Table 1. Percentage of *Heliothis* damaged pods, seed yields, initial residue deposits on green pods and number of days to reach the tolerance level with different insecticide treatments on chickpea.

Insecticide	No. of applications	% damaged pods	Seed yield (kg/ha)	Initial residue deposit (ppm)	No. of days to reach tolerance level
Monocrotophos 0.04%	1	7.0	2187	2.52	7.36
Monocrotophos 0.04%	2	4.2	2892	2.66	7.83
Endosulfan 0.07%	1	5.4	2276	2.98	3.40
Endosulfan 0.07%	2	3.2	2964	3.53	4.61
Quinalphos 0.05%	1	13.1	1533	2.89	3.27
Quinalphos 0.05%	2	9.3	2339	2.90	3.30
Untreated		28.5	982	-	-
SE (M)		0.18	16.8	-	-

Note: The tolerance level of monocrotophos is 0.2 ppm and of endosulfan and quinalphos 2 ppm - FAO/WHO (1973).

Before recommending any insecticide, the persistence of toxic residues needs to be studied. With this objective, the residues of monocrotophos, and quinalphos in green pods and grains were estimated chemically as described by Getz and Watts (1964)[1] and for endosulfan after Maitlen *et al* (1963)[2]. The initial residue deposits of 2.52 and 2.66 ppm on green pods, from the first and second applications of monocrotophos 0.04%, reached the tolerance level of 0.2 ppm (FAO/WHO 1973)[3], 7.36 and 7.83 days after insecticide application. With endosulfan 0.07%, the initial residues of 2.98 ppm and 3.53 ppm reached the tolerance level of 2 ppm, 3.40 and 4.61 days after the applications. Quinalphos 0.05% gave initial residues of 2.89 ppm and 2.90 ppm on the green pods which were reduced to the tolerance level of 2 ppm 3.27 and 3.30 days after the first and second sprays. None of the three insecticides left toxic residues in the grain and straw at harvest.

Based on time for dissipation of the residues and on yield, foliar application of endosulfan 0.07% emulsion is safe and can be recommended for the control of gram caterpillar, *Heliothis armigera* (Hubner).

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[1]Getz, M.E. and Watts, R.R. 1964. J. assoc. agric. Chem. 47:1094-1096.

[2]Maitlen, J.C., Walker, K.C., and Westlake, W.E. 1963. J. agric. Food. Chem. 11(5): 416-418.

[3]FAO/WHO. 1973. FAO Agricultural Studies 90: 37-38.

Screening of Chickpea Cultivars for Borer (*Heliothis armigera*) Susceptibility in Pesticide Free Conditions at ICRISAT Center

During rabi 1980/81 we tested seven chickpea cultivars included in Gram Coordinated Variety Trial of All India Coordinated Pulse Improvement Project together with two local checks and ICC-506, an ICRISAT germplasm accession, selected on account of low borer damage, in pesticide free conditions in a randomized complete block design with four replications. The plots were 5 rows, 4 m in length and the spacing was 30 cm x 10 cm. No fertilizers were applied.

The *H. armigera* infestation was moderate and so gave a good test of cultivar susceptibility. No other pests were of any importance. Pod damage assessments were made at harvest on 10 random plants in each plot and the plot yields were estimated from an area of 3.38 m^2 after discarding border rows and end plants. The results are shown in Table 1.

There were significant differences among cultivars in susceptibility to *H. armigera* and seed yields. Annigeri-1 (check) had the highest borer damage. ICC-506 was the least attacked by borer and gave the highest yield, equal to 1909 kg/ha. Other entries, BDN-9-3, Phule G-4 also gave higher yields than the check (Annigeri-1).

There was a significant negative correlation ($r = -.55$) between the days to flowering and yields of the cultivars, indicating

Table 1. Borer damage and yields of chickpea cultivars at Patancheru in 1980/81.

Cultivar	Days to flowering	% pod damage (mean)	Yield (kg/ha)
BDN-9-3	42	9.0	1594
Phule G-4	47	13.7	1639
ICCC-4	65	17.5	1433
BG-405	65	11.1	1276
BG-401	75	10.8	1272
Annigeri-1 (check)	47	22.8	1499
H-73-10	57	14.9	1461
ICCC-13	57	15.5	1395
ICC-506	47	4.5	1909
C-235 (check)	75	8.5	1204
SE of mean ±		2.23	108.8
CV%		34.7	14.8

that the early flowering cultivars gave higher yields in Patancheru conditions.

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Influence of Foliage Color of Chickpea Varieties on Relative Abundance of *Heliothis armigera*

In an effort to understand the possible influence of foliage color on the relative abundance of *Heliothis armigera*, we compared two genotypes with higher concentrations of anthocyanin pigmentation in the vegetative parts (ICC-5716, early maturing; BR-70, late) and two normal green cultivars (Annigeri, early; G-130, late) at ICRISAT Center during the postrainy (rabi) season 1980/81.

The four genotypes were planted in several places in small plots over a 2-ha field. Observations of the developing stages of *H. armigera* were made on 30 contiguous plants on two occasions (12 and 29 December 1980). The results are summarized in Table 1.

There appeared to be no differences in the numbers of eggs laid on the two foliage types. There were also no significant differences in the numbers of small and medium larvae on the

Table 1. Effect of foliage color of chickpea varieties on populations of developing stages of *Heliothis armigera*, ICRISAT Center, 1980/81.

Developing stages of *Heliothis*	Mean *H. armigera* per plant		SE (±)
	Green foliage	Pigmented foliage	
Eggs	0.13	0.14	0.08
Larvae - small	1.06	1.27	0.16
Larvae - medium			
Total	0.49	0.58	0.10
Green	0.32	0.37	0.08
Larvae - large			
Total	0.47	0.17	0.08
Green	0.40	0.16	0.08

differing foliage colors. However, there were significant larger numbers of large size larvae on green than on pigmented plants.

We have noted previously that *H. armigera* larvae on pigeonpea are predominantly brown and on chickpeas predominantly green. The present results can be accounted for by the green colored larvae having a selective advantage on green chickpea plants, being less likely to be detected by predators including birds, but not on pigmented plants.

These observations may also indicate that predation of large larvae is of major importance in chickpea and can greatly affect the *H. armigera* population and pod damage relationships. We are now conducting field experiments to investigate these factors.

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Microbiology

Effect of Different *Rhizobium* Strains on Nodulation, N Uptake and Grain Yield of Chickpeas

The performance of five *Rhizobium* strains with chickpea was investigated in a field