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Role of parasitoids, *Campoletis chlorideae* and natural enemies for management of *Helicoverpa armigera* (Hub.)

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Abstract

Chickpea pod borer, *Helicoverpa armigera* is notorious insect pest of chickpea crop. Its infestation starts from vegetative stage of crop but became serious during podding stage of the crop. Although, there are many insecticides to minimize the population of this insect-pest. These insecticides are not eco friendly and responsible for so many hazards to environment and crop eco system also. Some bio agents like parasitods are use full for managing their population. *Campoletis chlorideae*, *Ichnemnoid* wasp and Nuclear polyhedrosis virus, birds etc. are found in nature and effective to minimize *H. armigera* larva population.

Keyword: *Helicoverpa armigera*, parasitoids, natural enemies

Chickpea, *Cicer arietinum* L. known as Bengal gram is used as dal which is primary source of protein (Bhatnagar *et al*. 1998, Srivastava *et al* 2024a). The grain contains 52-70% carbohydrate, 8-22% protein and 4-10% fat. Both biotic and abiotic stresses are responsible for this sorry state of productivity and availability of the commodity. Insect pests are one of the important limiting factors in the successful cultivation of chickpea in India (Srivastava *et al.* 2024b). Mehto & Singh (1983) observed sixteen insect species attacking the crop at different stages of its growth gram pod borer, *Helicoverpa armigera* (Hubner), gram cut worm, *Agrotis ipsilon* (Hfn), gram semiloopers, *Autographa nigrisigna* (Walker), *Plussia orichalcea* F., and black aphid, *Aphis craccivora* Koch are however, the major insect pests. India is credited with three species of gram pod borers, namely, *H. armigera* Hubner, *H. assulta* Guenee and *H. peltigera* Denis Schiffermuller. These species occur in most of the states and Union Territories of India, ranging from the tropical Andaman and Nicobar Islands to temperate Jammu and Kashmir (Sachan 1992). The gram pod borer, *H. armigera* is one of the most devastating pests of chickpea (*Cicer arietinum* L.), causing significant yield losses globally (Veer *et al.* 2020, Srivastava *et al.* 2025).

Campoletis chlorideae and natural enemies associated with *H. armigera* larvae

The larvae of *H. armigera* were collected from chickpea in Kanpur, and reared them in the laboratory to determine the extent of natural parasitization by Ichneumnoid wasp, *Campoletis chlorideae.* Percentage of parasitization was found highest during December and lowest during February that becomes almost nil in March (Yadava *et al.* 1985). The incidence of pests on chickpea in subtropical area of India and other countries in 1985 is briefly reported *H. armigera* as the most damaging pest of various crops in all the areas of Andhra Pradesh. The observation of population ecology of *H. armigera* and its parasites on pulses in Maharashtra and reported that *Campoletis chlorideae* caused 14.73% parasitism during the 1st generation. The mortality of larvae due to nuclear polyhedrosis virus was 6.88%, 1.98% and 24.52% during Ist, 2nd and 3rd generations, respectively (Bilapate *et al.* 1988). The study of role of hymenopterous parasitoids in the biological control of *H. armigera* with special reference to *C. chlorideae.* About 100 parasitoids species tried on

the *H. armigera*, 70 belong to the order Hymenoptera; *C. chlorideae* found a promising species among them for the management of the pest (Nakim & Gaikwad 1989). The seasonal incidence record of *Campoletis chlorideae* on chickpea in Tamil Nadu, during October 1984 to February 1985. The maximum parasitization of *H. armigera* larvae (43.9%) was recorded by *C. chlorideae* during first 2 weeks of December (Srinivas 1989). The study on ecology of *H. armigera* on chickpea in Punjab and reported that *C. chlorideae*, house sparrows and bank myna were important natural enemies of *H. armigera* (Singh *et al.* 1990). Cahatian (1991) collected and identified number of parasitoids on larvae of *H. armigera* from different major host plants in Philippines. Five hymenopterous larval parasitoids namely: *Campolex rufigastor, Campoletis* sp. (Icheumonidae), *Snellenius manilae* (Braconidae), *Brachymeria sp*. (Chalcididae) and *Trichomalopsis* sp. (Pteromalidae) and four larval predators *Eocanthecona furcellata* Wolff. (Hemiptera: Pentatomidae), *Solenopsis geminata* (Hymenoptera: Formicidae), *Rhynchium atrissimum* (Hymenoptera: Vespidae) were identified. The observation of incidence of *H. armigera* on chickpea and its population phenology in north central plateau zone of Orissa and found that *C. chlorideae* and the tachinid *Carcellia illota* played a key role in suppressing the larval population during the podding stage (Patnaik *et al.* 1991).

The population dynamics of *H. armigera* in Madhya Pradesh, India were studied over 2 years (1983-84 and 1984-85) on various crops like chickpea, pigeonpea, pea, lentil and tomato in cropping season and tomato, berseem, okra, fodder and grain sorghum, soyabean, hollyhock, dhatura, rose and bougainvillea during the off season (April-August). The larval parasitoid, *Campoletis chlorideae* was found effective to reduced the larval population (Dubey *et al.* 1995). The seasonal incidence of chickpea pod borer, *H. armigera* and its larval parasitoid *C. chlorideae* on chickpea were observed and reported that incidence of *H. armigera* started in the first week of January and reached its peak in March. The parasitoid population followed the host population and declined after the 9th week due to rise in ambient temperature (Ravi & Verma (1997). The monitoring of *H. armigera* through light and pheromone traps and seasonal activity of their natural enemies in Madhya Pradesh and found that the level of attack by the larval parasitoid *C. chlorideae* and a dipteran pupal parasitoid varied from 4.8 to 27.3% and 2.9 to 20.1%, respectively under laboratory conditions. Both these parasitoids were quite active in chickpea fields from January to March on *H. armigera* (Bhatnagar *et al.* 1998). Sachan & Bhaumik (1998) recorded the extent of parasitization of *C. chlorideae*, a larval parasite of *H. armigera* in chickpea in U.P. and reported that parasitization varied between 12.69 and 56.28% during 1995-96 and 3.57 and 80.64% during 1996-97 on a standard weekly basis. Parasitization recorded during 1995-96 were 37.17, 46.10, 42.67, 16.16 and 26.19% during November, December, January, February and March, respectively, while during 1996-97 it were 51.04%, 65.14%, 63.19%, 21.46% and 5.85% in November, December, January, March and April, respectively.

In a laboratory experiment to determine the suitability of host age of *H. armigera* for its larval parasitoids *C. chlorideae*. The second instar larvae of *H. armigera* was found most suitable for parasitization that approached highest upto 45% (Dhembare 1999). The observation for activity of *C. chlorideae* on *H. armigera* in chickpea intercropped with coriander under rice based cropping system and found that when one row of coriander was intercropped between the rows of chickpea, there was significantly higher parasitization (6.4 cocoons/5m row) and lower pest activity (2.6 larvae/5m row) (Gupta *et al.* 1999). Kaushal *et al.* (1999) recorded *C. chlorideae* as larval parasitoid of *H. armigera* in carnation fields in Nauni, Himachal Pradesh. Nath *et al.* (1999) reported that the key mortality factors in the population dynamics of *H. armigera* in chickpea during first and the second generations were due to the failure of newly hatched larvae to survive and parasitization of the younger larvae by *C. chlorideae,* while the older larvae by *Carcelia illota* and the disease caused by nuclear polyhedrosis virus. Mortality was greater in younger larvae, followed by pupae and older larvae. An experiment was conducted to know the parasitism by *Senometopia illota* Curran on *H. armigera* in pigeonpea and chickpea using third, fourth, fifth and sixth instar larvae of *H. armigera* in Maharashtra. The average parasitization was 13.05%. The highest

parasitism rates were observed in November, 1993 (28%), 1994 (36%) and December 1995 (42.6%), while the lowest parasitism were recorded during January (0.8%), February (1.67%) and March (4.2%) (Chaudhari 2000).

The study of role of natural mortality factors in *H. armigera* on chickpea in Punjab, and found that the larval parasitoid *C. chlorideae* was found the most important mortality factor. Parasitism due to *C. chlorideae* ranged from 0.98 to 68.50% throughout the crop season. The maximum parasitization was recorded during 3rd week of February, when the minimum mean temperatures and relative humidity were 11.9°C and 95%, respectively. *C. chlorideae* helps in suppressing the pest population both at vegetative and flowering/pod formation stage of the crop Kaur *et al*. (2000). In an experiment to elucidate the effect of host density on sex ratio of parasitoid off spring, using *H. armigera* and its endoparasitoid *C. chlorideae*. They found that the sex ratio of *C. chlorideae* was female biased and showed a linear decrease with increasing parasitoid density at fixed host densities. However, with more hosts available, the number of parasitoids emergence increased after stabilizing a density of 32 hosts per parasitoid (Kumar *et al.* 2000). The study conducted on populations of *H. armigera* and their biological suppression agents on chickpea at four places in Madhya Pradesh. Natural enemies play a key role in population suppression of the pod borer and 52.7-90.1% peak parasitism was recorded in the various locations. Among the natural enemies, *Beauveria bassiana* and *C. chlorideae* were dominant (Mishra and Srivastava 2000). The observation was recorded on natural enemies of *H. armigera* on chickpea from November to May in 1998-2000 in Manipur. They found that five parasitoids were associated with *H. armigera* and among them *C. chlorideae* parasitoids was recorded as the most important natural enemy. The percentage of parasitism ranged from 0.18 to 23.81% from March to May. The maximum incidence of the parasitoids was recorded during the first and second week of April 1998-2000. Predators including spiders, birds, common myna, predatory beetle and some species of ants were also recorded (Devi *et al.* 2002).

The observation on larval parasitization of *H. armigera* on chickpea by *Apantelis* sp., *Diadegema fenestrale* and *Campoletis chlorideae* at Himachal Pradesh. 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%. The parasitoid remained active from the second week of April to the first week of May. Multiple regression analysis revealed that 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% (Gupta & Desh Raj 2003).

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