International Journal of Entomology Research
ISSN: 2455-4758; Impact Factor: RJIF 5.24
www.entomologyjournals.com
Volume 1; Issue 7; November 2016; Page No. 01-04

Diversity and distribution of mite fauna (Class: Arachnida) associated with mountain fruit crops in Shimla hills of Himachal Pradesh

VK Mattu, * Romila Devi

Sociobiology and Behavioral Ecology Research Laboratory, Himachal Pradesh University Shimla, Himachal Pradesh India

Abstract
Present studies were carried out for the incidence of mites on mountain fruit crops in different localities of Shimla hills of Himachal Pradesh during the year 2009-2010. A total of 21 species of mites belonging to 12 genera spread over 9 families under 3 orders were documented. Of these, 14 species were predatory (66.6%), 5 phytophagous (23.8%), one saprophytic (4.76%) and one species encountered was phoretic and pollen feeder (4.76%). Mite pests of fruit crops comprised 9 species of prostigmatic mites of different feeding habits, 11 species of mesostigmatic mites, predatory in nature and one species of astigmatic mites which were saprophytic in nature. Family Phytoseiidae was the most dominating with 10 species and constituted (47.61%) of the predatory fauna, followed by family Stigmaeidae and Tydeidae each contributing (4.76%) with one species each. Family Cheyletidae and Raphignathidae each was represented by a single mite species contributing (4.76%). One phoretic mite representing family Ameroseiidae contributed (4.76%).
Cropwise analysis revealed that 5 phytophagous, 11 predatory, one saprophytic and one phoretic species were found associated with apple; whereas one phytophagous and 2 predatory species were found associated with apricot, 6 predatory species were found on peach; 4 phytophagous, 6 predatory and one phoretic species were present on pear; 2 phytophagous, 5 predatory only one phoretic and one saprophytic species showed their presence on plum.

Keywords: mite, phytophagous, phytoseiidae, predatory, mesostigmatic, himachal pradesh

1. Introduction
Mites belong to class Arachnida of phylum Arthropoda. Mites are possibly one of the most common groups of arthropods to be found in any conceivable habitat. The mite problem in agriculture has gained further importance because many of the plant mites earlier considered to be innocuous are becoming major pests due to random and indiscriminate use of chlorinated hydrocarbons which kill the natural enemies of mites. Development of resistance and cross resistance has aggravated the problem still further [1, 2]. Mite cause serious damage to live stock, agricultural crops, fruit crops, ornamental plants and stored products [3]. There are some species of mites which are beneficial to mankind and predate upon phytophagous and other harmful species, thereby playing an important role in bio control programmes [4, 5, 6]. Mites and insects are the most important and significant pests of crops and plantations causing serious crop losses both in terms of quantity and quality of the produce [7, 8, 9, 10]. Keeping this in view, an attempt has been made to study the diversity and distribution of mite fauna from Shimla hills of Himachal Pradesh.

2. Materials and Methods
2.1 Study Area
Himachal Pradesh is mainly a hilly state lying between 33°22′ to 33°12′ North latitude and 75°47′ to 79°04′ East longitude in the lap of the Northwest Himalayas. The physiography of Himachal Pradesh is almost mountainous with elevations ranging from 350 to 6500 metres above mean sea level and the total area of the state is 55,673 sq. km. Its northern border is bounded by Tibet, whereas, in the Northwest, it has a common border with Kashmir and the eastern border of the state is common with the hills of Uttarakhand. The temperature in the state varies according to elevation [11, 12]. Shimla capital town of Himachal Pradesh bounded by Mandi and Kullu in North, Kinnaur in the East the State of Uttarakhand in the South, Sirmour Distirct in the West. Shimla is located in North Western Ranges of Himalayas. Periodic surveys for the incidence of mites were carried out in different localities of Shimla hills of Himachal Pradesh having different altitudes and climatic conditions. 5 different fruit crops viz; apple**,** apricot, peach, pear and plum were selected for these studies. Samples were collected from Kotkhai (1720m), Kharapathar (2680m), Jubbal (1904m), Hatkoti (1439m), Sarswatinagar (1530m), Rohru (1576m), Samoli (1531m), Seema (1635m), Badiyara (1676m), Mandli (1737m), Masli (1741m), Chirgaon (1890m), Sandhasu (1825m), Tikkri (1951m), Dhamwari (2012m), Larot (2438m), Andhra (1920.24m), Gushali (2011.68m) and Jabal (2286m) areas of Shimla hills.

2.2 Collection of mite specimens
Random samplings were done in order to collect mite specimens. For the purpose of collection of mites, samples of infested leaves were collected. Leaves were brought to the laboratory in the individual labelled polythene bags. The leaves were then examined under a stereo binocular microscope in the laboratory. Mites were directly picked up from the leaves with the help of a needle or a camel hair brush. The plant mites collected were preserved in the Oudeman's fluid for clearing, specimens were then transferred to lactophenol. After clearing, the mites were then mounted in Hoyer's medium. Identification of mites was done with the help of authentic literature.

3. Results and Discussion

Present studies revealed a total of 21 species of mites belonging to 12 genera spread over 9 families under 3 orders. Of these, 14 species were predatory (66.6%), 5 phytophagous (23.8%), one saprophytic (4.76%) and one species encountered was phoretic and pollen feeder (4.76%). Mite pests of fruit crops comprised 9 species of prostigmatic mites of different feeding habits, 11 species of mesostigmatic mites, predatory in nature and one species of astigmatic mites which were saprophytic in nature (Table 1, Fig.1). Further studies revealed that among predatory species, family Phytoseiidae was the most dominating with 10 species and constituted (47.61%) of the predatory fauna, followed by family Stigmaeidae and Tydeidae each contributing (4.76%) with one species each. Family Cheyletidae and Raphignathidae each was represented by a single mite species contributing (4.76%). One phoretic mite representing family Ameroseiidae contributed (4.76%). Similarly, phytophagous mites were represented by two families viz; Tetranychidae and Tenuipalpidae. Family Tetranychidae contributed 3 species (14.28%), family Tenuipalpidae was represented by 2 species (9.52%) single saprophytic species, belonged to family Acaridae (4.76%) (Table 1, Fig.1). The above data thus revealed that among phytophagous mites, family Tetranychidae was the most dominating one. Cropwise analysis revealed that 5 phytophagous, 11 predatory, one saprophytic and one phoretic species were found associated with apple; whereas one phytophagous and 2 predatory species were found associated with apricot, 6 predatory species were found on peach; 4 phytophagous, 6 predatory and one phoretic species were present on pear; 2 phytophagous, 5 predatory only one phoretic and one saprophytic species showed their presence on plum (Table 2, Fig. 2).

Similar studies have been conducted by some earlier investigators in different parts of the country [13] recorded 40 mite species belonging to 2 genera from different fruit crops like apple, pear, plum, peach, guava, citrus etc. in Punjab and Himachal Pradesh. [14] Have also listed 106 phytophagous mites under family Tetranychidae and of these 19 species were reported from the Northwest Himalayas and 15 species from Himachal Pradesh. Similarly, [15] reported 62 species of phytophagous mites and 56 species of predaceous mites associated with various agricultural and horticultural crops from Punjab. [16] revealed a total of 46 species of mites belonging to 24 genera spread over 13 families under 3 orders of these 28 species were predatory (60.87%), 14 phytophagus (30.44%), 3 saprophytic (6.52%) and one species encountered was phoretic and pollen feeder (2.17%) on various fruit crops like apple, almond, apricot, pear, plum, peach, cherry and kiwi in Himachal Pradesh. Recently, [17] were studied the seasonal variation population dynamics of *Panonychus ulmi* and *Amblyseius (Eusieus) pruni* or diversity of phytophagous and predatory mites in Kullu district of Himachal Pradesh. During recent years, the problem posed by Tetranychid mites like *Panonychus ulmi* and *Panonychus citri* gained more attention in most apple growing areas of the country, especially in Himachal Pradesh. Earlier, [18] and [19, 20, 21] reported an epidemic outbreak of *Panonychus ulmi* in apple orchards of Shimla hills of Himachal Pradesh. Present studies thus suggested an immediate need for the control of Tetranychid mites including *Panonychus ulmi* in various parts of Himachal Pradesh.

Table 1: Mite fauna associated with fruit crops in Shimla hills

Order: Prostigmata	Order: Mesostigmata	Order: Astigmata
Family: Cheyletidae 1. *Cheyletus sp.*	**Family: phytoseiidae** 10. *Amblyseius* (*Amblyseius*) sp. 11. *Amblyseius* (*Euseius*) *delhiensis* (Narayanan and Kaur) 12. *Amblyseius* (*Euseius*) *finlandicus* (Oudemans) 13. *Amblyseius (Amblyseius) paraaerialis* Muma 14. *Amblyseius (Neoseilus) indicus* (Narayan and Kaur) 15. *Amblyseius(Amblyseius) herbicolus* (Chant) 16. *Amblyseius* (*Euseius*) *pruni* Gupta 17. *Phytoseius* (*Phytoseius*) *neocorniger* Gupta 18. *Typhlodromus* (*Orientiseius*) *pruni* Gupta 19. *Typhlodromus (orientiseius) himalayensis* Gupta	**Family: acaridae** 21.*Tyrophagus longior* (Gervais)
Family: Tenuipalpidae 2. *Brevipalpus calfornicus* (Banks) 3. *Brevipalpus lewisi* McGregor		
Family: Raphignathidae 4. *Raphignathus* sp.		
Family: Tetranychidae 5. *Panonychus ulmi* (Koch) 6. *Tetranychus ludeni* Zacher *7. Tetranychus* sp.		
Family: Tydeidae 8. *Lorryia* sp.	**Family: Ameroseiidae** 20. *Neocypholaelaps indica* Evans	
Family: Stigmatidae 9. *Agistemus* sp.		

Table 2: Different fruit crops with associated mite fauna

S. No.	Crop / Mites	Phytophagous Mites	Predatory Mites	Saprophytic Mites	Phoretic Mites
1.	**Apple**	**Family:Tenuipalpidae** *Brevipalpus californicus* *Brevipalpus lewisi* **Family:Tetranychidae** *Panonychus ulmi* *Tetranychus ludeni* *Tetranychus* sp.	**Family: Phytoseiidae** *Amblyseius* (*Euseius*) *finlandicus* *Amblyseius* (*Euseius*) *pruni* *Amblyseius delhiensis* *Amblyseius indicus* *Amblyseius herbicolus* *Amblyseius paraerialis* *Amblyseius* sp. *Typhlodromus* (*Orientiseius*) *pruni* *Typhlodromus himaleyensis* **Family:Cheyletidae**	**Family: Acaridae** *Tyrophagus longior*	**Family:Ameroseiidae** *Neocypholaelaps indica*

			Cheyletus sp. **Family:Raphignathidae** *Raphignathus* sp. **Family:Stigmaeidae** *Agistemus* sp. **Family: Tydeidae** *Lorriya* sp.		
2.	**Peach**		**Family: Phytoseiidae** *Amblyseius* (*Euseius*) *finlandicus* *Amblyseius herbicolus* *Amblyseius paraerialis* *Amblyseius* (*Euseius*) *pruni* *Amblyseius* sp. *Typhlodromus* (*Orientiseius*) *pruni*	--	--
3.	**Pear**	**Family: Tenuipalpidae** *Brevipalpus californicus* **Family:Tetranychidae** *Tetranychus* sp. *Tetranychus ludeni* *Panonychus ulmi*	**Family: Phytoseiidae** *Amblyseius* (*Euseius*) *delhiensis* *Amblyseius* (*Euseius*) *pruni* *Amblyseius* (*Amblyseius*) sp. *Amblyseius* (*Euseius*) *finlandicus* *Typhlodromus* (*Orientiseius*) *pruni* **Family: Tydeidae** *Lorriya* sp.		**Family: Ameroseiidae** *Neocypholaelaps indica*
4.	**Plum**	**Family:Tetranychidae** *Tetranychus* sp. *Tetranychus ludeni*	**Family: Phytoseiidae** *Amblyseius* (*Euseius*) *delhiensis* *Amblyseius* (*Euseius*) *pruni* *Amblyseius* (*Euseius*) *finlandicus* *Typhlodromus* (*Orientiseius*) *pruni* *Phytoseius neocorniger*	**Family: Acaridae** *Tyrophagus longior*	**Family: Ameroseiidae** *Neocypholaelaps indica*
5.	**Apricot**	**Family: Tetranychidae** *Panonychus ulmi*	**Family: Phytoseiidae** *Amblyseius* (*Euseius*) *pruni* *Amblyseius* (*Euseius*) *finlandicus*	--	--

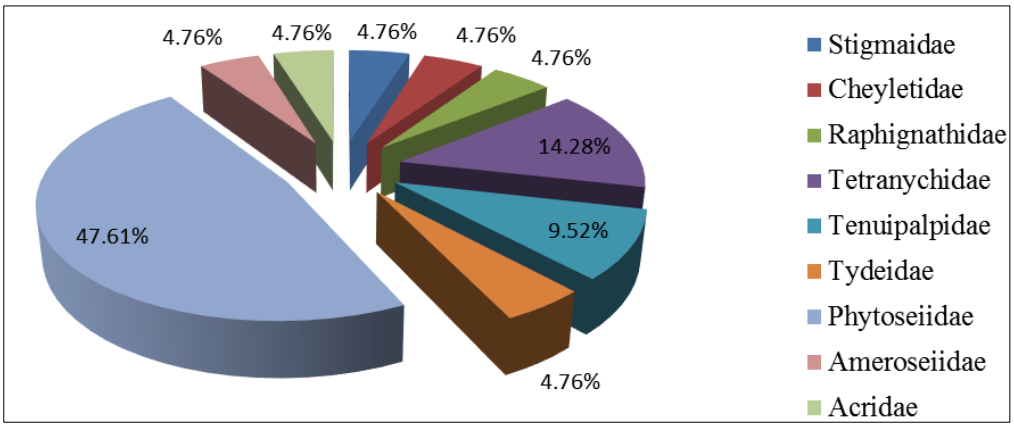

Fig 1: Percentage contribution of different families of mites in Shimla hills

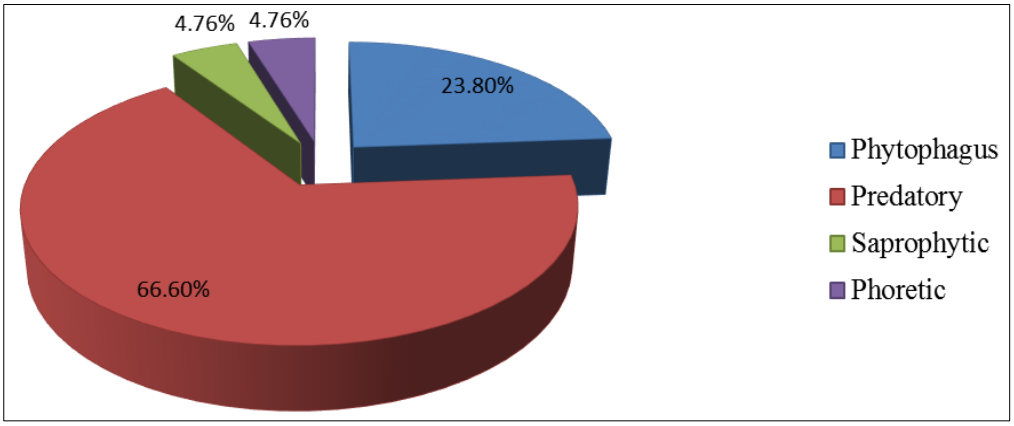

Fig 2: Percentage contribution of mite species to the acarine fauna in Shimla hills

4. Conclusion

It is clear from the present study that there is a need for the vast exploration of mites. Strategy should be developed for the management and control of injurious or phytophagous fruit mites.

5. Acknowledgement

The authors are thankful to the Chairperson Department of biosciences, Himachal Pradesh University Shimla, for providing necessary research facilities and encouragements.

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