



Research Article

Record of prostigmatid predatory mites from Himachal Pradesh

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ABSTRACT: A survey was conducted to study the prostigmatid predatory mites in different agro climatic zones of Himachal Pradesh. Plant samples collected from agriculturally important crops showed presence of predatory mites belonging to five families and six genera. Eight species, viz., *Agistemus* sp. nr. *edulis*, *A. industani* Gonzalez-Rodriguez, *A. javanicum* Gupta, *A. lakoocha* Gupta, *Pronematus sextoni* Baker, *Paraerythraeus delhiensis* Khot, *Tydeus gossabaensis* Gupta and *T. ornamentalicus* Gupta was reported for the first time from Himachal Pradesh. Distribution of prostigmatid predatory mites revealed that they were more diverse in Zone-I and Zone-II, whereas in Zone-III and IV unrelated species were recorded. *P. sextoni* established as dominant (15.90) species in the entire collection followed by eleven species, which were sub-dominant, and *Pronematus delhiensis* was recorded as sub-recipient (0.75).

KEY WORDS: *Agistemus*, Himachal Pradesh, predatory mites, prostigmatid

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INTRODUCTION

Predatory mites play an important role in agricultural ecosystem and are one of the potential biological control agents of mites and other insect pests of economically important plants. Predatory mites are valued by farmers as one of the preferred biological control agents in agriculturally developed countries. Predatory mites of order Mesostigmata of family Phytoseiidae are known worldwide as one of the natural enemies that provide effective pest control in greenhouses and on agricultural crops (Bjorson, 2008). However, predatory mites belonging to suborder Prostigmata are underexplored and are proving to be an effective natural control agent against plant feeding mites and other sucking insect pests (Khajuria, 2009). Predatory mite species belong to the suborder Prostigmata under the families, Anystidae, Bdellidae, Caligonellidae, Camerobiidae, Cheyletidae, Cunaxidae, Erythraeidae, Eupodidae, Raphignathidae, Stigmaeidae and Tydeidae. In Karnataka, 128 species of predatory mites were recorded (Jayaram and Sreeramakumar 2017). Most of them being predators of phytophagous mites and other soft-bodied insects, but some of them are phoretic, fungivorous, nematovorous and free living in certain situations (Gupta, 2002). In Himachal Pradesh, a prostigmatid group of predatory mites is under-explored and only thirteen species of prostigmatid predatory mites were reported on various agriculturally important crops (Thakur and Dinabandhu,

2005; Mattu and Devi, 2016; Singh, 2015). The present study was conducted to record the fauna of predatory mites belonging to suborder prostigmata and their distribution in various the agro-climatic regions of Himachal Pradesh.

MATERIALS AND METHODS

Random surveys of Himachal Pradesh were conducted during 2017-18 in various locations (Table 1) representing different agro-climatic zones on different agriculturally important crops. Plant and leaf samples were collected in the zip lock polyethylene covers and for anystids tapping of the plants and tree branches on the inverted umbrella. Collected samples were observed in the laboratory under stereozoom microscope Nikon SMZ745T and mites were picked up with modified needle (bent to 'J' shape with bamboo stick handle) and stored in the freshly prepared 70 per cent ethyl alcohol till the slides were permanently mounted. Specimens were mounted on standard microscopic slides with the help of Hoyer's fluid and for clearing the specimens slides were kept in the oven at 40°C for soft bodied mites and 45°C for erythraeids and anystids for 72 hours (Jayaram *et al.*, 2016). Dried slides were ringed with the help of transparent nail polish. Cleared specimens were identified with the help of published keys and their literature (Gupta, 2002) under compound microscope Nikon ECLIPSE 80i.

Table 1. Survey locations in different agro-climatic zones of Himachal Pradesh

Agroclimatic zones	Survey location (MSL)	District
Zone-I: Sub-mountainous and low hill subtropical zone (240-1000 m)	Tanda (671 m)	Kangra
	Rampur (357 m)	Una
	Jankaur (631 m)	Una
Zone-II: Mid hill sub-humid zone (1001-1500 m)	Bajaura (1046 m)	Kullu
	Palampur (1275 m)	Kangra
Zone-III: High hill wet temperate zone (1501-2500m)	Rajgarh (1555 m)	Sirmaur
Zone-IV: Dry temperate high hill zone (2501-4250m)	Kukumseri (2726 m)	Lahaul and Spiti

The diversity of prostigmatid predatory mites in different agro-climatic zones of the state was determined by involving following diversity indices (Kaundal, 2018), viz.,

Margalef’s index of richness (MI): $MI = S-1/\ln N$

Shannon-Wiener Diversity index: $H^1 = \sum_{i=1}^s Pi(\ln Pi)$

Simpson index: $1 - D = 1 - \sum_{i=1}^s pi^2$

Pielou’s evenness index: $J = H/H_{max}$

Berger-Parker index of dominance: $d = N_{max}/N$

Dominance structure of predatory mites at different agro-climatic zones of Himachal Pradesh was evaluated by Engelman’s scale of dominance with five classes of scale:

Dominance Structure	Relative abundance (%)
Eudominant	>31.7
Dominant	10.1–31.6
Subdominant	3.2–10
Recedent	1.1–3.1
Subrecedent	<1

RESULTS AND DISCUSSION

Prostigmatid mite fauna

Survey of different agroclimatic zones of Himachal Pradesh resulted in identification of 13 species of prostigmatid predatory mites belonging to five families, viz., Anystidae, Erythareidae, Iolinidae, Stigmaeidae and Tydeidae and six genera on different agriculturally important crops.

Family: Stigmaeidae

Agistemus sp. nr. *edulis*

Material examined: 3 ♀, Jankaur, 31° 25.869’N, 76° 16.379’E, ex. *Coccinea grandiflora* L.

Remarks: The species *A. edulis* was earlier reported from Arunachal Pradesh by Gupta (2002), but this one was not matching the measurements of setae. This was unknown from Himachal Pradesh.

Distribution: Arunachal Pradesh, Himachal Pradesh (New report).

Agistemus gamblei Gupta

Material examined: 5 ♀, Jankaur, 31° 25.728’N, 76° 16.217’E, ex. *Vigna mungo* (L.)

Distribution: Arunachal Pradesh, Himachal Pradesh, Karnataka and Kerala

Agistemus industani Gonzalez-Rodriguez

Material examined: 1 ♀, Rampur, 31° 26.804’N, 76° 15.904’E, ex. *Vigna mungo* (L.)

Remarks: This species was not known from Himachal Pradesh
Distribution: Arunachal Pradesh, Karnataka, Mizoram, Nagaland, Punjab, Tamil Nadu, Uttar Pradesh and Himachal Pradesh (New report)

Agistemus javanicum Gupta

Material examined: 4 ♀, Tanda, 32° 16.160’N, 76° 17.794’E, ex. *Capsicum annum* L.

Remarks: This species was earlier not known from Himachal Pradesh

Distribution: Manipur, Himachal Pradesh (New report)

Agistemus macrommatus Gonzalez-Rodriguez

Material examined: 4 ♀ & 2 ♂, Tanda, 32° 16.198’N, 76° 17.758’E, ex. *Vigna radiata* (L.)

Distribution: Arunachal Pradesh, Himachal Pradesh, Karnataka, Lakshadweep, Tamil Nadu, Uttar Pradesh and West Bengal

Agistemus lakoocha Gupta

Material examined: 4 ♀, Jankaur, 31° 35.096’N, 76° 16.019’E, ex. *Solanum melongena* L.

Remarks: This species was earlier not known from Himachal Pradesh

Distribution: Arunachal Pradesh and Himachal Pradesh (New report)

Family: Tydeidae

Tydeus cumini Gupta

Material examined: 2 ♀, Palampur, 32° 6.003’N, 76° 32.807’E,

ex. *Hibiscus rosa-sinensis* L.

Distribution: Himachal Pradesh and West Bengal

Tydeus gossabaensis Gupta

Material examined: 3 ♀, Kullu, 31° 50.175' N, 77° 10.359' E, ex. *Hibiscus rosa-sinensis* L.

Remarks: This species was earlier not known from Himachal Pradesh

Distribution: West Bengal and Himachal Pradesh (New report)

Tydeus ornamentalicus Gupta

Material examined: 5 ♀, Palampur, 32° 6.029'N, 76° 32.650' E, ex. *Holmskioldia sanguinia* Retz.

Remarks: This species was earlier not known from Himachal Pradesh

Distribution: West Bengal and Himachal Pradesh (New report)

Family: Anystidae

Anystis baccarum (Linnaeus)

Material examined: 3 ♀, Palampur, 32° 6.051'N, 76° 32.700'E, ex. *Musa paradisiaca* L.

Distribution: Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Punjab and West Bengal

Walzia darjeelingensis Gupta

Material examined: 3 ♀, Palampur, 32° 6.031'N, 76° 32.725'E, ex. *Lantana camara*

Distribution: Himachal Pradesh, Sikkim and West Bengal

Family: Iolinidae

Pronematus sextoni Baker

Material examined: 3 ♀, Kukumseri, 32° 41.995'N, 76° 41.372'E, ex. *Rosa* sp.

Remarks: This species was earlier not known from Himachal Pradesh

Distribution: Karnataka, New Delhi, Uttar Pradesh, West Bengal and Himachal Pradesh (New report)

Family: Erythraeidae

Paraerythraeus delhiensis Khot

Material examined: 2 ♀, Rajgarh, 30° 85.435'N, 77° 30.186'E, ex. *Brahmina coriacea* (Hope)

Remarks: This species was earlier collected on debris in orchard and not recorded from Himachal Pradesh

Distribution: New Delhi and Himachal Pradesh (New report)

Predatory mites diversity

Diversity of predatory mite fauna determined for different zones of Himachal Pradesh revealed that maximum species richness 'MI' was recorded at Zone-I (1.40) followed by Zone-II (1.32) and nil at both Zone-III and IV. The species diversity was maximum at Zone-I depicted by Shannon-Wiener Diversity index (1.87) followed by Zone-II. Similar trend was also witnessed in Simpson's index with maximum diversity in Zone-I (0.83) followed by Zone-II (0.82). The value of evenness is represented by Pielou's evenness index (J) was maximum at Zone-II (0.98) and followed by Zone-I (0.96) and minimum at Zone-III and IV. Berger-Parker index (d) depicted the dominance of species was maximum at Zone-III and Zone-IV (1.00) followed by Zone-III(0.22) and minimum at Zone-II (0.19) (Table 2). Species dominance structure was evaluated by using Engelmann's scale of dominance revealed that *P. sextoni* was dominant species with 15.9 percent followed by eleven species with relative abundance of 4.54–9.84 per cent, whereas *P. delhiensis* was the sub-recedent species (Fig. 1).

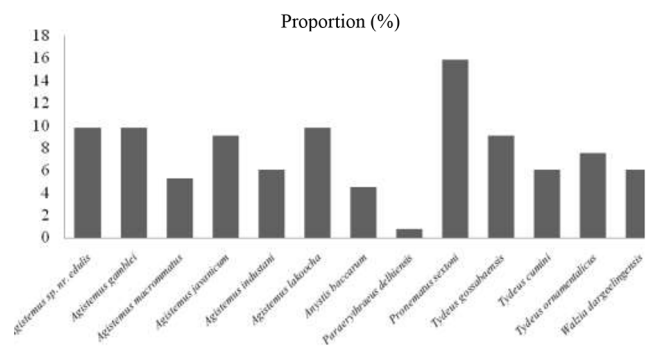


Fig. 1. Relative abundance of prostigmatid predatory mites in different zones of Himachal Pradesh.

Table 2. Diversity of prostigmatid predatory mites in different zones of Himachal Pradesh

Agroclimatic zone	Number of species	Margalef's index of richness	Shannon-Wiener Diversity index	Simpson's index	Pielou's evenness index	Berger-Parker index of dominance
	S	MI	H	1-D	J	d
Zone-I	7	1.40	1.87	0.83	0.96	0.19
Zone-II	6	1.32	1.75	0.82	0.98	0.22
Zone-III	1	0.00	0.00	0.00	∞	1.00
Zone-IV	1	0.00	0.00	0.00	∞	1.00

Prostigmatid predatory mites on various agriculturally important crops was the positive response in the view of biological control. Predatory mites of stigmatids were previously not reported from Zone-1, in which six *Agistemus* spp. were observed mostly from the Zone-1 and in Zone-2 only *A. javanicum* was reported and were associated with *Tetranychus urticae* Koch on various crop plants including pulses and vegetables. Amongst six species of stigmatids, four species were reported for the first time, whereas *A. gamblei* and *A. macrommatus* were already reported by Singh (2015). *Tydeus* species were recorded from Zone-2 on ornamental crops during spring season, viz., *T. gossabaensis* and *T. ornamentalicus* were reported for the first time from the state and earlier only a species was recorded from mid hills range (Singh and Chauhan, 2014; Khajuria, 2009), in which these were free living predators and helped in the survival of phytoseiid predatory mites as a prey, viz., *Euseius prasadi* (Chant & McMurtry) and *Typhlodromalus kalimpongensis* Gupta which was elucidated by McMurtry *et al.* (2015) in life-styles of phytoseiid mites. *Anystis baccharum* and *Walzia darjeelingensis* were reported from zone-2, whereas *A. baccharum* was associated with banana tinged bugs and later one was associated with *T. urticae*. *Pronematus sextoni* and *Paraerythraeus delhiensis* were reported from the higher altitudes in zone-3 and zone-4, respectively. *Paraerythraeus delhiensis* was found associated with the potato root grub, *Brahmina coriacea* near the joints of thorax and fore coxa of the adult beetle, which was earlier reported by Khot (1963) on debris collected in orchard of old Delhi and former was observed and collected on rose for the first time. Both the species were reported for the first time from the state.

Diversity of the predatory mites varied with the zones, in which Zone-1 and Zone-2 had different species with fluctuated number of individuals, whereas in Zone-3 and Zone-4 it was less diverse species wise, but in Zone-4, *P. sextoni* was recorded in highest number amongst the total recorded predatory mites. In case of the relative abundance of the predatory mites based on the Engelmann's scale of dominance, eleven species were belonging to subdominant(3.2–10); *P. delhiensis* was solitary species from Zone-3 which was sub-recedent (0.75) and *P. sextoni* was also solitary species from Zone-4, but number of individuals was highest in the collection scaled as dominant (15.90). Majority of the prostigmatid predatory mites are unreported and under exploited in India. In Himachal Pradesh, plant mites are one of the most common problems in polyhouse condition in which most of the high valued crops are grown. Most literature have identified prostigmatid predatory mites up to the generic level in the state. However, Khajuria (2009) reported the stigmatid

Zetzellia mali (Ewing) from Kullu district, which was a better natural control of european red mites, *Panonychus ulmi* (Koch) in apple. Hence, presently investigated prostigmatid predatory mites may be used as potential predators on both mite and insect pests in agriculturally important crops.

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