

## HELIOTHIS SPECIES AND THEIR LARVAL PARASITOIDS ON SOLE AND INTERCROP SAFFLOWER IN INDIA

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(Received 11 July 1984; revised 17 June 1985)

**Abstract**—A survey of *Heliothis* spp. and their larval parasitoids was conducted in the states of Andhra Pradesh and Maharashtra, India during the period 1977–1983. *H. armigera* and *H. peltigera* were recorded on safflower. *H. peltigera* was found dominant on sole crop, while both the species were equally important on intercrop. In general, eight parasitoids: four Hymenoptera and four Diptera emerged from the larvae of *Heliothis* spp. Six parasitoids were recorded from *H. armigera* larvae on sole crop and eight on intercrop safflower. The level of parasitism in *H. armigera* was higher on sole crop.

**Key Words:** *H. armigera*, *H. peltigera*, safflower, sole crop, intercrop, *Campoletis chlorideae*, *Enicospilus* sp., *Eriborus argenteopilosus*, *Microchelonus curvumaculatus*, *Carcelia illota*, *Goniophthalmus halli*, *Sturmiopsis inferens*, *Pallexorista solennis*

**Résumé**—Une enquête sur *Heliothis* spp. et leurs parasitoids larvaires a été effectuée au cours des années 1977–1983 dans les Etats de l'Andhra Pradesh et du Maharashtra en Inde. On a observé l'incidence d'*H. armigera* et *H. peltigera* sur le carthame des teinturiers (*Carthamus tinctorius* Linn.), mais tandis que *H. peltigera* a été plus répandu sur la culture pure, les deux espèces ont été également importantes sur les cultures associées. Dans l'ensemble, huit parasitoids dont quatre hyménoptères et quatre diptères ont émergé des larves d'*Heliothis* spp. Six parasitoids ont été signalés chez les larves d'*H. armigera* en culture pure et huit en culture associée. Cependant, le niveau du parasitisme s'est avéré plus élevé en culture pure.

### INTRODUCTION

Safflower (*Carthamus tinctorius* Linn.) is an important post-rainy season (rabi) oilseed crop in India, largely grown in the states of Andhra Pradesh and Maharashtra. It is one of the important hosts of both *Heliothis armigera* (Hub.) and *H. peltigera* Schiff. (Fletcher, 1919; Pruthi, 1941) which attack the crop from the flowering stage onwards and damage the developing capsules and seeds.

The parasitoids of *H. armigera* and *H. peltigera* are known in general and in relation to important crops (Rao, 1968; Bhatnagar *et al.*, 1982). Patel *et al.* (1971), Patel and Rajendra (1973) and Manjunath *et al.* (1976) described the parasitoids of these species in relation to safflower in the state of Gujarat, India. Here, we report our observations on *Heliothis* spp. and their larval parasitoids on safflower when grown as a sole and intercrop. These observations are part of our survey of *Heliothis* spp., and their parasitoids on different crops in Andhra Pradesh and Maharashtra (Table 1).

### MATERIALS AND METHODS

The larvae of *Heliothis* spp. were collected from the crop of safflower in the farmers' field in November, December and January between 1977 and 1983. The host larvae were reared in the laboratory on chickpea seed soaked in water overnight, and the parasitoids

that emerged were recorded. Our survey team which comprised three staff spent about 90 min in each field and picked up the larvae that came in their way. The fields were sampled after every 25–30 km of travel by the road. Seventy-four fields in seven districts of Maharashtra and 55 fields in three districts of Andhra Pradesh were covered in a period of 6 years (Fig. 1). A total 9339 *Heliothis* larvae were collected. Larvae were placed in individual specimen tubes, and sorted out for species after each collection.

The larvae of *H. peltigera* can be distinguished from those of *H. armigera* in early instars by the black head capsule and in later instars by conspicuous hairs on the body which is green throughout. *H. armigera* larvae, however, change their body colour with each instar and are covered with weak hairs (setae).

### RESULTS AND DISCUSSION

#### *Heliothis complex on safflower*

*H. peltigera* was more (72.8%) than *H. armigera* (27.2%) in the collection of *Heliothis* larvae from the sole safflower. However, on intercrop in general, *H. armigera* was more (51.5%) than *H. peltigera* (48.5%). This could conclusively be said only for safflower intercropped with sorghum, chickpea, linseed and sorghum + chickpea, but not for safflower intercropped with chillies, where from the collections of *Heliothis* larvae were fairly large (>100). The *Heliothis* larval collections from intercrops with cowpea, lentil, sunflower, wheat and sorghum + linseed

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Table 1. *Heliothis* spp larvae collected from sole and intercropped safflower in Andhra Pradesh and Maharashtra States, India (1977–1983)

Cropping systems	Companion crop in intercrop	Number of larvae collected	Percentage of larvae of	
			<i>H. armigera</i>	<i>H. peltigera</i>
Sole crop:		2717 (49)	27.2	72.8
Intercrop with:				
	Cereals			
	Sorghum	1215 (24)	54.0	46.0
	Wheat	24 (2)	8.3	91.7
	Grain legumes			
	Chickpea	3328 (32)	55.6	44.4
	Cowpea	64 (2)	75.0	25.0
	Lentil	13 (1)	7.7	92.3
	Oil seeds			
	Linseed	965 (20)	50.6	49.4
	Sunflower	8 (2)	50.0	50.0
	Spices			
	Chillies	485 (4)	43.3	56.7
	Cereals/grain legumes			
	Sorghum + chickpea	486 (7)	55.6	44.4
	Sorghum + linseed	34 (2)	38.2	61.8
	Total:	6622 (96)	51.5	48.5

Figures in parentheses refer to number of fields sampled.

were low (<100), for these combinations were rarely grown, that too in small plots.

All crops that were recorded grown intercropped with safflower, are hosts of *H. armigera* (Bhatnagar and Davies, 1978). The attraction of *H. armigera* to these crops, must have resulted in increased incidence of *H. armigera* on safflower in intercrops.

#### Parasitoid complex on *Heliothis* spp.

Four Hymenoptera—*Campoletis chlorideae*, *Encospilus* sp., *Eriborus argenteopilosus* and *Microchelonus curvumaculatus*, and four Diptera—*Carcelia illota*, *Goniophthalmus halli*, *Sturmiopsis inferens* and *Palexorista solennis*—were reared from the *Heliothis*

Table 2. Percentage parasitism of *Heliothis* spp. on safflower in sole and intercrop situations in Andhra Pradesh and Maharashtra States, India (1977–1983)

Crop systems	Hymenoptera					Diptera					Overall parasitism	
	Total number of larvae collected	<i>Campoletis chlorideae</i>	<i>Encospilus</i> sp.	<i>Eriborus argenteopilosus</i>	<i>Microchelonus curvumaculatus</i>	Total Hymenoptera	<i>Carcelia illota</i>	<i>Goniophthalmus halli</i>	<i>Sturmiopsis inferens</i>	<i>Palexorista solennis</i>		Total Diptera
<i>Heliothis armigera</i>												
Sole crop	738	36.2	0.7	7.5	—	44.4	2.4	0.1	1.4	—	3.9	48.3
Intercrop												
Sorghum	656	11.1	—	2.2	0.8	14.2	3.8	—	—	—	3.8	18.0
Wheat	2	—	—	—	—	0.0	—	—	—	—	0.0	0.0
Chickpea	1717	21.5	0.1	2.4	0.6	24.6	3.0	0.1	0.1	0.1	3.2	27.8
Cowpea	48	79.2	—	—	—	79.2	—	—	—	—	0.0	79.2
Lentil	1	—	—	—	—	0.0	—	—	—	—	0.0	0.0
Linseed	488	23.8	0.8	1.2	—	25.8	2.3	—	—	—	2.3	28.1
Sunflower	4	100.0	—	—	—	100.0	—	—	—	—	0.0	100.0
Chillies	210	9.5	—	16.7	3.8	30.0	10.0	0.5	—	—	10.5	40.5
Sorghum + chickpea	270	10.7	—	8.9	2.2	21.8	2.6	—	—	—	2.6	24.4
Sorghum + linseed	13	76.9	—	—	—	76.9	—	—	—	—	0.0	76.9
Overall	3409	19.3	0.1	3.6	0.9	23.9	3.4	0.1	0.1	0.02	3.5	27.4
<i>Heliothis peltigera</i>												
Sole crop	1979	9.3	0.9	7.0	0.4	17.6	7.7	0.2	0.3	0.4	8.6	26.2
Intercrop												
Sorghum	559	1.6	0.5	12.7	4.3	19.1	4.8	—	0.5	1.4	6.8	25.9
Wheat	22	—	—	—	—	0.0	22.7	—	4.5	9.0	36.3	36.3
Chickpea	1611	5.1	0.4	8.3	1.2	15.0	9.4	0.1	0.6	0.2	10.3	25.3
Cowpea	16	—	—	—	—	0.0	—	—	—	—	0.0	0.0
Lentil	12	—	—	—	—	0.0	33.3	—	—	—	33.3	33.3
Linseed	477	6.5	2.5	5.0	—	14.0	14.5	0.4	0.4	0.2	15.5	29.5
Sunflower	4	—	—	50.0	—	50.0	—	—	—	—	0.0	50.0
Chillies	275	—	2.2	17.8	—	20.0	22.5	—	1.1	1.1	24.7	44.7
Sorghum + chickpea	216	6.5	—	14.4	4.1	25.0	2.8	—	1.4	—	4.2	29.2
Sorghum + linseed	21	—	—	23.8	—	23.8	14.3	—	—	—	14.3	38.1
Overall	3213	4.2	0.8	9.8	1.6	16.4	10.2	0.1	0.7	0.6	11.6	26.0

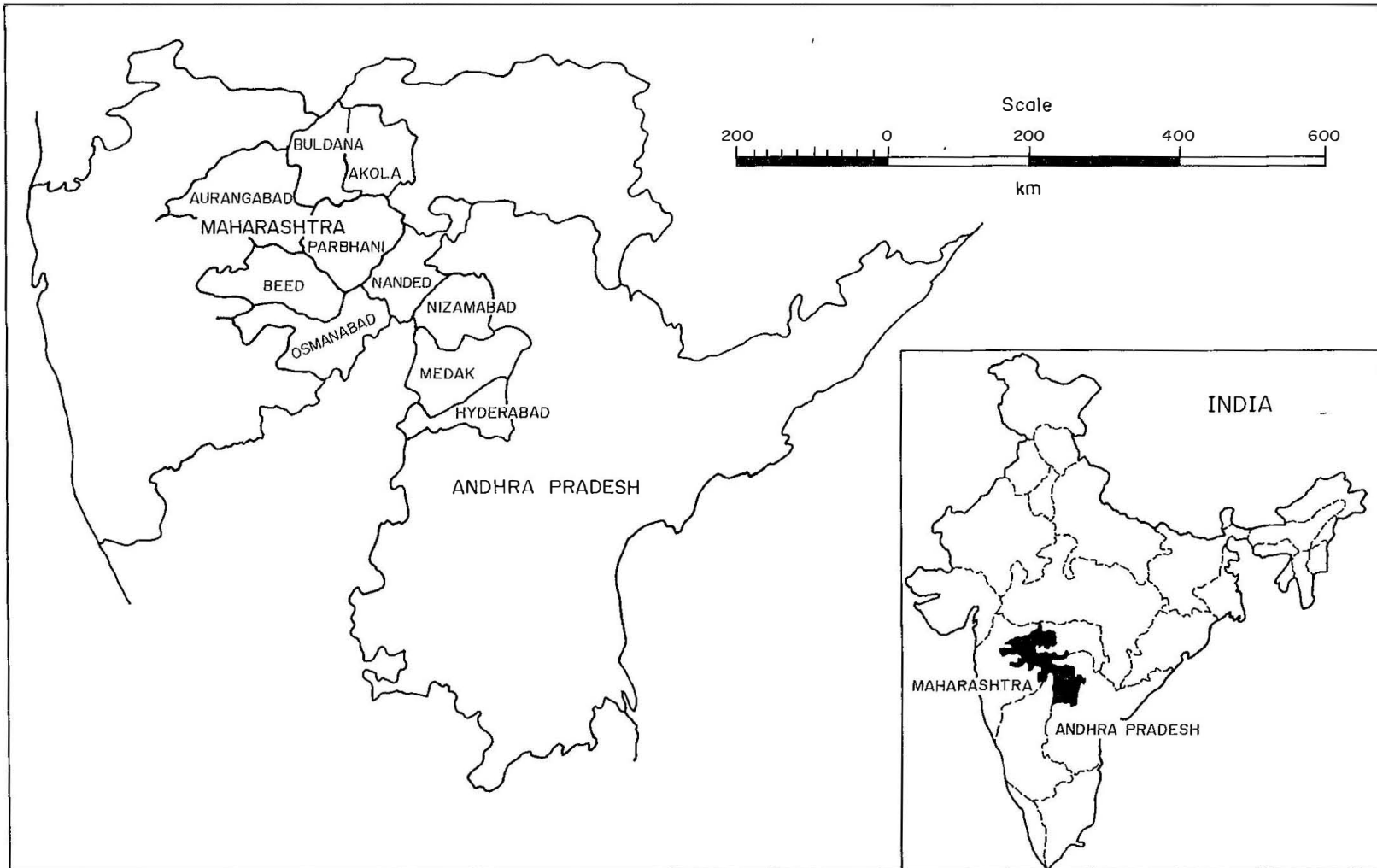


Fig. 1. Area covered in survey of *Heliothis* spp. and their larval parasitoids on safflower in India (1977–1983).

larvae (Table 2) Hymenoptera emerged from small-medium larvae (I-III instars) and Diptera from medium-large larvae (III-VI instars) *Microchelonus curvumaculatus* which is an egg-larval parasite (Bhatnagar *et al*, 1981) emerged exclusively from I-II instar larvae

More Hymenoptera were reared from *H armigera*, however, a greater number of Diptera were reared from *H peltigera* Hymenoptera parasitised 44.4% of *H armigera* as opposed to 17.6% of *H peltigera* on sole crop, and 23.9% of *H armigera* as opposed to 16.4% of *H peltigera* on intercrops in general. In contrast, Diptera parasitised 3.9% of *H armigera* as opposed to 8.6% of *H peltigera* on sole crop, and 3.5% of *H armigera* as opposed to 11.6% of *H peltigera* on intercrops. The parasitism by Hymenoptera in both *Heliothis* spp was higher on sole crop than on intercrops. However, while parasitism by Diptera in *H armigera* was not much different on sole and intercrops, the parasitism in *H peltigera* was higher on intercrop than on sole crop. *C chloridae* (Hymenoptera) and *C illota* (Diptera) were common parasitoids on both species of *Heliothis*.

While all the above mentioned eight parasitoids were reared from *H armigera* on intercrops in general, the parasitoids *M curvumaculatus* and *P solennis* were absent from sole crop. All the eight parasitoids were, however, reared from *H peltigera* on both sole and intercrops. Like *Heliothis* spp, the assessment of relative importance of parasitoids was possible only for intercrops with sorghum, chillies, chickpea, linseed and sorghum + chickpea. *M curvumaculatus* was reared from *H armigera* on most intercrops, and its parasitism was higher in *H peltigera* on intercrops than on sole crop. *P solennis*, although reared in considerable proportion (1.4%)

from *H armigera* on sole crop, was absent on intercrops except on the chickpea intercrop, where too its activity was low (0.1%). In general, it was reared more from *H peltigera* on intercrop than on sole crop.

*Acknowledgement*—We are grateful to the Commonwealth Institute of Entomology, London for identifying the parasitoids.

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