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Seasonal Incidence of Diamondback Moth, *Plutella xylostella* L. and its Parasitoids in Nilgiris

N. CHANDRAMOHAN

Department of Sericulture, Centre for Plant Protection Studies,
Tamil Nadu Agricultural University, Coimbatore 641 003

ABSTRACT

In Nilgiris, the larval population of diamond backmoth *Plutella xylostella* L. in cabbage was more from December to May with its peak activity during April. *Diadegma semiclausm* (Horstmann) and *Cotesia plutellae* (Kurdjumov) are widely established larval parasitoids. Activity of *D.semiclasm* was more during September. Level of parasitism by *D.semiclausm* was not influenced much by weather elements and host density. The parasitism by *C.plutellae* was more in hot-weather period and parasitoid activity was influenced by host density. Maximum temperature, and morning relative humidity had positive influence whereas, evening relative humidity had negative influence on *C. plutellae* parasitism.

KEY WORDS : Diamondback moth, *Diadegma semiclausm*, *Cotesia plutellae*, seasonal incidence

The diamondback moth (DBM), *Plutella xylostella* L. is recognised as a widely distributed and serious pest of crucifers in many countries (Lim, 1986). Several natural enemies had been reported regulating DBM in India (Cherian and Basheer, 1938; Simmonds and Rao, 1960; Jayarathanam, 1977). Information on the natural enemies of DBM at higher altitudes is lacking in peninsular India and hence the present study was carried out in Nilgiris to understand the population dynamics of DBM in different periods and the role of natural enemies in regulating DBM larval population at higher altitude.

MATERIALS AND METHODS

The parasitoid complex of DBM was studied on cabbage at the Horticultural Research Station, Udhagamandalam, Nilgiris district, Tamil Nadu. The experimental site was at 2300 m above mean sea level. Twenty larvae/pupae were collected every week from pesticide free cabbage fields. The immature stages were confined in glass vials (7.5 cm x 2.5 cm) plugged with cotton. Pesticide-free cabbage leaves were provided daily for the larvae till parasitoid emergence and per cent larval/pupal parasitism was calculated. Parasitism was studied weekly for two years from July, 1990 to June 1992.

To relate the host density with parasitoid abundance in different seasons, DBM larval count was made weekly in 10 randomly-selected plants and mean larvae per plant was arrived. Multiple regression analysis was made to understand the influence of eight weather elements (Table 1) on the parasitoids.

RESULTS AND DISCUSSION

Two larval parasitoids, *Diadegma semiclausm* (Ichneumonidae: Hymenoptera) and *Cotesia (Apanteles) plutellae* (Braconidae: Hymenoptera) and one pupal parasitoid, *Tetrastichus* sp. (Eulophidae: Hymenoptera) were recorded as the chief natural enemies of DBM in Nilgiris district. Larval parasitoids have a greater potential in natural regulation of DBM than the natural enemies of other stages of the pest (Lim, 1986). Parasitism by *D.semiclausm* was observed throughout the year and it ranged from 2.32 to 68 per cent in the first year (1990-91) (Fig.1) and 1.05 to 50.90 per cent in the second year (1991-92) (Fig.2). In both the years, highest level of parasitism was noticed in the month of September. Harcourt

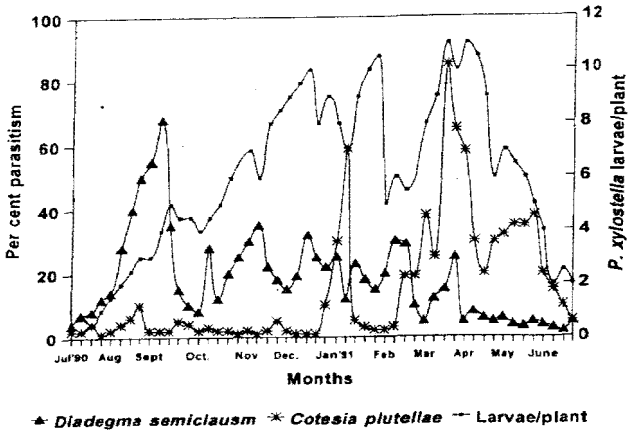

Fig.1. *P.xylostella* larval population and per cent larval parasitism (1990-91)

(1986) observed a similar rise in *Diadegma* parasitism from August and reaching a peak in September in temperate region.

D.semiclausm had established well in places of cooler temperature and high lands (Koshihara, 1986; Sastrosiswojo, 1987). Talekar *et al.* (1990) reported increased parasitic activity at a temperature range of 15 to 25°C. During the study period, the monthly mean temperature at Udhagamandalam in different months ranged from 13.4 to 17.8°C with an annual mean temperature of 15.06°C. Congenial temperature at the experimental site in Nilgiris favoured the establishment of *D.semiclausm* as in the other high lands.

Diamondback moth is a hot weather pest in mountainous regions (Bhalla and Dubey, 1986). In the present study also, higher larval population was recorded in summer moths than in other periods. During 1990-91, DBM larvae/plant ranged from 0.5 to 11 and in the subsequent year, the population per plant varied from 0.5 to 22. The pesticide usage was more in the above season than in other periods. The low level of *Diadegma* activity from May to July during the peak period of host activity was attributed to susceptibility to pesticides (Chua and Ooi, 1986).

Weekly parasitism by *C.plutellae* ranged from 1.69 to 85.71 per cent in the first year (Fig.1 and 2.) Parasitoid activity steadily increased from January and high level of parasitism was recorded during March and April. High build up of host population was reported during hot-weather period in Western Ghats of Tamil Nadu (Abraham and Padmanabhan, 1968) and density dependent relationship was earlier established between DBM and *C.plutellae* by Nagarkatti and Jayanth (1982). DBM density in Nilgiris was also higher in the hot weather season and *Cotesia* parasitism was

Table 1. Multiple regression analysis of larval parasitoids *Diadegma semiclausm* on *Cotesia plutellae* with weather elements (n = 10)

Variable	*D. semiclausm*				*C. plutellae*			
	b Value	Standard error	T Value	Beta	b Value	Standard error	T Value	Beta
X_1 Maximum temperature ^oC	-0.5616	1.1840	-0.4743	-0.1003	2.7132	1.4663	1.8506*	0.2756
X_2 Minimum temperature ^oC	-0.3079	1.2538	-0.2455	-0.0431	1.3698	1.3853	0.9898	0.1774
X_3 Relative humidity-Morning%	-0.2460	0.2593	-0.9485	-0.2530	0.8223	0.2999	2.7416*	0.6132
X_4 Relative humidity-Evening%	0.4176	0.2789	1.4971	0.5140	-1.0327	0.3223	-3.1991*	-0.9215
X_5 Wind velocity-km/h	0.1200	0.5472	0.2193	0.0290	-0.0669	-0.6325	-0.1059	-0.0117
X_6 Sunshine hours	1.1682	0.7682	1.5207	0.2526	0.0481	1.0081	0.0477	0.0075
X_7 Total rainfall-mm	-10.0180	0.0441	-0.4107	-0.0562	0.0130	0.0509	0.2562	0.02943
X_8 Number of rainy days	-1.1184	1.2900	-0.3667	-0.1555	0.4574	1.4921	0.3065	0.04612
Constant team R^2 = 0.0879 A = 16.26					Constant team R^2 = 0.3598 A = 35.77			

* Significant (P=0.05)

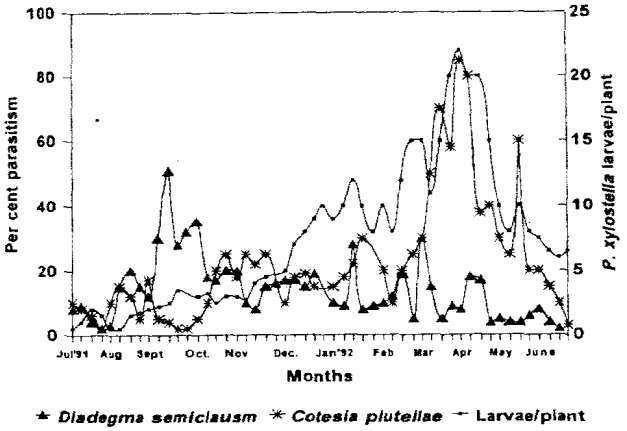

Fig.2. DBM larval population and per cent larval parasitism (1991-92)

more from December to May when there was corresponding increase in DBM population.

The multiple correlation regression analysis between *D.semiclausm* and weather elements indicated a cumulative contribution of 8.79 per cent by weather elements (Table 1). The multiple regression equation fitted to predict the level of parasitism with weather elements was $Y = 16.26 - 0.5616\ X_1 - 0.3079\ X_2 - 0.2460\ X_3 + 0.4176\ X_4 + 0.12000\ X_5 + 1.1682\ X_6 + 10.0180\ X_7 + 1.1184\ X_8$. The high searching and killing power (Chua and Ooi, 1986) and adaptability to cooler temperature had made it as a dominant parasitoid in upland (Talekar *et al.*, 1990).

Contrary to *Diadegma*, weather elements had decisive role in *Cotesia* activity. Weather elements cumulatively contributed to 35.98 per cent variation in parasitoid activity. The multiple regression fitted to predict parasitism was $Y = 35.77 + 2.7132\ X_1 + 1.3698\ X_2 + 0.8223\ X_3 - 1.0327\ X_4 - 0.0669\ X_5 + 0.0418\ x_6 + 0.0130\ x_7 + 0.4574\ x_8$. Among the weather elements, maximum temperature and morning relative humidity had positive influence. *C.plutellae* preferred to multiply in higher temperature range of 20 to 35°c (AVRDC, 1988) than at lower temperature (Mushtaque and Mohyuddin, 1987). In the present study, for every degree rise in maximum temperature, there was an increase in *Cotesia* parasitism by 2.71 per cent. For every per cent increase in morning relative humidity, parasitism increased by 0.82 per cent and decreased by 1.03 per cent by evening relative humidity. Other elements had no influence on parasitic activity.

The pupal parasitoid, *Tetrastichus* sp. was recorded in the months of April-May. In the first year, the parasitism ranged form 4.83 to 21.42 and in the second year it was between 2.85 and 10 per cent. Unlike the larval parasitoids, pupal parasitoids had little role in population regulation of DBM.

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