Entomology

Atypical Oviposition Behavior in *Helicoverpa armigera* (Hübner)

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Gram pod borer (*Helicoverpa armigera*) is a prolific and widespread pest which attacks a range of plants, including many important crops. It is the key pest of chickpea (*Cicer arietinum* L.) in India, the world's largest producer of this crop (Lateef 1985). Though pod borer larvae feed on both leaves and pods, yield losses are mainly due to pod damage. Pod damage in excess of 80% has been reported in India and Pakistan (Ahmed et al. 1990).

Four biological characteristics contribute directly to the pest status of *Helicoverpa*: high degree of polyphagy, high mobility, facultative diapause, and high fecundity (Fitt 1989). With regard to fecundity, *Helicoverpa* (=*Heliothis*) spp are unlike other noctuids which deposit eggs in batches or egg masses. *Helicoverpa* produces large numbers of eggs. More than 3000 eggs per female has been reported (Reed 1965) though fecundity in the range of 1000-2000 eggs is more common. The eggs are laid singly on the oviposition substrate. In chickpea, females typically lay individual eggs on the undersurface of the leaflets (Reed et al. 1987). This oviposition pattern is similar on alternative hosts, including weeds.

We have observed large numbers of fertile and densely aggregated pod borer eggs on exotic and atypical substrates during the 1992/93 chickpea season. Observations were made in and around a chickpea field sown at ICRISAT Center on 2 Nov 1992. This atypical oviposition behavior was not peculiar to this field. It did, however, appear to be restricted to chickpea fields and was not observed in and around flowering pigeonpea fields.

Helicoverpa armigera egg densities were recorded from a variety of substrates in and around a chickpea field on 7 Jan 1993. These included thin metal stakes with cardboard labels of various colors, weeds within and outside the crop, stubble remaining from the previous cereal crop, and from the chickpea crop itself. The density of eggs on these substrates was quite high (Table 1) and equalled or exceeded the density of eggs on the crop. There did not appear to be any marked preference for cardboard labels of specific colors, though blue labels contained the fewest eggs. The metal stakes were approximately 10 cm higher than the chickpea canopy. This may explain the higher number of eggs on that substrate.

Table 1. Pod borer, *Helicoverpa armigera* eggs on various substrates in and around a chickpea field, ICRISAT Center, India, Jan 1993.

	Pod borer eggs		
Substrate	N[1]	Mean	Range
Metal pegs	20	23.1	6-51
Labels			
- green	5	7.2	4-11
- yellow	5	6.2	4-9
- red	5	5.4	2-9
- blue	5	3.0	2-4
- all	20	5.4	2-11
Weeds outside crop	20	6.8	0-16
Weeds within crop	15	6.1	0-24
Stubble	12	3.8	0-18
Chickpea	10	5.5	0-13

1. N = Number of samples.

One possible explanation for this behavior was the exceedingly high pest pressure during that season. Trap catches of male moths in a pheromone trap placed in this field were well above the 10-year ICRISAT average. Data for the 10-year average comes from pheromone traps (2 to 6 traps depending on the year) at various locations on the ICRISAT farm between 1981/82 and 1990/91. During some standard weeks, the number of moths caught during the 1992/93 season was greater than the 10-year average. The high pest pressure may have induced females to lay eggs on any available substrate, including biologically inappropriate ones (e.g., metal stakes). It seems that females were attracted to chickpea fields through normal visual and olfactory stimuli. But host-selection behavior appeared to have broken down and females deposited their eggs on any substrate.

Though pest pressure was high, it is not clear why more eggs were not deposited on the chickpea plants, as opposed to weeds, stubble, and stakes. From our observations, it appears that eggs which are laid on weeds and other substrates within the crop hatch and the larvae crawl onto the chickpea plants and begin feeding. The significance of this observation is that by counting eggs present only on the crop, the pest population can be significantly underestimated. Two other points are relevant: pheromone trap catches may not correlate with egg or larval populations in the field because eggs are laid on various substrates. And finally, field sanitation could play an important role in reducing or minimizing the availability of alternative oviposition sites.

References

Ahmed, K., Lal, S.S., Morris, H., Khalique, F., and **Malik, B.A.** 1990. Insect pest problems and recent approaches to solving them on chickpeas in South Asia. Pages 165-168 *in* Chickpea in the nineties: proceedings of the Second International Workshop on Chickpea Improvement, 4-8 Dec 1989, ICRISAT Center, India. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Fitt, G.P. 1989. The ecology of *Heliothis* species in relation to agroecosystems. Annual Review of Entomology 34:17-52.

Lateef, S.S. 1985. Gram pod borer (*Heliothis armigera*) resistance in chickpea. Agriculture, Ecosystems and Environment 14:95-102.

Reed, W. 1965. *Heliothis armigera* (Hbn.)(Noctuidae) in western Tanganyika. I. Biology with special reference to the pupal stage. Bulletin of Entomological Research 50:117-125.

Reed, W., Cardona, C., Sithanantham, S., and **Lateef, S.S.** 1987. Chickpea pests and their control. Pages 283-318 *in* The Chickpea (Saxena, M.C., and Singh, K.B., eds.). Wallingford, Oxon, UK: CAB International.

Dusting vs Spraying of Insecticide for Control of Pod Borer, *Helicoverpa armigera* in Chickpea

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In chickpea, farmers apply insecticide mainly in the form of dust and they often report that dusting is better than spraying for the control of *Helicoverpa armigera* in chickpea.

During the 1990/91 postrainy season, a trial was conducted at ICRISAT Center to test the available dust (1.5%) and two spray formulations, the emulsifiable concentrate (EC 20) and the acquaflow (AF 20), of quinalphos for the control of pod borer in chickpea. Three adjacent plots of chickpea (ICCV 2), each measuring 0.03 ha were marked and treated twice with one specific formulation. The first application was made when the chickpea had fully flowered and the second when pods were formed. A mist blower was used for both dusting and spraying. For dusting, the mist blower was used with a deflector (Pawar 1990) to direct the dust well into the crop. Pod borer larvae were counted before treatment and 24, 48, and 72 h after each treatment in all the three plots. The average per cent reduction in larval populations following two applications is given in Table 1.

Table 1. Larval populations of *Helicoverpa armigera* recorded on chickpea before treatment and 24, 48, and 72 h after application of quinalphos in different formulations, ICRISAT Center, India, postrainy season 1990/91.

Formulation and dosage of quinalphos[2]	*H. armigera*[1] plant^{-1}			
	Before application	24 h later	48 h later	72 h later
		Small larvae (<20 mm)		
Dust 1.5%	8.4	4.2 (50)[3]	1.8 (79)	0.2 (98)
EC 20	8.0	5.6 (30)	4.0 (50)	1.8 (77)
AF 20	8.9	5.2 (42)	3.4 (62)	1.4 (84)
SE	±0.26	±0.42	±0.66	±0.05
		Big larvae (>20 mm)		
Dust 1.5%	1.5	1.0 (33)	0.8 (47)	0.8 (47)
EC 20	1.4	1.0 (28)	0.7 (50)	0.5 (64)
AF 20	1.4	0.9 (36)	0.7 (50)	0.5 (64)
SE	±0.02	±0.02	±0.02	±0.05

1. Average of the two applications.
2. Dust (1.5%) applied at 25 kg ha^{-1}; emulsifiable concentrate 20 and acquaflow 20 at 2 L ha^{-1}.
3. Figures in parentheses are percentage reduction of larval population after applications.