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Effect of different release rates of predatory mite *Phytoseius domesticus* in the control of European red mite, *Panonychus ulmi* (Koch) on apple in Kashmir

A. Q. RATHER and RAZIA BANO

S. K. University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar 191121, Jammu and Kashmir, India.

ABSTRACT: **Investigations were undertaken to study the effect of releases of predatory mite, *Phytoseius domesticus* @ 9, 18 and 27/plant on the population suppression of European red mite *Panonychus ulmi* (Koch) on apple (cv. Red delicious) in early summer. An individual predatory mite consumed an average of 208.15 eggs and 240.45 motile stages of European red mite during its life cycle on the leaf disc assemblies in the laboratory. The feeding capacity thus proved it to be a good predator. Field studies indicated that the population of *P. ulmi* significantly declined in release plots as compared to control. It was 37.77 mites/leaf in control and 23.72, 8.83 and 3.84 after 30th day of release of predatory mites @ 9, 18 and 27, respectively. The population of predatory mites was in the ascending order, being 0.83, 2.43 and 3.99 mites /leaf with the release of 9, 18 and 27 mites/plant, respectively.**

KEY WORDS: Apple, biocontrol, *Panonychus ulmi*, *Phytoseius domesticus*, releases.

INTRODUCTION

Among fruits, apple (*Malus domestica* Borkh) is economically very important and a good source of vitamins and minerals. It is produced on a major scale in China, USA, Poland, Iran, Turkey, Russia, Germany, and India (FAO, 2006). India produces 14,70,000 metric tons of apple from 2,50,000 hectares (FAO, 2006), mostly from Jammu & Kashmir, Himachal Pradesh, Utarakhand and Andhra Pradesh. However, the productivity is low and the quality of apple is poor in India compared to those produced in other countries, because of various constraints including diseases, insect pests and mites. Nineteen species of phytophagous mites regularly occur on apple trees, of which chiefly *Panonychus ulmi* (Koch) inflicts heavy loss and at times causes total crop failure through its desapping activities. The indiscriminate use of broad spectrum pesticides, particularly carbamates and organophosphates, has been the main cause of out break of *P. ulmi* populations. Any long term commitment to a purely chemical approach is unsatisfactory and this has necessitated focusing research on other methods, especially biological control. A complex of predatory mites distributed among nine families devours spider mites, the genus *Phytoseius* of family Phytoseiidae being of the greatest importance. They have proved to be effective predators of European red mite, *P. ulmi* and other phytophagous mites in many diverse crop systems such as strawberries (Oatman, 1966), apples (Hoyt, 1969) and in green houses (Hussey *et al.*, 1965).

The present investigations were, therefore, undertaken to record the predatory potential of *Phytoseius domesticus* in the laboratory and study the effect of its releases in different numbers on the population of European red mite infesting apple (cv. Red delicious) during summer at SKUAST-K, Shalimar, during 2002-2003.

MATERIAL AND METHODS

The mites for the study were obtained from cultures of *P. ulmi* and *P. domesticus* maintained on leaf disc assemblies in the laboratory. The consumption rate of the predatory mite was studied using leaf discs with known number of eggs and motile stages of *P. ulmi* placed on wet cotton wad in petridishes. A larva was provided with 5 eggs and 5 motile stages/day which was doubled at each subsequent stage. For field evaluation, 36 apple plants (growing in soil) free from any infestation (cv. Red delicious) of uniform age, size and vigour were selected randomly from central rows of nursery as per randomized block design (RBD). There were 4 treatments (P0-P3) replicated thrice and every treated plant was separated by two buffer plants on each side. The recommended agricultural practices were followed except pesticide sprays were stopped. These plants were enclosed in muslin cloth cages to prevent the entry of insects or mites or their natural enemies. Eighteen female deutonymphs (diapausing) and adult males of European red mite in 1:2 ratio were isolated from infested apple leaves collected from apple orchard using a stereo-binocular microscope in the laboratory and transferred to a plastic drinking straw with one end closed by a thread. To each plant, three such straws were tied, one each at basal, middle and terminal level of the plant to initiate mite infestation on the plant by infesting each caged plant with 54 mites in summer. The straws were cut at the basal end after tying with the plant. The population was well established on the plants within 20 days of infestation.

After 20 days, the deutonymph females and males of *P. domesticus* at 2:1 ratio were released on the same apple plants following the same method as for *P. ulmi*. The plants numbered in treatment (P0) received no predatory mites and were kept as control, while the plants in treatment P1 received 9 predatory mites (three per canopy level), the plants in treatment P2 received 18 predatory mites (6 per canopy level) and those in treatment P3 received 27 predatory mites (9 per canopy level). The population of predatory mites got well established on the plants within 10 days after release. Observations were recorded on 30th, 40th and 50th day after infestation (DAI) of ERM and 10th, 20th and 30th day after release (DAR) of the predatory mite. The number of eggs and motile stages recorded on 6 leaves/replication collected randomly (2/level) were recorded under a stereo-binocular microscope by direct counting. The data on mean population per leaf was analyzed using analysis of variance technique (Snedecor and Cochran, 1967). The values recorded in release and control treatments were compared by using the least significant difference ($p<0.05$).

RESULTS AND DISCUSSION

Feeding potential of *P. domesticus* All the post-embryonic stages of the predatory mite were found feeding on different stages of European red mite. An individual mite consumed a total of 208.15 eggs and 240.45 motile stages during its life cycle in the laboratory. A larva required 4.50, protonymph 11.70, deutonymph 15.60 and an adult consumed a total of 415.80 different stages of the mite. The feeding capacity indicates this is a good predator. (Table 1)

Effect of releases of predatory mite upon European red mite

The population build of motile stages of ERM on apple plants increased with the increase in infestation period (Table 2). Observations recorded 10 days after release (18th June) of predatory mites revealed significantly higher population of ERM in P0 (13.65 mites, 36.10 eggs /leaf) than release treatments. Treatments P2 and P3 were on par but differed significantly from P1. The population of ERM reached 29.33 mites and 45.76 eggs /leaf in P0 on 28th June (20 DAR) while during the same period only 19.27 mites and 30.84 eggs / leaf were recorded

Table 1. Feeding potential of the predatory mite *Phytoseius domesticus* in the laboratory

Stage of predatory mite	Number of *P. ulmi* consumed by single individual		
	Eggs	Motile stages	Total
Larva	3.60*±0.70	0.90±0.36	4.50
Protonymph	5.95±0.90	5.75±1.95	11.70
Deutonymph	7.25±1.85	8.35±1.15	15.60
Adult	190.35±40.15	225.45±38.56	415.80
Total	208.15±40.30	240.45±38.50	447.60

* mean of five observations

Table 2. Effect of predatory mite, *Phytoseius domesticus* released during early summer (June-July) on the population build up of *Panonychus ulmi*

Days after release	Treatments/population of ERM									
	Eggs				Mean	Motile stages				Mean
	P0	P1 (9)	P2 (18)	P3 (27)		P0	P1 (9)	P2 (18)	P3 (27)	
10 (D1)	36.10	23.11	18.60	15.66	23.36	13.65	10.60	5.99	4.44	8.67
20 (D2)	45.76	30.84	23.15	19.33	29.77	29.33	19.27	15.49	12.60	19.17
30 (D3)	51.27	35.48	23.61	15.67	31.51	37.75	23.72	8.84	3.83	18.53
Mean	44.38	29.81	21.78	16.88	——	26.91	17.86	10.11	6.96	——

	C.D	
	Eggs	Motile stages
Treatments (P)	10.94	6.63
Days (D)	9.48	5.74
Treatments x Days (P x D)	18.96	11.48

in P1 followed by 15.49 motile stages and eggs, 23.15 in P2 and 12.60 adults and 19.33 eggs in P3, respectively. The release treatments carried significantly lower population than control and differed significantly from one another on the 30th day (18th July) after release of predatory mites. The treatments P1 (23.72 motile stages and 35.48 eggs / leaf) higher than P2 (8.83, 23.61) and P3 (3.83 mites, 15.61 eggs /leaf) had progressively lower populations of motile stages and eggs of ERM, in that order. However P3 and P2 were on par in respect of motile stages but carried significantly lower population than P1 and control (P0). P0 harboured the peak population (37.77 mites, 51.27 eggs/leaf).

Populations build up of *Phytoseius domesticus*

The data recorded after 10 days intervals indicated highest number of motile stages and eggs in the treatment P3 followed by P2 and P1 (Table 3). On the 10 DAR, P1 carried 0.34, 1.00; P2 0.77, 1.16 and P3 2.15 and 1.42 motile stages and eggs per leaf, respectively. P3 showed significantly higher population than P1 and P2 which were on par with another. However on 20th and 30th days after release, the treatments P3 and P2 carried significantly higher

Table 3. Population build up of predatory mite *Phytoseius domesticus* during early summer (June-July)

Days after release	Treatments/population of predatory mites							
	Eggs			Mean	Motile stages			Mean
	P1 (9)	P2 (18)	P3 (27)		P1 (9)	P2 (18)	P3 (27)	
10 (D1)	1.00	1.16	1.42	1.19	0.34	0.77	2.15	1.08
20 (D2)	1.49	3.23	6.21	3.64	0.98	3.16	4.60	2.91
30 (D3)	2.55	3.87	4.87	3.77	1.17	3.37	5.24	3.26
Mean	1.68	2.75	4.17	——	0.83	2.43	3.99	——

	C.D	
	Eggs	Motile stages
Treatments (P)	0.33	0.15
Days (D)	0.33	0.15
Treatments x Days (P x D)	0.57	0.26

population of predatory mites than P1. On the 30th DAR, P3 maintained maximum population (5.24, 4.87/ leaf) more than P2 (3.37 and 3.87/leaf) and P1 had the least population (1.17 motile stages, 2.55 eggs / leaf).

These studies indicated significant differences in the mite populations between released and control plants as found earlier by Oatman *et al.* (1977b). High prey densities probably disturbed the phytoseiid predator in the treatment P1 resulting in decrease of its functional and numerical response as found by Mori and Chant (1966) and Mori (1969). The phytoseiids were very active in P3 and P2 treatments, since a decrease of 16.80 and 19.95 motile stages/leaf was observed respectively, exerting a satisfactory check over control to the extent of 56.68 to 74.20 percent. Predator: prey ratio of 1:6.7 to1:11 resulted in satisfactory to good biological control.

During the present course of investigations, low ERM population was witnessed during early summer, which was ideal for the release of predatory mites as concluded by Oatman (1976) in his studies. Avilla *et al.* (1993) reported that peak population of *Amblyseius andersoni* ranged from 0.3 to 2.8 mites / leaf while Prischmann *et al.*, (2002) found that *T. pyri* peaked at 0.69±0.13 / leaf in July 1998 but during the year 1999 densities were highest in June with a medium value of 0.73 ± 0.8/ leaf. In the present studies under undisturbed environment, the population of predatory mite *P. domesticus* ranged between 0.83 and 3.99 / leaf.

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