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Predatory complex of phytophagous mites and their role in integrated pest management in apple orchard

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ABSTRACT

Predatory complex of phytophagous mites, their diversity, abundance, predatory potential and their role in integrated mite management (IPM) in apple orchards was studied. Two species of predatory mites *viz.*, *Amblyseius fallacis* A-H and *Zetzellia mali* (Ewing); one species of black coccinellid beetle, *Stethorus punctum* Le Conte; a mirid, *Chrysoperla* spp. ; anthocorid bug, *Orius* spp; the black hunter thrip, *Leptothrips mali* (Fitch) and various species of spiders were recorded feeding on phytophagous mites. Predatory mites were the most abundant species. The black coccinellid beetle was the next most predominant species. *Amblyseius fallacis* consumed 2.0 and *Stethorus punctum* 12-18 European red mites per day. Population of phytophagous mites remained high in orchards heavily sprayed with insecticides adults, whereas predatory mites population was highest in orchards receiving zero insecticidal applications. Stoppage of insecticidal applications resulted in a rise of predacious mite populations, which in turn brought decline in spider mite populations.

Key words: Predatory complex, predator, Phytophagous mites, European red mite, two spotted red mite

INTRODUCTION

Phytophagous mites species *Panonychus ulmi* (Koch), the European red mite and T*etranychus urticae* (Koch), the two-spotted red spider mite are the key pests of apples in Himachal Pradesh (Khajuria and Sharma, 1996). World over, large number of predatory organisms have been reported to be associated with phytophagous mites which keep their populations under control in apple ecosystem (Childers and Enns, 1975; Horton *et al.*, 2002). Among these, predatory mites are considered as the most important as they are able to feed on alternate sources of food and can survive even in the absence of spider mites (Overmeer, 1985). In India, Thakur and Dinabandhoo (2005) identified some of the species of predatory mites on apple. Spray of insecticides in apple orchards has often been attributed to alter the delicate predator mite dynamics resulting in their outbreak (Mansour, 1990). In India there is no information available on the predatory complex of phytophagous mites, their predatory potential and role in integrated mite management in apple orchards, therefore the present studies were under taken.

MATERIALS AND METHODS

Studies on predatory complex of phytophagous mites, their diversity and abundance were studied on 10 randomly selected apple trees at the university orchard at Bajaura from March 1998 to December 2000. In each tree, a sample of 20 leaves was taken fortnightly and the natural enemies were counted, while coccinellids and spiders were observed by examining the branches for three minutes under each tree. For studying the predatory potential of various predators under laboratory conditions, different species of predators were collected from the field and kept over night inside glass vials. Next morning each adult predator was released on apple leaf having counted number of European red mite adults spread over a moist cotton swab in a Petri dish. The no of European red mites devoured by a predator were counted after 24 hours. The experiment was continued for ten days and repeated thrice. In order to study the role of predators in managing spider mite populations in apple ecosystem, orchards with history of heavy application of insecticides (2 - 4 application of insecticides), moderate to low application of insecticides (1- 2 application of insecticides) and zero application of insecticides were observed fortnightly for population of phytophagous mites and their natural enemies by the same method as mentioned above for three years from 1998-2000 at Raison, Naggar and Bajaura areas of Kullu valley. During 1999 in another experiment insecticides application was stopped in a orchard with history of regular sprays of insecticides and observations for predatory and spider mite populations were made for two years to study the effect on phytophagous and predatory mite populations in an experimental set up.

Table 1. Population of natural enemies of phytophagous mites in apple orchards at Kullu (Mean data of three years)

Month	Average/leaf				Average/ minute		Average/ month
	Predatory mites	Predatory thrip	Chrysopids	Anthocorids	Coccinelids	Spiders	
April	0.17	0.15	0.37	0.1	0.0	0.11	0.15
May	0.53	0.1	0.29	0.16	0.19	0.17	0.24
June	1.37	0.0	0.03	0.0	0.14	0.02	0.26
July	1.8	0.04	0.31	0.03	0.5	0.33	0.49
August	1.91	0.3	0.38	0.17	0.71	0.64	0.68
September	1.42	0.13	0.16	0.12	0.26	0.26	0.39
October	0.38	0.0	0.0	0.0	0.03	0.02	0.07
November	0.05	0.0	0.0	0.0	0.01	0.0	0.008
%	54.7	5.6	10.74	4.52	13.09	11.27	

RESULTS AND DISCUSSION

Eight different species of predators were identified feeding on spider mites on apple with maximum population during July to September (Table 1). The eight species recorded were black coccinellid beetle, *Stethorus punctum* Le Conte; mirid, *Chrysoperla* spp; predatory thrips, *Leptothrips mali* (Fitch); anthocorid bug, *Orius* spp; predatory mites, *Amblyseius fallacis* A-H., *Zetzellia mali* Ewing and various species of spiders. Predatory mites were the most abundant predator, which remained associated with spider mites throughout the season for eight months i.e. from April to November with peak population in July, August. They remained on the apple tree even when the host population was low and survived on pollen as alternate source of food. The predatory mite, *A. fallacis* was very efficient predator as it consumed 2 adults, 4-5 protonymphs, 5-6 deutonymphs and 8-10 larvae of the European red mite per day under laboratory conditions (Table 2). Black Coccinelid, *Stethorus punctum* was the next most predominant species, which remained, associated with phytophagous mites from May-November. This coccinellid was very efficient predator as its adult consumed 12-18 adult spider mites per day under laboratory conditions. However it was seen to migrate from the apple tree as soon as the prey mite population declined. The Chrysopids, was the third most frequent predator. The population of anthocorid bug, *Orius* spp and predatory thrips, *L. mali* remained low and decreased with decrease in prey mite populations. However both the species are highly efficient predators (Table 2). Various types of unidentified species of spiders have been recorded feeding on mite colonies by weaving nets for catching their prey. These spiders, however, did not feed on the mites in captivity under laboratory conditions. In India, Thakur and Dinabandhoo (2005) reported *Euseius finlandicus* and *Neoseiulus longispinosus* in temperate zone of Himachal Pradesh. These species were not

Table 2. Predatory potential of various natural enemies of phytophagous mites.

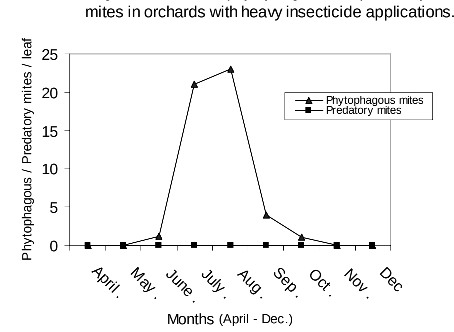
Name of the predator	Stage of the prey	Number consumed per day.	
		Mean ± SD	Range
Predatory mite (Adult) *Amblysius fallacis*	Larvae	9.0 ± 0.89	8 – 10
-	Protonymph	4.3 ± 0.45	4 -5
-	Deutonymph	5.5 ± 0.5	5 - 6
-	Adult	2.0 ± 0.0	2.0
Black coccinellid beetle (Adult) *Stethorus punctum*	Adult	15.1 ± 4.09	12 - 18
Predatory thrips (Adult) *Leptothrips mali*	Adult	10.9 ± 0.69	10 – 12
Anthocorid bug (Adult) *Orius* spp	Adult	10.6 ± 1.64	8 - 10

Table 3. Population of natural enemies in apple orchards with zero, heavy and moderate application of insecticides (mean data of three years).

Months	Population/leaf/month								
	Zero insecticide application			Moderate insecticide (1-2 in a season)			Heavy insecticide (2-3 in a season)		
	Spider mites	Predatory mites	Other predators	Spider mites	Predatory mites	Other predators	Spider mites	Predatory mites	Other mites
April	0.01	0.16	0.19	0.03	0.05	0.66	0.23	0.0	0.03
May	0.31	0.49	0.03	0.47	0.21	0.53	1.28	0.0	0.0
June	1.32	1.47	0.0	7.27	0.30	0.25	5.9	0.0	0.0
July	3.2	1.67	0.03	9.01	0.25	0.3	28.1	0.05	0.0
Aug.	1.47	1.83	0.06	1.73	0.31	0.0	38.7	0.04	0.03
Sep.	0.65	1.03	0.03	0.46	0.15	0.08	10.5	0.006	0.0
Oct.	0.27	0.4	0.0	0.55	0.08	0.0	2.34	0.0	0.0
Nov.	0.21	0.07	0.0	0.21	0.01	0.0	0.43	0.0	0.0

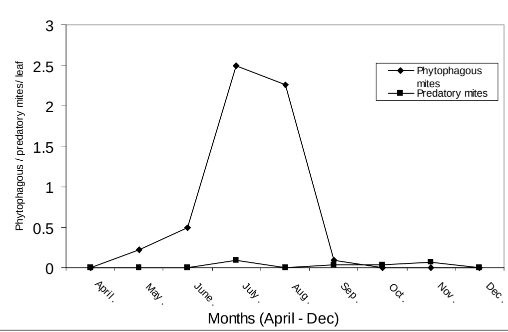
encountered in the present study. All the above mentioned predators in this study have also been found associated with apple in Missouri, USA (Childers and Enns, 1975). Horton *et al.* (2002) also reported predatory spiders in apple orchards in Washington, USA. Similarly predatory mite, *Amblyseius fallacis and Zetzellia mali* are being used against European red mite in China and Canada (Wang *et al.*, 1990 and Villanueva and Harmsen, 1998), because they are very efficient and are able to survive on alternative food under low prey densities (Herbert and Sanford (1969). Efficiency and use of black cocci nellid beetle, predatory thrips and anthocorid bug has been well demonstrated against the European red mite in USA (Hull *et al.*, 1976 and Parella *et al.*, 1980).

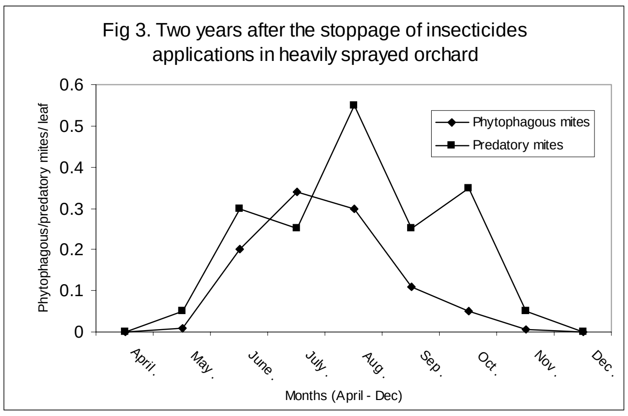
Fig 1. Interaction of phytophagous and predatory mites in orchards with heavy insecticide applications.



The population of phytophagous mites was the highest in orchards receiving heavy insecticide application as low populations of predatory mites in these orchards failed to check their populations (Table 3). Whereas, orchards receiving moderate insecticide applications, population of phytophagous mites remained moderate because of the appreciable population of predatory mite and other predators observed in this category. In apple orchards receiving zero insecticide application, the predatory mite population was the highest (0.07 – 1.83/leaf) along with other predator as a result the populations of phytophagous mites was kept under control. In heavily sprayed orchards where the application of insecticide was stopped, an increase in the population of predatory mites was observed one year later (Fig. 1 and Fig.2.). Two years after the stoppage of spraying of insecticides enormous increase in the population of predatory mite was observed resulting in complete control of the spider mite populations in such orchards (Fig. 3). Present finding are in agreement with those of Mansour (1990) and Hardman *et al.* (1995), who reported high population of phytophagous and low population of predatory mites in insecticide sprayed apple orchards. Whereas Hislop and Procopy (1979) observed great diversity and more population of predatory mites in abandoned apple orchards, similar to the zero application orchards in the present study.

Fig 2. one year after stoppage of insecticides applications in heavily sprayed orchard.





From the study it can be concluded that predatory mites are most important predators that decide the population of mites in an apple orchard. In case an insecticide spraying is stopped in orchards receiving insecticides earlier than predatory mites reappear within 2-3 years and can provide biological control of the phytophagous mites in these orchards again.

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