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NATURAL ENEMIES OF APPLE WOOLLY APHID, *ERIOSOMA LANIGERUM* HAUSMANN AND THEIR POPULATION DYNAMICS IN A MID HILL APPLE ORCHARD

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ABSTARCT

Among the several insects infesting apple, *Eriosoma lanigerum* Hausmann is a major pest of apple in Bharsar, Pauri Garhwal, Uttarakhand. A survey of its natural enemies was conducted and studies on their population dynamics made during 2008 and 2009. Fourteen natural enemies were recorded belonging to Coccinellidae, Syrphidae, Chrysopidae, Forficulidae and Anthocoridae. *Coccinella septempunctata* played an important role in the spring season, while in summer common earwig, *Forficula auricularia,* green lacewing, *Chrysoperla carnea* and syrphid flies (Syrphidae) were important. *C. carnea* and syrphid flies were observed from August to October.

Key words: Apple, *Eriosoma lanigerum*, natural enemies, population dynamics

Uttarakhand is the third largest producer of apple in India occupying around 32.5 thousand ha. Among the several factors responsible for low production of apple here, insect pests such as apple woolly aphid, *Eriosoma lanigerum* plays a major role. This infests both the aerial and root parts of the tree, and forms large and serious galls on the stems, twigs and roots. As root colonies remain uncovered from the pesticide sprays during the growing season, these are the major source of aerial re-infestation in the following spring (Nicholas *et al*., 2003). Therefore, pesticide application alone does not give good results. It needs to be integrated with biological control, and many biological control agents have been reported. *Aphelinus mali* is the most important of these, and despite the major reductions of *E. lanigerum* after its introduction, there is a need to reinforce it with other natural enemies. Keeping above in view present investigation was carried out, with a survey of the natural enemies and their population dynamics at Bharsar, Uttarakhand.

MATERIALS AND METHODS

Samples of natural enemies were collected from several locations in the apple orchards of Bharsar during 2008 and 2009. Ten blows (shots) were applied on the branches by stick on the surroundings of the 5 chosen trees at one location. The operation was repeated on the same chosen trees for the entire season in each field. Insect aspirator was used to collect the falling insects on the beating tray and the hiding predator insects between the leaves. To study the incidence of parasitoids associated with woolly aphid, colonies of aphids were gathered from the branches and leaves using a brush made up of natural goat hair. Collected samples were kept in small glass vials in order to collect and identify the emerging parasitoids. Insect net was used to collect flying insects like chrysopids, syrphids and other flies.

Damaged trees were marked for sampling to study the population fluctuations of natural enemies, and beating trays were used for collecting predators. 10 blows (hitting) with a stick on the surrounding branches of injured tree were given to five randomly selected trees at fortnightly intervals. All the fallen insects were gathered, identified and counted.

RESULTS AND DISCUSSION

Five species of Coccinellidae, six species of Syrphidae, one species each of Anthocoridae and Chrysopidae were found associated with *E. lanigerum* (Table 1). Earwig, *Forficula auricularia*, was also found, and parasitoids were not observed. Bayhan *et al.* (2006) identified a total of 29 natural enemies of aphids.

The population dynamics of important predators during 2008 and 2009 are presented in Figs. 1 and 2, respectively. *Coccinella septempunctata* appeared first

Table 1. Predators of apple woolly aphid in apple orchards, Bharsar (2008, 2009)

Family	Order	Natural enemies
Coccinellidae	Coleoptera	*Coccinella septempunctata* Linnaeus
		Hippodamia convergens Guerin-Meneville
		Chilomenes sexmaculata Fabricius
		Coccinella transversalis Fabricius
		Adalia bipunctata Linnaeus
Syrphidae	Diptera	*Episyrphus balteatus* Degeer
		Eupeodes corollae Linnaeus
		Syrphus ribesii Linnaeus
		Scaeva pyrastri Linnaeus
		Sphaerophoria scripta Linnaeus
		Syritta pipiens Linnaeus
Chrysopidae	Neuroptera	*Chrysoperla carnea* Stephens
Forficulidae	Dermaptera	*Forficula auricularia* Linnaeus
Anthocoridae	Hemiptera	*Anthocoris* sp.

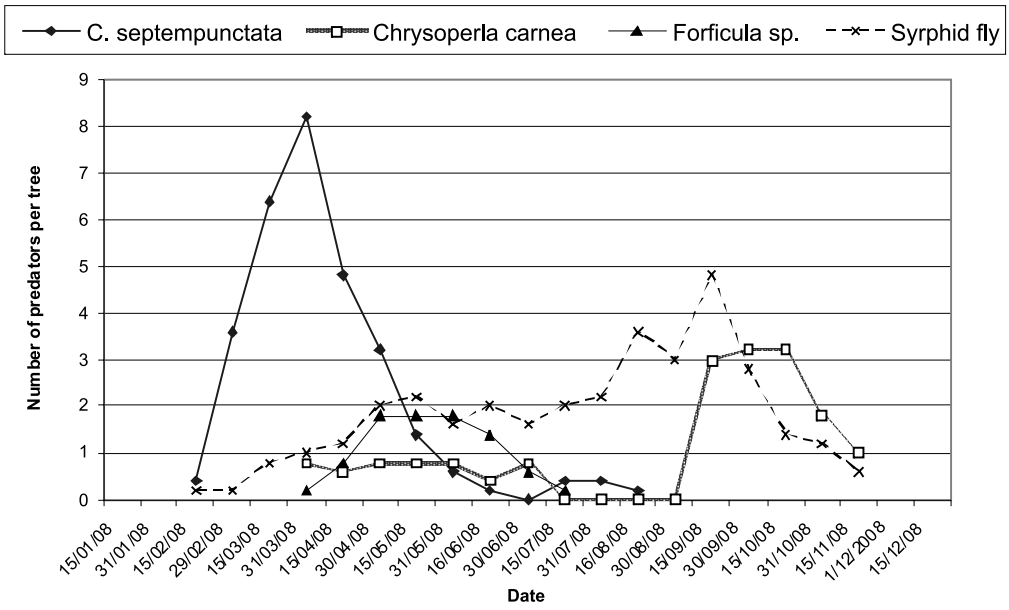

Fig. 1. Population dynamics of predators on apple tree during 2008

in small numbers at the beginning of aphid incidence in February during both years, its peak population was recorded in the last week of the March to first week of April during 2008, and in the 2nd fortnight of March during 2009; its population decreased after April quickly and became very less during the rainy season, until it disappeared totally by July- August. Almatni *et al.* (2002) reported similar early appearances of *C. septempunctata* in spring on apple trees. Gupta and Bhalla (1993) also reported in Himachal Pradesh, that coccinellids, *C. septempunctata* and *Hippodamia variegata*, appeared in large numbers during April-May on apple trees. Crawlers of *E. lanigerum* migrated from the roots on to the trees during spring to initiate above-ground colonies (Gautam and Verma, 1983; Beers *et al.*, 2007) and at the same time *C. septempunctata*

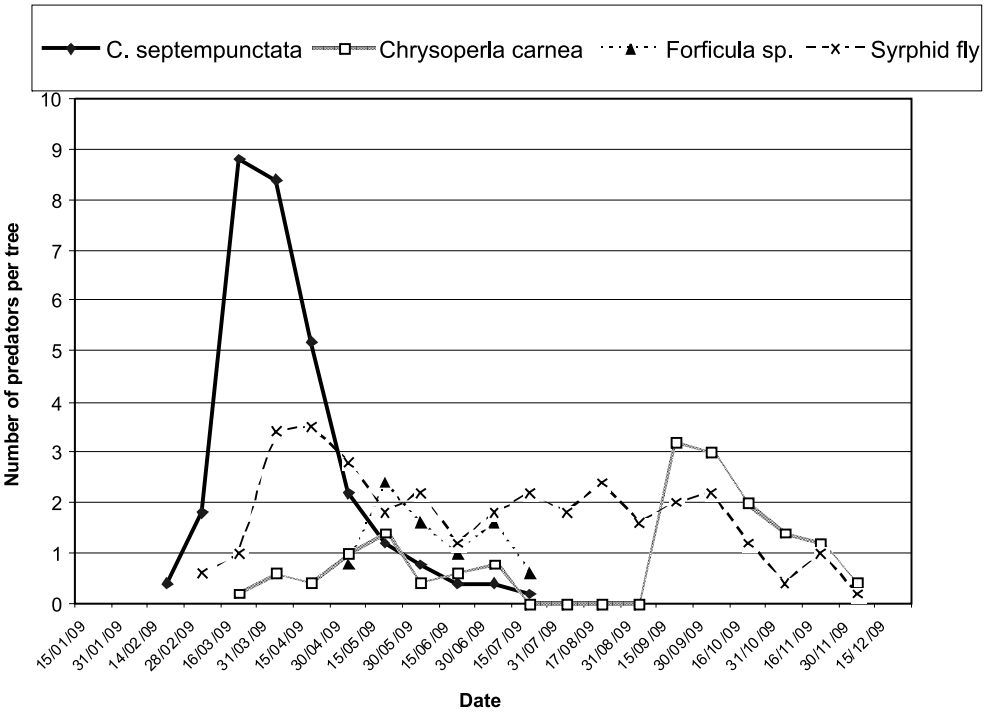

Fig. 2. Population dynamics of predators on apple tree during 2009

started attacking *E. lanigerum*. With the increase in temperature, population of *E. lanigerum* also increased (Gautam and Verma, 1983) but in our studies *C. septempunctata* population decreased with onset of summer. Singh (2003) reported that the consumption of woolly aphid by the coccinellid grubs uniformly decreased with increase in size of woolly aphid at all stages of the grub.

Appearance of the syrphids started from February during 2008 and 2009, which was 15 days after that of *C. septempunctata*. During 2008, its peak activity was observed in September, whereas in 2009 it was in March and April. Present findings revealed the dominance of syrphid predators up to November. Thakur and Pawar (1986) observed that *Eupeodes confrater* was more abundant and apparently an important natural enemy of *E. lanigerum* in Himachal Pradesh.

Chrysoperla carnea was another important predator observed, during 2008, its activity started from the beginning of April and its peak was in September and October, while in 2009, its activity started from mid March and had only one peak in September. This predator had two peak activity periods one before and another after rainy season. Before rainy season, its population fluctuated around 1 predator/tree but after rainy season it reached up to 3 per tree. Hence, activity of *C. carnea* was dominant in September and October. Oresek *et al*. (2004) reported its maximum population in July at Slovenia. Whereas, Thakur *et al*. (1988) observed that the larvae of *Syrphus confrater* and *Chrysopa scelestes* destroyed all the aphid colonies during August. *C. carnea* was followed by the earwig, *Forficula auricularia*, and it was a dominant predator during May and June. During 2008, its activity started in the beginning of April, while in 2009 it was recorded from end of April to beginning of May. Its peak activity was noted from May to June during both the years, and drops immediately on the onset of the rainy season (Figs. 1 and 2). Nicholas *et al*. (2005) found *F. auricularia* as a principal control agent of *E. lanigerum* under IPM programme in apple orchard. Presence of the hemipetran predators like anthocorids though was very less, was very efficient. Almatni *et al*. (2002) observed *Deroeocoris punctulatus* as a common predator of woolly apple aphid.

It was concluded that predation by the *C. septempunctata* depends on the density of *E. lanigerum*, and it played an important role at initial stages, in the spring season when aphid population was not so high, but with increase in aphid population, its population decreased. In the summer season, *F.*

auricularia, *C. carnea* and syrphids were the important predators. *C. carnea* and syrphids were also present in numerous numbers from August to October. Thus, *C. septumpunctata*, *C. carnea* and syrphids had the greatest potential as biological control agents against apple woolly aphid in the mid hill apple orchards of Bharsar.

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