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Natural parasitism by *Campoletis chlorideae* Uchida, a promising parasitoid of *Helicoverpa armigera* (Hübner) on chickpea

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ABSTRACT: ***Helicoverpa armigera*** **(Hübner) larvae on chickpea were found to be parasitized by *Apanteles* sp., *Diadegema fenestrale* (Holmgren) and *Campoletis chlorideae* Uchida at Palampur, during two consecutive years. Among these, parasitization by the former two parasitoids remained negligible. However, the extent of parasitism by *C. chlorideae* ranged from 8.33 to 28.00 per cent. The parasitoid remained active from 2nd week of April to 1st week of May. Activity of the parasitoid ceased when the mean maximum temperature reached above 40°C and a significant positive correlation with total rainfall was observed. Multiple regression analysis revealed significant effect of relative humidity and total rainfall on larval parasitism, both individually as well as in association with other abiotic factors to the extent of 74.15 per cent.**

KEY WORDS: *Campoletis chlorideae, Helicoverpa armigera,* parasitism, parasitoids, seasonal incidence

In India, altogether 77 parasitoid of *H. armigera* have been reported on different crops (Achan *et al.*, 1968; Romies and Shanower, 1996; Shanower *et al.*, 1997). But unlike other cropping systems, chickpea harbours very few natural enemies, the most predominant being *C. chlorideae* Uchida, *Banchopsis ruficornis* (Cameron), *Carcelia* sp. and *Eriborus* sp. (Srinivas and Jayaraj, 1989; Singh *et al.*, 1991). Among these, *C. chlorideae* is the most promising, parasitizing 10-80 per cent of host larvae on chickpea in different parts of the country (Singh *et al.*, 1991; Patnaik *et al.*, 1994; Banchhor, 2000). Therefore, the conservation of this parasitoid is very important, for which estimation of the field parasitization in order to quantify the natural field mortality of the pest by the action of this parasitoid is important. Studying the activity of this parasitoid in relation to abiotic factors is also of vital importance. Since *Trichogramma* spp. do not work in chickpea ecosystem, the role-played by *C. chlorideae* in nature needs exploration for the formulation of future biointensive management strategy for *H. armigera* in chickpea ecosystem. Keeping in view the above-mentioned facts the present studies were conducted.

MATERIAL AND METHODS

Various stages of *H. armigera* were collected from unsprayed fields of chickpea in and around

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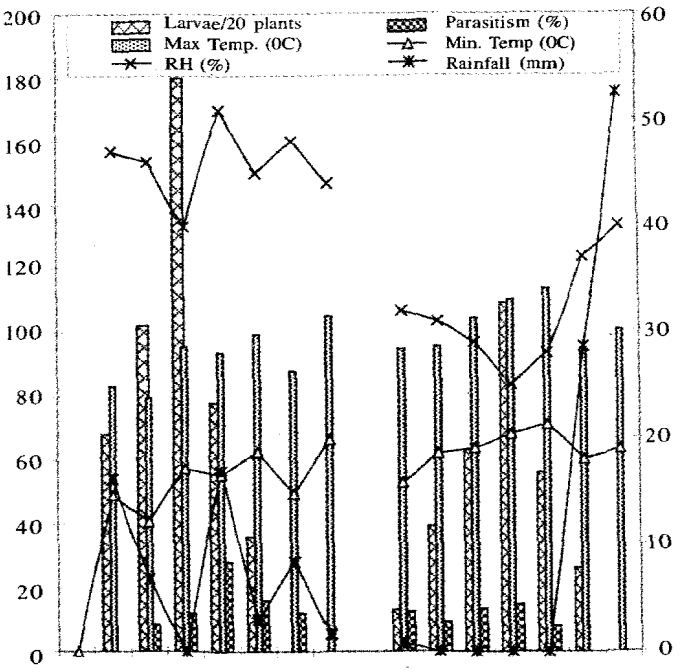
Entomological Research Farm, HPKV, Palampur situated at an altitude of 1290.8 meters above mean sea level between 32.6°N latitude and 76.3° longitude during *Rabi* season of 1997-98 and 1998-99. The eggs and pupae of the pest were kept separately in glass vials (50x5mm) for the emergence of parasitoids, if any. *H. armigera* larvae were collected at weekly interval and reared on semi-synthetic diet in pre-sterilized small screw cap plastic containers having a small circular hole on the lid covered with the fine brass mesh, individually. The diet was changed regularly as and when required until pupation of pest/parasitoid was observed. Data recorded on percent parasitism were correlated with the meteorological variables and subjected to multiple regression analysis as suggested by Gomez and Gomez (1983).

RESULTS AND DISCUSSION

The larval parasitoids, *viz.*, *Apanteles* sp., *Diadegma fenestrale* and *Campoletis chlorideae* were found associated with *H. armigera* in chickpea ecosystem at Palampur during 1997-98 and 1998-99. These larval parasitoids have already been recovered and described in India (Mathur, 1970; Singh *et al.*, 1991; Ravi and Verma, 1997). However, no egg and pupal parasitoids were recovered from this pest in chickpea ecosystem. Among the three parasitoids recovered, *C. chlorideae* appeared to be the most promising, as the parasitism by the other two larval parasitoids remained very low and almost negligible. The adult activity of the parasitoid was noticed as early as in last week of February onwards during both the crop seasons. However, the larval parasitism (8.33-12.50 %) in the chickpea fields could be ascertained only after the appearance of pest on crop from first (14 standard week (SW)) to 2nd week of April (15 SW) (Fig.1). These findings reflected that either the parasitoids were surviving on some alternate hosts on different crops/weeds or they could have emerged from over wintered cocoons during successive seasons as the minimum temperature nearly increased to 10°C. Activity of this parasitoid was suppressed at 8.0°C and below. A minimum daily temperature between 10-14°C has been reported to be the most favourable for development (Dakwale and Singh, 1980). The parasitoid remained active on chickpea from first week of April (14 SW) to first week of May (19 SW) within a maximum temperature and relative humidity range of 26.2 to 39.5°C and 25 to 51 per cent, respectively. Similar results were obtained by Patnaik *et al.* (1994) in northern Orissa. In the present investigation, the activity of this parasitoid commenced on chickpea when the mean maximum temperature reached 23.8°C and ceased at 40°C and above, which agreed with the findings of Yadav *et al.* (1982) and Patnaik *et al.* (1994). The peak parasitism (14.56-28.0 %) was noticed in the 2nd fortnight of April during both the years within a



Standard Week

Fig. 1. Natural parasitism by *C. chlorideae* in relation to pest population and abiotic factors at Palampur during 1997 to 1999

temperature range of 28.1 to 33.0° C (maximum temperature). However, Sachan (1992) and Ravi and Verma (1997) noticed maximum parasitism during December- January in northern plains.

Parasitism by *C. chlorideae* exhibited non-significant correlation with all the abiotic factors during 1997-1998. However, during 1998-99, a significant positive correlation between per cent parasitism and total rainfall was obtained (Table 1).

Regression studies of the data pooled over two years indicated strong combined influence of abiotic factors on the parasitization of *C. chlorideae* with coefficient of multiple determination (R^2) of 74.15 per cent (Table 2).

It is concluded that in the absence of diversified natural enemy complex on chickpea, *H. armigera* population fluctuated in time and space. Among the three parasitoids recorded *C. chlorideae* appears to be the most promising. The biocontrol potential of this parasitoid, both in terms of conservation and augmentation, needs further explorations.

Table 1. Correlation coefficients of *C. chlorideae* with abiotic factors

Crop season	Temperature °C		R. H. (%)	Total rainfall (mm)
	Maximum	Minimum		
1997-98	0.4936	0.4663	0.6179	0.7343
1998-99	-0.0350	-0.2509	-0.3364	0.8792*

*Significant at 5% level of significance

Table 2. Multiple Regression analysis of *C. chlorideae* with abiotic factors

Regression equation	Co-efficient of multiple determination (R^2) (%)
$Y=7.3309+0.7502X_4$	34.7
$Y=2.6196+0.2676X_3+0.7395X_4$	54.3
$Y=49.6043+1.2475X_1+0.5589X_3+0.6958X_4$	73.9
$Y=46.4065+0.9415X_1+0.3358X_2+0.5533X_3+0.7052X_4$	74.2

X_1 = Maximum Temperature
X_2 = Minimum Temperature
X_3 = Relative Humidity
X_4 = Total Rainfall

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