073	0.350	305**	12.8	9.99
Error	40	4.64	0.35	1.40	0.057	0.237	28	7.8	5.82
Variances									
GCA		5.13	8.52	0.06	0.010	0.029	215	17.8	2.64
SCA		16.61	30.30	2.42	0.016	0.114	285	5.0	4.17

Table 17.9. Estimates of GCA and SCA mean squares and variances from F_1 6x6 medium duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

	df	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
Mean squares									
GCA	5	273.15**	95.03**	16.93**	0.09	0.86**	321	52.86**	26.47**
SCA	15	24.72**	17.67**	6.46*	0.08	0.36**	359*	17.32*	13.56*
Error	40	4.84	2.25	3.03	0.07	0.13	168	8.68	6.55
Variances									
GCA		33.54	11.60	1.74	0.00	0.09	20	3.42	2.49
SCA		19.88	15.42	3.43	0.01	0.23	195	8.64	7.01

Table 17.10. Estimates of GCA effects of parents in F_1 6x6 short duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
ICC-506-EB	-0.29	-1.00**	0.22	-0.07	0.26	10.30**	-4.46**	1.81
ICC-10619-EB	2.30*	2.03**	0.64	-0.07	-0.16	22.24**	-3.25*	0.88
ICC-10667-EB	1.35	1.57**	-0.03	0.18	0.22	-7.16**	-1.50	0.60
ICCX-730094-18-B-2-1P-BP-EB	-2.16*	3.54**	-0.06	0.14	0.16	3.68	-1.17	0.85
Annigeri	-1.89	-1.66**	-0.85	-0.04	-0.13	-13.53**	3.44*	-0.83
ICCX-730266-3-4-1P-EB	-3.63**	-4.47**	0.07	-0.14	-0.34	-15.53**	6.93**	-3.32**
SE ±	0.69	0.19	0.38	0.08	0.16	1.45	0.90	0.78

Table 17.11. Estimates of GCA effects of parents in F_1 6x6 medium duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
ICC-4663-EB	0.65	-1.02	0.56	0.06	-0.09	9.72	-1.11	0.81
ICCX-730213-9-1-3B-BP-EB	4.13**	3.24**	0.40	0.08	0.42*	3.11	-2.22	0.30
ICC-3137-EB	-2.64*	-1.06	1.51	-0.20	-0.52*	-6.74	3.15*	-1.25
ICCX-730020-11-1-1B-B-EB	8.40**	4.24**	-2.10*	-0.03	-0.15	-1.58	-3.06*	-2.59
ICC-5003	-8.44**	-5.37**	1.11	0.03	0.19	-6.64	2.59	2.74*
ICCC-4	-2.09	-0.02	-1.48	0.05	0.17	2.13	0.64	-0.01
SE ±	0.78	0.53	0.62	0.10	0.13	4.48	1.04	0.91

Table 17.12. Estimates of GCA effects of F_1s in 6x6 short duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

ICCR number	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
810y97	-3.33	-4.76**	0.18	-0.14	0.10	26.93**	0.80	3.27
810998	8.57**	8.51**	2.75*	0.43	0.61	3.07	0.89	3.18
810999	0.34	0.66	2.28	-0.01	0.58	- 5.71	-0.59	1.20
811000	0.45	2.47**	-1.18	-0.07	-0.82	-14.20**	-0.18	-0.81
811001	-0.41	-0.33	-0.31	-0.33	-0.65	-15.82**	-0.61	-2.73
811002	6.89**	6.73**	1.30	0.41	0.34	- 8.48	-0.95	0.80
811003	7.32**	8.38**	2.41*	-0.16	-0.38	- 6.64	0.11	-3.91
811004	2.32	4.66**	0.65	0.17	1.07*	-18.70**	0.48	-0.89
811005	-0.95	0.45	-0.87	0.25	0.09	- 4.28	3.17	1.40
811006	1.96	3.28**	-1.47	0.21	0.02	1.75	-1.04	1.15
811007	-3.12	-5.79**	1.46	-0.14	0.58	33.70**	-5.62	4.97*
811008	-1.98	-2.04**	2.54*	-0.04	0.12	23.17**	-5.38	1.60
811009	0.41	-0.75	0.48	-0.24	-0.36	5.92	-4.26	2.79
811010	-1.39	-3.27**	0.10	0.26	-0.29	-12.00*	2.11	-2.30
811011	0.47	0.12	0.43	0.11	0.33	11.01*	-1.76	2.00
SE ±	1.58	0.44	0.86	0.00	0.36	3.29	2.05	1.77

Table 17.13. Estimates of SCA effects of F_1s in 6x6 medium duration desi diallel trial for borer resistance at Hyderabad in 1982-83.

	Days to first flower	Days to maturity	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
811012	0.46	2.30	3.89	0.01	0.37	-0.21	1.83	1.17
811013	6.13**	4.64**	-2.22	0.15	0.31	23.32	-7.11*	3.58
811014	6.98**	4.70**	-0.61	-0.02	0.67	-15.72	3.49	-2.84
811015	-4.24	-3.76*	1.71	0.18	0.13	3.07	2.51	1.90
811016	4.94*	5.02**	-2.16	-0.10	-0.31	-23.09	-3.32	-4.12
811017	3.83	1.48	-0.72	0.13	1.07**	22.85	-3.10	3.14
811018	1.50	0.05	-0.39	0.30	-0.24	7.49	-3.05	1.07
811019	-3.39	-3.69*	1.60	-0.03	0.03	14.48	0.70	3.40
811020	1.26	-2.10	2.00	0.41	-0.29	3.65	-0.35	0.48
811021	3.62	0.61	0.11	0.04	0.10	9.40	-7.26*	1.19
811022	-4.27	0.18	0.80	-0.11	0.00	-7.32	1.00	-1.41
811023	-4.69*	-5.00**	3.83*	0.29	0.52	23.56	2.00	5.98*
811024	-3.87	-3.95*	4.17*	0.48	0.86*	17.84	0.88	3.93
811025	-0.82	-1.36	0.09	-0.41	-0.32	-3.92	4.11	-1.54
811026	-0.84	-3.03*	0.62	-0.01	-0.32	-0.27	2.16	0.74
SE ±	1.56	1.06	1.23	0.19	0.26	8.95	2.00	1.81

Table 17.14. Correlations among characters in F_1 6x6 short (upper diagonal) and medium (lower diagonal) duration desi diallel trials for borer resistance at Hyderabad in 1982-83.

	Days to first flower	Days to maturity	Plant height	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Percent borer damage	Seed yield/ plant(g)
Days to first flower	-	0.91**	0.21	0.44**	0.06	0.02	-0.37**	0.10
Days to maturity	0.88**	-	0.22	0.42**	0.16	0.02	-0.32*	0.1
Plant height	-0.48**	-0.55*	-	0.09	0.45**	0.40**	-0.23	0.46**
Primary branches	-0.06	-0.14	0.15	-	0.35**	0.03	-0.11	0.29*
Secondary branches	0.01	0.04	0.14	0.46**	-	0.44**	-0.20	0.66**
Pods/plant	0.01	-0.15	0.32*	0.41**	0.56**	-	-0.51**	0.80**
Percent borer damage	-0.67**	-0.56**	0.37**	-0.01	-0.15	-0.21	-	-0.52**
Seed yield	-0.43**	-0.53**	0.54**	0.42**	0.59**	0.81**	0.04	-

flowered and matured later more branches. In the medium duration trial, earlier flowering and maturing plants were taller.

F_2 POPULATIONS

We grew 110 F_2 populations at Hyderabad in unprotected conditions. They included populations from: the 6x6 short (Table 17.4) and medium (Table 17.5) duration desi diallels, the F_1s of which were also in the diallel trials described in the previous section (pages to), and crosses of low borer and adapted lines (ROW 1981-82, Table 17.3) made in 1981-82; and the 6x6 desi diallel (ROW 1981-82, Table 17.4), the 4x4 kabuli diallel (ROW 1981-82, Table 17.9) and crosses of low borer and adapted desi and kabuli lines (ROW 1981-82, Table 17.13) made in 1980-81. The plot sizes ranged between 10 and 25 rows (200 and 500 plants) depending on seed quantities.

In one field, borer damage was small and only the better appearing single plants were harvested. In the remaining populations, single plants selected visually for low and high borer damage were harvested and their seed yields and percent borer damage determined.

The percent borer damage of plants selected as high borer was significantly greater than that of plants selected as low borer (Table 17.15), confirming the effectiveness of visual selection of single plants in segregating populations. Fewer low borer plants were selected in kabuli combinations (ICCX-800751 to -800756; -800775 to -800783) among crosses made in 1980-81 but otherwise there was no clear relationship between the borer characteristics of the parents and the F_2 populations. Among the crosses made in 1981-82, which were sown in a separate field, there was a significant negative correlation between borer damage and seed yield ($r = -0.37$, P 0.001) although no such correlations were detectable in other materials. We selected 241 low borer and 40 high borer plants and 354 plants with good seed yields for F_3 progeny tests in 1983-84.

F_2 populations were also grown in protected conditions to compare the effects of insecticide on selection for borer resistance but, as in previous years, they suffered high mortality due to wilt and the study was discontinued.

PROGENY ROWS

This season F_4 and F_5 progenies were grouped according to duration. Short duration progenies were grown at Hyderabad and long duration progenies at Hissar. The progenies were mainly from plants with low borer damage or good seed yields in unprotected conditions at Hyderabad in 1981-82. Progenies of a few high borer plants were also included for comparison. The total numbers sown are given in ROW 1981-82, Table 17.15. Each progeny comprised a single row and two sets were sown with Annigeri and K-850 repeated every 20 progenies as checks. No insecticide was applied.

Table 17.15. Means and standard deviations for percent borer damage and seed yields of plants visually selected for low (LB) and high (HB) borer damage in F_3 populations for borer resistance at Hyderabad in 1982-83.

Population	% borer damage						Seed yield/plant (g)			
	LB			HB			LB		HB	
	No.	Mean	S.D.	No.	Mean	S.D.	Mean	S.D.	Mean	S.D.
800736	7	7.2	5.86	5	20.4	4.89	15.8	4.94	15.2	4.78
800737	13	8.7	4.36	7	24.7	2.85	19.3	4.44	17.0	2.75
800738	30	4.5	2.91	3	18.3	3.51	18.5	7.62	17.8	8.92
800739	10	7.2	4.99	1	19.8	-	15.0	6.39	14.7	-
800740	13	3.3	3.11	4	20.6	6.54	16.9	6.28	16.5	6.46
800741	14	10.5	4.73	4	24.6	6.89	18.9	7.61	13.5	2.03
800742	19	6.3	4.34	5	17.3	5.20	17.5	7.53	16.4	7.25
800743	10	9.2	3.85	5	15.5	2.28	15.9	7.39	16.9	7.40
800744	25	5.7	4.05	6	20.8	8.55	16.2	7.99	11.9	4.30
800745	34	4.5	3.09	4	15.2	3.53	20.8	9.43	21.7	9.20
800746	16	3.9	4.43	3	20.1	4.86	16.9	7.19	30.7	12.65
800747	25	4.4	3.55	5	18.0	5.17	15.9	6.18	15.6	8.77
800748	12	3.4	3.85	4	17.8	3.86	16.5	5.69	19.4	8.58
800749	29	3.6	3.85	11	17.9	14.79	18.7	8.73	15.1	9.16
800750	16	2.6	3.66	3	15.6	3.29	18.2	8.30	21.1	6.45
800751	17	7.0	4.83	7	19.0	5.12	20.5	11.31	14.5	5.60
800752	6	8.3	5.29	5	22.4	5.21	14.2	5.40	21.8	11.85
800754	7	8.3	3.12	1	13.9	-	15.7	7.19	28.8	-
800755	5	11.5	2.49	6	24.0	4.06	18.9	10.73	14.6	4.81
800756	5	7.4	4.81	4	32.3	5.39	9.1	3.02	10.8	2.68
800757	26	8.8	4.71	10	21.4	3.52	20.0	9.86	20.7	6.41
800758	10	3.3	3.99	6	13.9	3.19	13.1	4.82	13.0	3.99
800759	4	9.4	4.71	2	22.7	8.84	14.4	8.19	33.1	1.20
800760	20	3.4	4.09	3	28.6	15.34	14.9	4.44	11.6	8.41
800761	12	7.4	5.77	3	20.4	1.10	11.8	3.34	10.0	4.57
800762	19	5.3	4.65	4	21.8	3.40	11.7	3.11	6.6	2.93
800763	27	3.1	3.33	8	17.6	5.82	15.0	5.10	17.7	7.25
800764	13	7.4	3.22	5	20.3	5.00	21.1	7.91	18.9	5.08
800765	15	8.5	4.98	13	24.5	6.98	20.4	7.28	18.0	7.21
800766	9	10.5	4.25	6	21.8	4.69	13.1	12.82	22.0	4.43
800767	40	4.4	3.40	7	19.5	5.15	18.0	6.30	13.7	6.46
800768	31	5.2	4.28	7	29.9	9.49	14.6	6.10	12.6	4.13
800769	16	8.9	4.27	5	21.7	7.64	24.2	9.80	16.4	6.21
800770	3	4.2	5.69	1	13.0	-	14.6	7.57	29.4	-
800771	5	7.3	6.58	1	19.4	-	15.8	4.41	12.2	-
800772	3	4.5	0.76	1	14.8	-	19.6	16.52	24.5	-
800773	16	9.8	6.43	6	22.8	2.95	24.2	14.87	15.4	4.27
800774	17	11.2	6.00	5	29.9	10.58	21.2	12.84	17.4	8.94
800775	2	11.6	2.40	2	28.1	0.35	37.3	0.99	20.7	1.98
800776	3	11.1	6.86	3	22.0	1.13	17.6	12.33	14.9	5.77
800777	7	3.0	4.23	3	25.6	4.70	16.7	8.94	15.2	5.72
800778	14	11.3	5.92	10	24.4	5.80	18.0	12.76	24.0	6.33

Table 17.15...Contd.

Population	% borer damage						Seed yield/plant (g)			
	LB			HB			LB		HB	
	No.	Mean	S.D.	No.	Mean	S.D.	Mean	S.D.	Mean	S.D.
800779	5	5.0	3.40	3	25.7	9.80	20.9	12.21	18.7	8.34
800780	5	8.8	3.49	2	21.4	12.52	15.4	9.30	22.0	15.06
800781	4	7.2	4.49	3	18.1	5.69	46.8	23.85	27.8	12.85
800783	8	10.5	4.96	3	21.4	3.23	16.5	12.14	21.3	15.23
811052	17	4.7	3.42	3	15.0	2.21	30.9	10.43	21.9	6.62
811053	19	4.4	2.04	2	18.5	5.66	44.8	17.19	47.5	42.43
811054	12	3.9	2.21	5	27.3	17.88	56.4	20.74	19.9	10.44
811055	22	3.4	2.65	2	43.5	13.72	47.2	16.66	7.9	2.90
811056	9	6.4	3.88	1	22.2	-	62.3	28.20	18.8	-
811057	21	3.0	1.92	3	7.7	0.51	44.9	20.17	53.2	28.07
811058	3	1.6	1.07	2	14.5	7.57	69.2	10.82	32.5	27.22
811059	18	2.0	1.99	1	35.8	-	49.0	16.73	9.3	-
811060	4	4.0	1.70	1	15.2	-	78.3	25.01	15.1	-
811061	4	3.8	0.71	2	7.9	1.91	67.8	20.48	42.5	3.75

The progenies were visually rated for pod borer damage in the vegetative and reproductive stages. In F_3 and F_4 progenies at Hyderabad and F_4 and F_5 at Hissar, five random plants were harvested fr 100 rows in each set to compare their pod damage and seed yields with those of the corresponding plants and progenies in earlier generations

At Hyderabad, for borer damage, the correlations between successive generations and between the two plantings of the same generations were positive and frequently significantly greater than zero, but were always small (Table 17.16). The poor correlations are partly attributable to segregation within progenies in early generations and to the restricted variability caused by the selection of mainly low borer progenies. They also arise from the escape of susceptible lines in early generations as many lines derived from low borer plants subsequently showed high borer damage. However, they also reflect the generally poor heritability and unreliability of selection for the character. Thus, the proportion of plants with borer damage less than 10% in the F_3 generation (40%) was little different from that in the F_4 (35%).

This variability was also reflected in large variations within the two control cultivars. We determined the percent borer damage of two random plants from each of the control rows in the second sowing of the F_4 progenies. Percent borer damage ranged from 0 to 50.7% in Annigeri and 0 to 60.6% in K-850.

Table 17.16. Correlations between generations for percent borer damage - F_2 to F_5 generations for borer resistance at Hyderabad.

Generation (1982-83)	F_3		F_4		F_5(13)	
Planting	I	II	I(97)	II	I	II
Generations(1980-82)						
F_2	0.28	0.11	0.13	0.15	-	-
F_3	-	-	0.32	0.36	-0.50	-0.10
F_4	-	-	-	-	0.32	0.41
			0.37(81)		0.31	

d.f. 98 except where indicated in parentheses.

Similar variability occurred among F_5 progenies. Only thirteen with sufficiently early maturity were sown and percent borer damage was again determined on five random plants from each plot. Sixty five percent of plants had borer damage less than 10% indicating some advance over the F_4 generation. All but one progeny were from low borer plants in the F_2, F_3 and F_4 generations yet more than 20% borer damage was recorded for one progeny in both plantings and a second, in one planting only, again highlighting the difficulties of selection for borer resistance.

We visually selected low borer plants in F_3, F_4 and F_5 progenies and those with low or high borer damage or good seed yields from these and the randomly selected plants were advanced for a further generation. Their numbers are shown in Table 17.17.

We also selected 21 short and 12 medium duration low borer F_4 and F_5 progenies for evaluation by the entomologists in replicated trials to assess the progress made in breeding for borer resistance.

Since the borer resistant lines identified by the entomologists have proved to be highly susceptible to fusarium wilt, the F_4 and F_5 progenies selected for low borer damage or good seed yield were also screened in the wilt-sick plot. Most of them wilted quickly and totally but we were able to select 20 progenies and 93 single plants which survived, for further evaluation for borer resistance. All F_3 and F_4 single plants selected for low borer damage or good seed yield in 1982-83 will be screened in the wilt-sick plot in 1983-84 to identify further sources of combined resistance.

Table 17.17. The numbers of single plants selected for low or high damage or good seed yields in unprotected conditions at Hyderabad in 1982-83.

Generation	Reason for selection			Unclassified	Total
	Low borer	High borer	Good yield		
F_3	195	28	85	85	393
F_4	258	39	160	8	465
F_5	40	1	18	0	59

At Hissar, we evaluated long duration F_4 and F_5 progenies of single plants selected for their borer damage characteristics in unprotected conditions at Hyderabad in 1981-82. For borer damage, as at Hyderabad, there were small but significant positive correlations between the two plantings of the same generations (r=0.27 and 0.32, P 0.01), but none of the correlations with earlier generations (grown at Hyderabad) were significantly greater than zero. This is not unexpected since, in addition to the factors disturbing such correlations at Hyderabad, the phenology of the crop and the nature and timing of borer attack at Hissar are very different and resistance is probably controlled by quite different mechanisms. The observations do, however, emphasise the importance of selecting for resistance to borer attack in appropriate conditions. Also, as at Hyderabad, we found large variations in borer damage among the control cultivars ranging from 0 to 57.7% in Annigeri and 0 to 46.1% in K-850.

Table 17.18. The number of single plants selected for low or high damage or good yield in unprotected conditions at Hissar, 1982-83.

Generation	Reason for selection			Total
	Low borer	High borer	Good yield	
F_4	251	30	154	435
F_5	199	30	158	387

We selected low or high borer or good seed yielding plants from these and other plants selected visually for low borer damage for progeny rows at Hissar in 1983-84. Their numbers are shown in Table 17.18.

Table 17.19. Characteristics of entries in short duration trials of *Heliothis* resistant and breeders' lines at Hyderabad in 1982-83.

	Unprotected					Protected				
	Days to 50% flowering	Days to maturity	Wt. of 100 seeds(g)	Percent borer damage	Seed yield (kg/ha)	Days to 50% flowering	Days to maturity	Wt. of 100 seeds(g)	Percent borer damage	Seed yield (kg/ha)
Heliothis resistant lines										
ICC-906-BB4	52.8	105	17.9	6.0	2059	46.5	101	17.5	0.0	1800
ICCX-730094-18-2-1P-BP-2BB	56.6	114	18.5	6.4	2318	47.1	104	19.7	0.1	2099
ICCX-730080-8-1-1P-BP-2BB	58.1	109	15.7	0.4	2067	49.5	101	15.5	0.4	1830
ICCX-730103-10-2-2B-BP-2BB	51.5	109	16.8	3.8	2047	44.6	101	16.2	0.5	1835
Breeders' lines										
ICCC-1	56.0	107	20.0	1.5	2093	48.1	102	19.7	0.4	1874
ICCC-4	53.7	110	24.1	1.5	2151	43.2	99	24.1	0.2	1684
ICCC-8	53.9	110	25.5	3.0	1912	45.8	100	26.0	0.4	1725
ICCC-9	55.9	107	18.6	1.8	2208	43.5	100	18.1	0.7	1950
Check										
Annigeri	54.4	111	20.8	2.2	2133	45.3	100	20.4	0.1	2051
Mean	54.8	109	19.8	2.3	2110	45.9	101	19.7	0.3	1872
SE ±	1.10	0.7	0.36	1.48	146.4	0.99	0.6	0.34	0.18	96.0
CV%	4.0	1.2	3.6	129.6	13.9	4.3	1.1	3.4	118.2	10.3

Table 17.20. Characteristics of entries in medium duration trials of Heliothis resistant and breeders' lines at Hyderabad in 1982-83.

	Unprotected					Protected				
	Days to 50% flowering	Days to maturity	Wt. of 100 seeds(g)	Percent borer damage	Seed yield (kg/ha)	Days to 50% flowering	Days to maturity	Wt. of 100 seeds(g)	Percent borer damage	Seed yield (kg/ha)
Heliothis resistant lines										
ICC-1477-BB4	74.7	121	19.3	1.1	2116	64.1	108	19.9	0.1	1837
ICCX-730041-8-1-1-BP-2BB	69.6	121	14.5	0.3	2380	60.6	108	15.3	0.1	2122
ICCX-730105-2-4-1B-2BB	74.5	119	12.5	0.2	1805	63.1	107	13.2	0	1761
ICCX-730213-9-1-3B-B-2BB	74.5	121	16.0	0.1	1978	61.0	112	17.2	0.1	1777
Breeders' lines										
ICCC-4	67.6	116	15.3	0.3	2103	57.6	106	15.6	0	1845
ICCC-13	64.5	116	14.1	0.9	2050	57.0	106	14.3	0.4	1698
ICCC-14	67.0	118	19.1	1.0	2230	55.2	105	20.8	0.1	1809
ICCC-15	73.4	120	14.6	0.9	1986	62.0	107	16.0	0.5	1833
Check										
Annigeri	57.9	115	20.0	0.4	2095	44.8	101	19.8	0.2	2012
Mean	69.3	118	16.1	0.6	2002	58.4	107	16.9	0.2	1854
SE ±	0.53	0.8	0.29	0.26	123.8	0.69	0.5	0.36	0.13	99.2
CV%	1.5	1.3	3.6	91.0	11.8	2.4	0.9	4.2	171.8	10.7

LOW BORER VS BREEDERS' LINES

The three trials of short, medium (Hyderabad) and long (Hissar) duration desi cultivars selected and unselected for borer resistance were repeated under protected and unprotected conditions to assess the importance of the interactions between genotypes and insecticides. The entries, design and data recorded were the same as for 1980-81 and 1981-82 (ROW 1980-81, P.249-251 and 1981-82, p.42-45).

At Hyderabad, although differences were small and the data extremely variable, pod borer damage was significantly greater in the unprotected than in the protected trials (Tables 17.19 and 17.20). Days to flowering and maturity were longer in the unprotected than the protected trial, probably arising from greater vegetative damage from Heliothis. There were significant differences among entries in days to flowering and to maturity and in seed size. In the medium duration trial, entries differed in borer damage but the differences were not consistent with known borer resistance characteristics. There were also differences among entries in the medium duration group for seed yield. For days to flowering and maturity there were significant interactions between insecticide and entries but for other characters interactions were not significant. However, projected comparisons were vitiated because of the low levels of borer damage in the unprotected trials.

At Hissar, in the long duration group, borer damage was significantly more in the unprotected (20.7%) than in the protected (8.0%) trial and seed yields significantly less (Table 17.21). There were no significant differences among entries in borer damage nor seed yield and the interactions between insecticides and entries were also non-significant.

Table 17.21. Characteristics of entries in long duration trials of Helicthis resistant and breeders' lines at Hissar in 1982-83.

	Unprotected		Protected		
	Percent borer damage	Seed yield (kg/ha)	Days to 50% flowering	Percent borer damage	Seed yield (kg/ha)
Helicthis resistant lines					
ICC-3474	28.5	2028	92.2	7.5	2359
ICCX-730179-9	23.8	1859	107.3	11.5	2549
ICCX-730020-11	14.6	1916	94.9	4.7	2389
ICCX-730001-9	18.1	2173	106.2	5.0	2173
Breeders' lines					
ICCX-730075-15-	15.6	2183	80.6	7.6	2726
ICCC-2	26.0	1936	103.9	12.8	2841
ICCC-10	18.4	2199	99.9	0.2	2434
ICCC-18	19.1	1897	76.2	13.9	2286
Check					
G-130	22.4	2009	91.1	9.2	2555
Mean	20.7	2022	94.7	8.0	2479
SE ±	4.80	168.9	0.80	1.32	199.4
CV%	46.4	16.7	1.7	32.7	16.1