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Seasonal activity of natural enemies of *Pieris brassicae* (Linnaeus) (Lepidoptera : Pieridae) in cauliflower seed crop ecosystem

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ABSTRACT : Studies conducted on the natural enemies of *Pieris brassicae* (Linnaeus) in the mid-hill region of Himachal Pradesh, revealed that mortality caused by hymenopteran parasitoids, *Cotesia glomeratus* (Linnaeus) and *Hypersota ebeninus* Gravenhorst ranged between 3.9-23.6% with its peak during mid April, while the mortality due to bacterial pathogens *viz.*, *Bacillus* sp. and *Serratia marcescens* Bizio varied between 1.2 - 23.7%. Predators like *Episyrphus balteatus* (de Geer), *Coccinella septempunctata* Linnaeus and *Polistes hebreus* (Fabricius) though active, their role in suppressing the population of *P. brassicae* was negligible. The role of meteorological factors in the dynamics of natural enemies is also discussed.

KEY WORDS : Abiotic factor, parasitoids, pathogens, *Pieris brassicae*, predators, seasonal activity

The cabbage white butterfly, *Pieris brassicae* (Linnaeus) (Lepidoptera : Pieridae) is a serious pest of late cultivars of cauliflower seed crop in the mid-hills of Himachal Pradesh (Gupta, 1984; Sood *et al.*, 1993). Lal and Chandra (1976), Gupta (1984) and Kakar and Sharma (1991) reported some of the natural mortality agents associated with *P. brassicae* but their precise role on population build-up of this pest has not been ascertained. The present investigations aim at determining the impact of natural enemies and abiotic factors in the dynamics of *P. brassicae* population.

Investigations were carried out on cauliflower seed crop during two consecutive seasons, 1989-90 and 1990-91 at the University Farm, Nauni, Solan (1250 m asl). Cultivar PSB-1, transplanted during October, was raised in a pesticide free environment. During the period of activity, larval count of *P. brassicae* at weekly interval was recorded on 20 randomly selected plants. For recording the extent of parasitization and mortality due to pathogens; eggs, larvae and pupae were collected from the field at weekly interval and reared in the laboratory. Mortality due to parasitoids and pathogens was calculated using the formula of Root and Skelsey (1969). Predators feeding on eggs and larvae were also observed in the field. Effect of parasitoids and pathogens on abundance of *P. brassicae* larvae was determined through simple correlation analysis. A relationship between abiotic factors (temperature, relative humidity, rainfall and sunshine) and activity of these mortality factors was also established.

The natural mortality factors associated with larvae of *P. brassicae* were three larval parasitoids *viz.*, *Cotesia glomeratus* (Linnaeus) (Hymenoptera : Braconidae), *Diatora* sp. and *Hypersota ebeninus* Gravenhorst (Hymenoptera : Ichneumonidae), three predators *viz.*, larvae of syrphid fly *Episyrphus balteatus* (de Geer) (Diptera:Syrphidae), lady bird beetle *Coccinella septempunctata* Linnaeus (Coleoptera : Coccinellidae) and wasp *Polistes hebreus* (Fabricius) (Hymenoptera : Vespidae), two bacterial pathogens (*Bacillus* sp. and *Serratia marcescens* Bizio), and a fungal pathogen (*Entomophthora* sp.). Among these, the parasitoids *C. glomeratus* and *H. ebeninus* and the bacterial pathogens were predominant. Earlier, *C. glomeratus*, *P. hebreus* and *S. marcescens* were reported to be associated with different stages of *P. brassicae* from Himachal Pradesh (Lal and Chandra, 1976; Gupta, 1984; Kakar and Sharma, 1991).The other natural enemies seem to be new records from the state. Adults of

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C. septempunctata and larvae of *E. balteatus* were observed to feed on eggs and newly hatched larvae of *P. brassicae* only when the cabbage aphid, *Brevicoryne brassicae* (Linnaeus), the primary prey of these predators was either absent or sparse. *Entomophthora* sp. isolated from the early instar dead larvae after the heavy rains was also of occasional occurrence.

The mortality due to parasitoids and bacterial pathogens began in second fortnight of March (Fig.1). The gregarious endoparasitoid, *C. glomeratus* which killed the larvae of *P. brassicae* in the fifth instar remained associated till early May and resulted in the mortality ranging from 3.9 to 23.6% with the peak parasitization in the second week of April. The mortality recorded in the present studies is in the range observed by Bendek (1972), Lal and Chandra (1976) and Kakar and Sharma (1991). However, Karnavar (1983), Gupta (1984) and Thapa (1987) recorded parasitization above 40%. The solitary parasitoid *H. ebeninus*, which killed 8.2-10.1% third instar larvae, was active for a short duration (till mid-April) which may be due to rise in temperature and activity of hyperparasitoid *Baryscapus* sp. (Hymenoptera : Eulophidae). *Hypersota ebeninus* has been recorded parasitizing *P. brassicae* larvae in different parts of the world (Uzun, 1987; Isakowa and Moiseeva, 1967; Figueiredo and Araujo, 1987) but none have quantified the pest mortality by it. Incidence of bacterial pathogens was higher in later part of the cropping season and more so in 1990 (1.8 - 23.7%) than in 1991 (1.2 - 14.3%). Isakowa and Moiseeva (1967) and Mushtaque and Mohyuddin (1984) found *Bacillus* sp. associated with larvae of *P. brassicae*. *Serratia marcescens* was earlier recorded from the state resulting in mortality to the extent of 2-5% (Kakar and Sharma, 1991).

The collective mortality due to parasitoids and bacterial pathogens in *P. brassicae* population varied from 12.6 - 28.7 per cent, with the seasonal average of 22.2 and 19.1 per cent during 1990 and 1991, respectively.

Relationship between abiotic environmental factors and mortality agents reveals that the rainfall coupled with long sunshine hours did not favour activity of both the parasitoids. The temperature was significantly negatively correlated with activity of *H. ebeninus* only (r= -0.5717 and -0.5784 for maximum and minimum temperature P=0.01). But in contrast to these, maximum and minimum temperatures favoured bacterial pathogens as evident from the correlation values presented in Table 1. *Cotesia glomeratus* was the only mortality agent which responded positively and significantly to increasing *P. brassicae* larval population (r=0.6044). Therefore, strategies to conserve and enhance the activity of *C. glomeratus* should be followed for effective supperession of the pest in cauliflower seed crop ecosystem.

Table 1. Correlation between mortality due to natural enemies, and abiotic environmental factors and host population (pooled data of 1989-90 and 1990-91)

Environmental factor	Mortality factor		
	C. glomeratus	*H. ebeninus*	Bacteria
Temperature (°C)			
Maximum	-0.3275	-0.5717*	0.6640**
Minimum	-0.2821	-0.5784*	0.6351**
Relative humidity (%)	0.2449	-0.4382	-0.4777
Rainfall (mm)	-0.0997	-0.1293	0.0450
Sunshine hours	0.5005	0.5080	0.4621
Larval population	0.6044*	-0.7969**	-0.3185

* Significant at P = 0.01

** Significant at P = 0.05

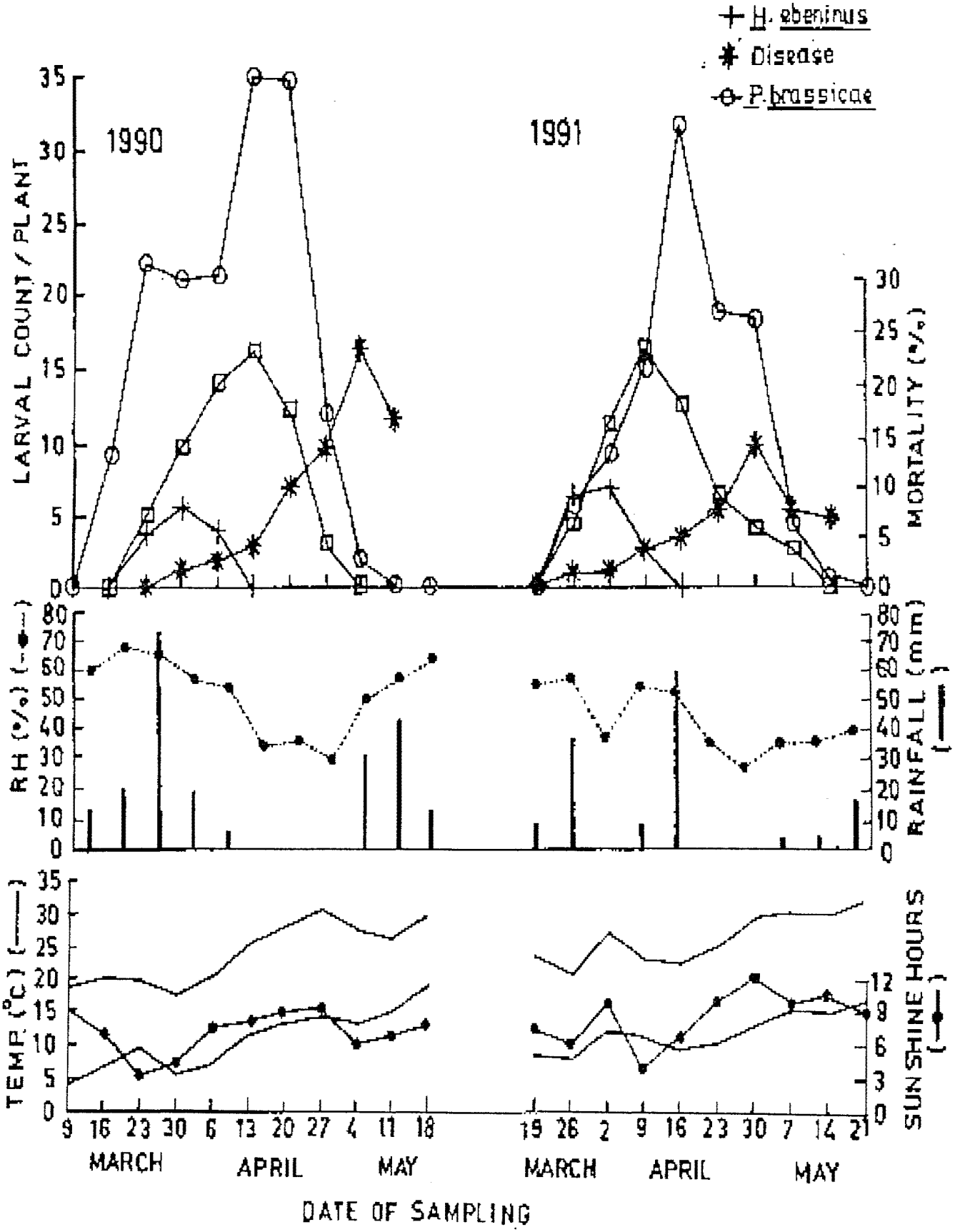

Fig.1. Seasonal abundance of *Pieris brassicae* and its natural mortality agents

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