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HELICOVERPA ON SORGHUM*

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The importance of *Helicoverpa* as an earhead pest of sorghum is well recognized in many countries including those in Africa. In India, however, this pest on sorghum receives little attention because pigeonpea and cotton are preferred crops and are severely damaged. Nevertheless, *Helicoverpa* is one of the important earhead pests reported to be causing as much as 37.11 per cent yield loss in sorghum (Kulkarni *et al* , 1980). This loss is sufficiently substantial for the management of this pest on sorghum to be considered. Management would benefit not only sorghum but also other crops which are attacked by the progenies of the pest that disperse from sorghum, particularly from the kharif crop which normally preceeds the valnerable stages of crops such as pigeonpea, chickpea and cotton that are preferred by the pest. In this paper, we describe our observations on *Helicoverpa* on sorghum over the past six years, to generate ideas for its management.

Helicoverpa spp and infestation through seasons

Of the three *Helicoverpa* species in India; *H. armigera* (Hub.), *H. peltigera* Schiff and *H. assulta* Guenee, found in India (Bhatnagar, 1980), only *H. armigera* has been recorded on sorghum. Pest infestation is usually evident on the panicle though there are reports of economic damage to the foliage by another closely related species, *H. zea*, in the USA (Hayes, 1922; Young and Teetes, 1977). Moths lay eggs on the glumes, and the larvae feed on the developing grains. The eggs are rather difficult to count, but large larvae are easily seen among panicle spikelets.

At the International Crops Research Institute for the Semi-Arid Tropics. Patancheru, Andhra Pradesh, we have recorded, so far, a maximum 16 larvae on a single panicle of the cultivar CSH 6 (semi-compact type). In general, we have observed less infestation in the open-panicle cultivars than in the compact ones. A higher infestation was recorded in the kharif crop than in the rabi (Fig. 1). This is because during kharif, in most areas, sorghum appears to be one of the more attractive crops to *H. armigera*, which have bred and survived through the hot summer. During April-June we have recorded it mainly on weeds and irrigated crops particularly tomatoes around ICRISAT Center (Bhatnagar and Davies, 1978; ICRISAT, 1982). During rabi *H. armigera* infestation on sorghum is less, possibly because the crop is growing at the same time as pigeonpea and chickpea, which are very attractive to *H. armigera* (Fig. 2). This situation, although common in most areas, may vary with the cropping pattern in different regions.

Parasites and predators

We studied the natural enemies of *H. armigera* on sorghum by collecting eggs and larvae from ICRISAT trials and from formers' fields, rearing these in our laboratory and recording the emergence of parasites. Reference to these studies have been made in relation to *Helicoverpa* spp in general in some of our earlier publications

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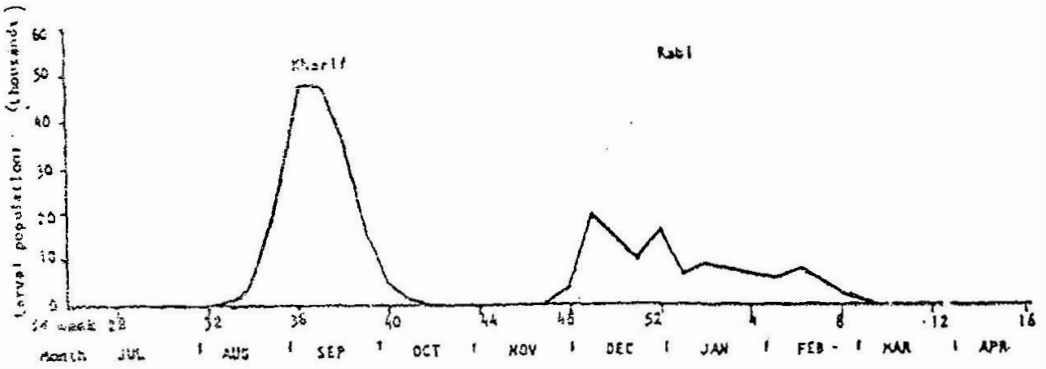

Fig. 1. Population of *H. armigera* larvae recordedon crops in the pesticide-treated area of ICRISAT Centre, mean data of 1979-80 and 1980-81 seasons (after Bhatanagar *et al.*, 1982)

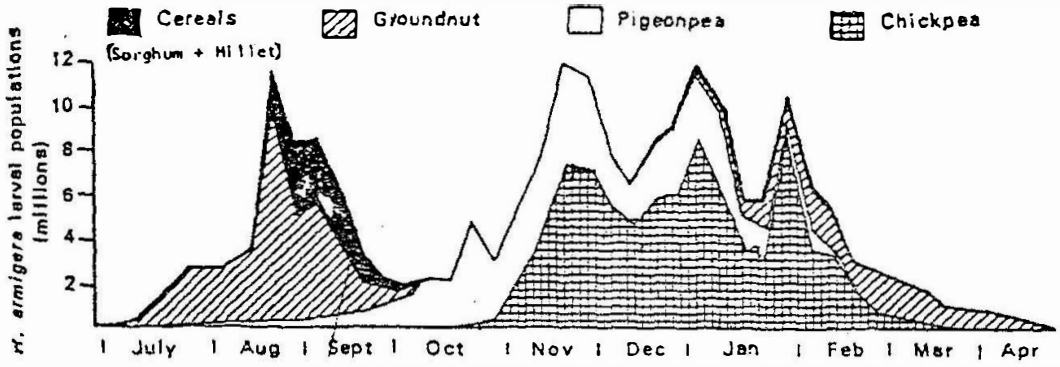

Fig. 2. Average population of *H. armigera* larvae/ha recorded on sorghum, ICRISAT Center, 1979-82

(Bhatnagar *et al*, 1982; Sithanatham *et al.*, 1982). The parties and parasitism rates recorded on sorghum are given in Table 1. Amongst the 15 insect paraites recorded on eggs and larvae, the egg parasites *Trichogramma chilonis* and *Trichogrammatoidea bactrae* sp *fumata* were very active on sorghum since over 60 per cent of the eggs collected were found to be parasitised. Of the seven hymenopteran parasites, that attack 1-3 instar larvae, *Campoletis chlorideae* was the most common, being recorded from 60 per cent of the small larvae collected. Dipteran parasites in general were less common, but *Carcelia iltota* and *Exorista xanthaspis* were regularly found. These dipterans emerge from the larvae (4-6 instar), and therefore, provide little advantage in reducing the damage to the crop. We also found one mermithid parasite, but it occurred relatively rarely on sorghum.

We made observations on predators of *H. armigera* on sorghum, and recorded six insect species preying on the larvae (Table 2). These predators, however, need to be studied in greater detail to determine their efficiency and potential for exploitation. One of our attempts to rear the wasps (*Delta* spp) in field cage was successful but various factors limit the exploitation of these natural enemies (Pawar and Jadhav, 1983).

Effect of crop system

Over the past five years, we have studied sorghum intercropped with pigeonpea, a system most common in the farmes' fields. We grew sole crops and intercrops of sorghum (CSH 6) with pigeonpea (ICP 1) on fairly large areas each plot :

Table 1. Egg and larval parasites and average rate of parasitism (%) recorded *H. armigera* on sorghum. 1975-83

Parasite	% paratism at peak parasite activity
Egg parasites	n=24,841
Hymenoptera	
Trichogramma chilonis Ishii	50.0 (87.0)
Trichrogrammatoidea bactrae sp *fumata* Nagaraja	16.0 (27.0)
Larval parasites	n=22,645
Apanteles sp	— (1.0)
Campoletis chlorideae Uchida	60.0 (90.0)
Disophrys sp.	— (1.0)
Eriborus argenteopilosus Cameron	— (1.0)
Eriborus trochanteratus Morley	3.0 (6.0)
Eriborus trochanteratus Cameron	4.0 (10.0)
Temelucha sp	4.0 (16.0)
Diptera	
Carcelia illota Curran	8.0 (18.0)
Exorista xanthaspis Wied.	5.0 (17.0)
Goniophthalmus halli Mes.	1.0 (6.0)
Palexorista laxa Curran	2 0 (4.0)
Sturmiopsis inferens Tns.	2.0 (4.0)
Mermithid (Nematode)	
Ovomermis oblicans Sieb.	— (1.0)

n : Total collection over years.
( ): Figures in parantheses refer to maximum percentage recorded tn the series of collections.

Table 2. Predatory insects observed as active against *H. armigera* on sorghum, ICRISAT Center 1978-83

Coleoptera	
Coccinellidae	*Menochilus sexmaculatus P.*
Hemiptera	
Lygaeidae	*Paromius gracilis* (Rambur)
Nabidae	*Tropiconabis capsiformis* (Germar)
Hymenoptera	
Eumenidae	*Delta companiforme esuriens* F.
	D. conoideus G. soyka
Dermaptera	
Labiduridae	*Nala lividipes* (Dufour)

>0.3 ha) and observed *H. armigera* populations throughout the season. In the intercrop, sorghum and pigeonepea were grown in a row ratio of 2:1 and normal sole crop plant populations (sorghum : 1,80,000 plants per ha; pigeonpea : 45,000 plants/ha) were maintained across the systems. We do not observe significant differences in the infestation of *H. amigera* and its paratism between the sole and

Table 3. Average *Helicoverpa* infestation and parasitism at peak activity on sole and pigeonpea intercropped sorghum (CSH 6) ICRISAT Center, 1978-83

Crop system	*H. amrigera*		Parasitism (%)	
	Eggs/10 earheads	Larvae/100 earheads	Egg	Larval
Sole				
Sorghum	91.5	70.5	50.9	27.3
Inter				
Sorghum/pigeonpea	87.4	63.7	46,7	29.8
SE (m) ±	8.19	3.69	1.97	3.78

Table 4. Average *Helicoverpa* infestation and parasitism on sorghum (CSH 6) at peak activity in Vertisols and Alfisols, ICRISAT Center, 1978-83

Soil	*H. armigera*		Parasitism %)	
	Egg/10 earheads	Larvae/100 arheads	Egg	Laryal
Vertisols	55.8	89.2	44.5	29.3
Alfisols	103.4	39.9	50.9	39.4
SE (m) ±	19.32	9.39	4.37	6.22

intercropped sorghum (Table 3). The *H. armigera* situation in the succeeding pigeonpea crop has been described by Bhatnagar and Davies (1980).

Effect of soil type

At ICRISAT Center, we have two distinct soil types—Alfisols (red) and Vertisols (black), and we normally conduct trials on both soils. In our intercropping trials we have found significant differences in *H. armigera* infestation and parasitism between the crops grown on these two soil types (Table 4). On the Alfisols, we found more eggs but lower subsequent larval populations than on the Vertisols, presumbly as a result of greater activity by natural enemies on this soil type. Predators, including the wasps (*Delta* spp), which prefer red soil to build their mud nests, (Pawar and Jadhav, 1983) were more active on the Alfisols.

Discussion

Considerable information is now available at ICRISAT and also within the Indian national program about *H. armigera* on sorghum. The information should be considered with the information available on other major hosts, because the playphagous nature of this insect calls for a management strategy involving the entire cropping system. It appears that, 10-20 years ago this pest was largely reported on chickpea and pigeonpea; but during recent years it has been increasingly reported as an important pest of many other crops including sorghum. Whether this is a charge in the host preferences of the pest, or simply an increase in the awareness of reporters is not clear. To date, efforts to increase host plant resistence, develop biological control and determine appropriate insecticide treatments appear to be

directed towards pigeonpea, chickpea (Bhatnagar *et al.*, 1982; Lateef and Reed. 1983) and cotton (Anan., 1975-83. It now seems appropriate to initiate such studies on sorghum, using on-going work in other countries (Teetes and Wiseman, 1979) as a model.

The development of open panicle cultivars that sustain less damage, presumbly because they facilitate the access of parasites and predators to *H. armigera* larvae feeding in the panicle, appears to have good potential. It may be advantageous to adjust planting times with reference to thepattern of *Helicoverpa* infestation in a given area.

The greatest control potential, however, is to encourage the natural enemies which appear to be more active on sorghum than on most other crops (Bhatnagar *et al.*, 19⁸2). An augumentation and conservation of parasites such as *Trichogramma* spp and *Campoletis chlorideae* would merit study. Insecticide trials are being increasingly conducted by the Indian national programs, for control of earhead worms including *H. armigera.* The emphasis should be on the insecticides that are relatively safe to the parasitic and predatory funa. Host resistance to *H. amrigera* in sorghum has not yet been explored and this may be worth future investigation.

SUMMARY

Work at ICRISAT Center, Patancheru, AP., India from 1978-83 showed that intensive *H. armigera* attack occurred on sorghum in the rainy session. Larvae damaged the developing grains. Fifteen parasites including one mermithid and six insect predators were recorded to be feeding on this pest on sorghum. Parasitism rates of more than 50 per cent were commonly recorded in both eggs and Larvae. Infestation and parasitism did not differ between sole and pigeonpea intercropped sorghum. Natural enemies were, however, more active on Alfisols than on Vertisols. *Heliothis* management in sorghum is discussed in relation to these studies.

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