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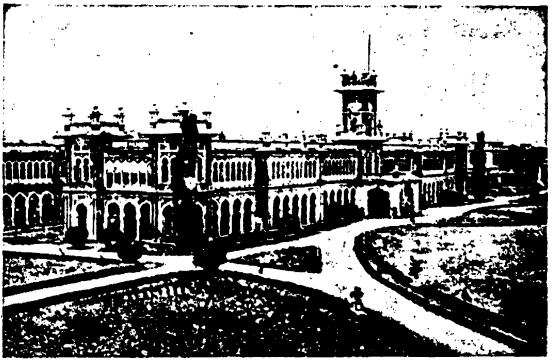

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better for yield in addition to resistance to CAMV. Single plants were selected from these lines in the subsequent generations and their yied performance was assessed up to F_6 generation at which stage homozygosity for yield and resistance was achieved. The progenies of the lines 1-20, 1-26 and 1-27 were labelled and they were sown in the field after F_8 generation in a Randomised Block Design. The results of the trial are presented in the following Table.

Table 1 Yield of cowpea lines

S. No.	Genotypes	Mean yield in kg/ha
1.	1-20	517
2.	1-26	700
3.	1-27	450
4.	MS 9804	335
5.	CO 1	400
6.	CO 3	525
	CD (P = 0.05)	119.55

The lines 1-20 and 1-26 gave higher yield than both the parents and in addition, they were on par with the ruling cultivar CO. 3. This trend was noticed consistently and hence these lines are under consideration for release as improved varieties. The above lines entailed a duration of 75-80 days which is similar to that of the resistant parent MS. 9804.

References

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Breeding for resistance to *Heliothis armigera* in chickpea

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Chickpea *(Cicer arietinum L.)* is a mandate crop of International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The crop has fewer pest problems than other legumes, *Heliothis arimgera* is the major past in most chickpea growing areas and is polyphagous attacking many crop species.

Identification of resistant sources

Singh and Sharma (1970) and Srivastava *et al.*, (1975) reported variation in susceptibility to *Heliothis* among released chickpea cultivars.

ICRISAT has screened the world germplasm collection for resistance. In the 1976-77 season, 8629 germplasm lines were sown in unreplicated single rows in insecticide free areas where natural levels of *Heliothis* are moderate. Of these, 955 had no borer damage (Reed *et al.*, 1980). Some were escapes as shown by replicated tests in subsequent years but others maintained reduced suspectibility to pod borer-

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We have found that maturity plays a major role; and it is essential that only materials of the same maturity group are tested together in any screening trial. To date we have screened more than 12,000 lines and at least ten have been confirmed to exhibit reduced susceptibility. These have been tested over 3 to 4 years at Hyderabad and the best of them, ICC-506, has shown around 6% borer damage compared with 20% in the high yielding check Annigeri (Table 1). Thus, although complete resistance is not available, ICC-506 has shown consistently lower pod damage over the years, and improved yields under unsprayed conditions (Table 1).

Breeding for resistance

The percent borer damage in some of the lines used in the breeding program are compared with the check cultivar Annigeri during 1979-82 in Table 2. The list contains early maturity desi type cultivars adapted to growing conditions in peninsular India. We also have mid-and late-maturity desi lines, and kabuli types with reduced susceptibility and these have been used in crosses to transfer resistance to high yielding, adapted lines.

Table 1. Comparison of percent borer damage (and yield kg/ha) in ICC-506 and Annigeri (check) during 1978-1982 at ICRISAT Center.

Cultivar	Year of test			
	1978/79	1979/80	1980/81	1981/82
ICC-506	8.0 (849)	5.7 (1137)	5.1 (1997)	5.2 (1345)
Annigeri	31.2 (529)	15.8 (1047)	20.0 (1828)	15.4 (1269)
S. E. $\pm$	1.73 (49.5)	1.64 (49.5)	1.70 (46.2)	1.51 (*)

*Unreplicated large plot tests.

Table 2. Chickpea cultivars (early maturity group) showing reduced susceptibility to *Heliothis armigera* and used extensively in breeding program at ICRISAT center.

Cultivars	Percent borer damage		
	1979/80	1980/81	1981/82
ICC-10619	5.0	5.2	7.5
ICC-10667	5.6	5.9	8.1
ICC-6663	4.3	9.9	4.1
ICC-506	5.7	4.5	5.2
Annigeri (check)	15.8	17.7	15.4
S. E. $\pm$	1.64	1.27	1.51

Diallel crosses were made among resistant and susceptible desi lines to study the nature of gene action. We studied the F_1s of a 4x4 diallel in 1980-81 and a 6x6 diallel in 1981-82. The estimates of the variance components are given in Table 3. Variances due to general combining ability (gca) for borer damage were highly significant in both sets indicating a preponderance of additive genetic variation for this character and that conventional breeding methods will be effective in handling resistance to *Heliothis*.

Resistant desi and kabuli types have been crossed in a diallel to accumulate resisant genes and improve the level and stability of resistance.

Selection in segregating generations

F_2 populations of crosses involving lines resistant to *Heliothis* were spaceplanted in a pesticide-free area at ICRISAT Center. At maturity, single plants were visually selected for resistance and were subsequently analysed for percent pod borer damage. Percent borer damage was lower in plants visually selected as resistant than in susceptible plants indicating visual selection to be effective in identifying resistant plants in the field (Table 4).

Selected F_2 Plants were sown as F_3 progeny rows with checks every 20 progenies for comparison. Some 120 F_3 progenies were randomly assessed

Table: 3 Estimates of general (gca) and specific combining ability variences in the 4 x 4 (a) and 6 x 6 (b) diallel for *Heliothis* resistance at ICRISAT Center 1980-81 and 1981-82, respecctively.

Source	Variances							
			Days to flower		Borer damage		Plant yield	
	a	b	a	b	a	b	a	b
GCA	3	5	NR	28.62**	225.08**	6.01**	40.11*	0.72**
SCA	6	15	NR	6.68*	1.90*	0	10.85**	0
Error	18	40	NR	4.18	4.69	9.20	5.91	2.67

NR - data not recorded.
*and** denote significance at 5% and 1% level of probability, respectively.

Table 4 Means of percent borer damage in 'resistant' and 'susceptible' plants in 10 F_2 popugrown at ICRISAT Center.

F_2 Populations	Resistant Plants		Susceptible plants	
	Mean	S.D. ±	Mean	S.D. ±
1	13.9	10.48	24.5	12.22
2	7.6	4.58	20.2	6.68
3	11.3	5.05	20.9	9.15
4	10.4	8.51	33.0	13.53
5	5.5	4.91	20.3	7.01
6	5.6	2.75	12.4	4.95
7	2.9	3.80	17.7	8.32
8	5.5	4.53	14.3	10.07
9	4.5	4.10	22.9	5.43
10	14.9	8.73	27.3	9.66