



Diversity of mite fauna associated with agro-horticultural crops in West Bengal, India

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Received : 11.09.2021 ; Revised : 12.02.2022 ; Accepted : 22.02.2022

DOI: <https://doi.org/10.22271/09746315.2022.v18.i1.1542>

ABSTRACT

A study was undertaken to understand the diversity of mite fauna associated with agro-horticultural crops in West Bengal in order to develop better and sound mite pest management strategy. A total of 24 species of phytoseiid mites were recorded belonging to the genera *Amblyseius*, *Euseius*, *Paraphytoseius*, *Typhlodromips*, *Scapulaseius*, *Neoseiulus*, *Phytoseius*, *Asperoseius*, *Typhlodromus* (*Anthoseius*), *Indoseiulus* and *Phytoscutus*. Among them *Amblyseius largoensis* was observed as predominant species followed by *Typhlodromips syzygii* occupied 20.87% and 16.26 % of total predatory mite population, respectively. The other predatory mites belonging to the family Tydeidae, Bdellidae, Ascidae, Cunaxidae, Cheyletidae and Stigmaeidae were also recorded. Concerning the phytophagous mites, *Tetranychus urticae*, *Eutetranychus orientalis*, *Schizotetranychus baltazari*, *Schizotetranychus andropogoni*, *Polyphagotarsonemus latus*, *Brevipalpus phoenicis*, *Aceria tulipae* and *Aceria guerreronis* were recorded as destructive mite pests. Predatory mites were found effective against phytophagous mites and other soft-bodied insect and they could be utilized for biological control programme to minimize the use of chemical pesticides.

Keywords: Agro-horticultural crops, diversity, mite fauna

The use of chemical pesticides in agra-horticultural crops in West Bengal are being gradually decreased (Hazra *et al.*, 2011). Thus, knowledge about the predominant species of predatory mites associated with agri-horticultural crops is more important for use of biological pest control programs. Though, few farmers relied on chemical pesticides to manage insect and pests to their crop that invoke development of resistance against pests and diseases (Jallow *et al.*, 2017). Moreover, due to introduction of high yielding varieties, expansion of irrigation facilities and adoption of modern cultural practices, mite pest problem has been increasing enormously and affecting crop production. Recently, mite pests appeared as one of the major limiting factors for cultivation of different crops. Among them, spider mite problem is a serious concern for cultivation of solanaceous and cucurbitaceous vegetables. The average yield loss was estimated around 9.15-100% in vegetable crops due to severe infestation of spider mite (Gupta, 1991, Prasad and Singh, 2007, Patil and Nandihalli, 2009, Prasad *et al.*, 2008, Prasad, 2007, Vinoth Kumar *et al.*, 2009) in different agro-climate regions in India. Predatory mites belonging to the family Phytoseiidae constitute a significantly beneficial group of mites having their pivotal role for maintaining the harmful phytophagous mites as well as soft bodied insect pests. The predatory mites have received global attention since 1950 owing to their significance as natural predators of phytophagous mites. Therefore, they could be adopted in the biological and integrated pest management

programmes (Swirski and Amitai, 1997). Before that it is absolutely important to know about the diversity of phytoseiid mite that could be employed in pest management strategies. Till to date predatory mite of the family Phytoseiidae contains more than 2,400 nominal species worldwide (Demite *et al.*, 2019) and every year new species are being added to this list. The knowledge of Indian Phytoseiidae is based on major contributions by Gupta (2003). Recent studies have raised the total 243 species in 21 genera in three subfamilies of Phytoseiidae those are known from India by Karmakar and Gupta, 2014; Pramanik and Karmakar, 2016; Karmakar *et al.*, 2017; Karmakar and Bhowmik, 2018; Kar and Karmakar, 2021; Molla *et al.*, 2021 and Bhowmik and Karmakar, 2021. So far, there is no consolidated report of predatory mite from agro-horticultural crop in West Bengal (Lahiri *et al.*, 2004; Gupta and Karmakar, 2011 and Haneef and Sadanandan, 2013). Due to inadequate information regarding mite fauna associated with agro-horticultural crops, the present investigation was undertaken to explore the diversity of mite fauna associated with agro-horticultural crops in West Bengal.

MATERIALS AND METHODS

Study area

Mite samples were collected from different agro-climatic zones of West Bengal mainly covering Darjeeling, Jalpaiguri, Cooch Behar, Malda, Murshidabad, Nadia, North 24 Parganas, South 24

Parganas, Howrah, Hooghly, Burdwan and Bankura districts of West Bengal.

Collection and preservation of specimens

The phytoseiid mite fauna harbouring on different agro-horticultural crops was examined by making extensive survey covering different locations of West Bengal during 2017-2020. Phytoseiid mites were collected directly from the plant with the help of fine camel hairbrush (size 000) and then preserved in 70% alcohol until permanent slides were prepared. Besides, a direct beating method was adopted, simply beating the plant parts over black cardboard and the dislodged mites were collected by using a single hairbrush. The mite specimens were preserved in a separate small plastic vial containing 70% alcohol mentioning the name of the host and the location.

Identification of specimens

The specimens were brought to the AINP on Agril. Acarology Laboratory, Department of Agricultural Entomology, BCKV, West Bengal. The collected mite specimens were transferred into a cavity block and mounted on modified Berlese's medium for identification. The slides were dried keeping on hot plate at 35-40°C for 5-7 days. The mites were examined with a phase contrast microscope (BX 53, Olympus, Japan) and the species were identified following the keys provided by Chant and McMurtry (2007).

Statistical analysis

To understand the diversity and community structure of different phytoseiid mite as well as phytophagous mites in different locations, the number of specimens for each species was enumerated reflecting the species richness (S) and the following diversity and evenness indices were calculated based on the formulae provided by Shannon-Weiner (1963), Pielou (1975) and Simpson (1949).

RESULTS AND DISCUSSIONS

The present investigation was aimed focusing on different agro-horticultural crops in West Bengal for collection of mite species. Altogether, 3300 mite specimens were collected associated with different agro-horticultural crops in West Bengal. A total of twenty four species of predatory mite belonging to nine genera viz, *Amblyseius*, *Euseius*, *Paraphytoseius*, *Typhlodromips*, *Scapulaseius*, *Phytoseius*, *Neoseiulus*, *Asperoseius*, *Indoseiulus*, *Typhlodromus* (*Anthoseius*) and *Phytoscutus* were recorded under the family Phytoseiidae (Table 1). Furthermore, under the genus *Amblyseius* five species like *Amblyseius largoensis*, *Amblyseius brachycalyx*, *Amblyseius dahlia*, *Amblyseius herbicolus* and *Amblyseius parbatabasii*, under the

genus *Euseius*, six species viz. *Euseius ovalis*, *Euseius alstoniae*, *Euseius arunachalensis*, *Euseius sajnekhalicus* and *Euseius sundarbanensis* were recorded. Moreover, under the genus *Scapulaseius* two species *Scapulaseius asiaticus* and *Scapulaseius morasei*, under the genus *Neoseiulus*, four species namely *Neoseiulus longispinosus*, *Neoseiulus pranadae*, *Neoseiulus imbricatus*, *Neoseiulus paspalivorus*, under the genus *Phytoseius*, two species like *Phytoseius jujuba*, *Phytoseius kapuri* and each of one species under the genus *Typhlodromips*, *Indoseiulus*, *Typhlodromus* (*Anthoseius*) sp. and *Phytoscutus* sp. were also recorded. Concerning the proportional abundance of predatory mite population, *Amblyseius largoensis* occupied 20.87 per cent of the total predatory mite population followed by *Typhlodromips syzygii*, *Euseius alstoniae*, *Euseius ovalis* and *Paraphytoseius orientalis* was enumerated 16.26, 7.17, 6.30 and 5.39 per cent of predatory mite population in surveyed areas, respectively (Table 2). However, *Amblyseius largoensis* was found as most predominant species followed by *Typhlodromips syzygii*. The other predatory mites belonging to the family like Tydeidae, Bdellidae, Cunaxidae, Ascidae, Stigmaeidae and Cheyletidae belonging to the order Prostigmata were also recorded during the period of investigation. This study revealed that highest diversity of predatory mite in terms of $H^1 = 3.46$ with good number of species evenness 1.79, effective number of species 16 and highest dominance was $D = 0.95$ which reflected that agro-horticultural crops in West Bengal has been highly congenial for survival of predatory mites (Table 3). So far as phytophagous mite infesting in different crops is concerned, the most dominant species were *Tetranychus urticae*, *T. macfarlanei*, *Eutetranychus orientalis*, *Schizotetranychus andropogoni*, *Brevipalpus phoenicis* and *Polyphagotarsonemus latus* have diverse host range and fed on different agro-horticultural crops in West Bengal. The present findings are in agreement with the findings of Rai and Inderajeet (2011), Maheswary *et al.* (2015), Singh and Chauhan (2014) and Roy and Gupta, (2016) who reported *Tetranychus urticae*, *Schizotetranychus andropogoni*, *Eutetranychus orientalis*, *Polyphagotarsonemus latus*, and *Brevipalpus phoenicis* infesting on many fruits, vegetables, flowers and other allied crops. Concerning proportional abundance of phytophagous mite, *Tetranychus urticae* was observed as leading species occupying 43.0 per cent of the total phytophagous mite population followed by *Eutetranychus orientalis*, *Polyphagotarsonemus latus*, *Schizotetranychus andropogoni* recorded 9.80, 8.40 and 7.40 per cent of mite population, respectively (Table 5). The present study displayed that maximum diversity of phytophagous mite in terms of $H^1 = 2.35$, where effective number of species 10, species evenness 2.15

Table 1: Diversity of predatory mite fauna associated with different agro-horticultural crops in West Bengal

Order :Mesostigmata, Family:Phytoseiidae	Host habitat	Distribution in West Bengal	Associated arthropods
<i>Amblyseius largoensis</i> (Muma)	Jute, Rose, Tagor, Marigold, Bel, Lemon, Brinjal, Chilli, Litchi, Betelvine, Mango, Arecanut, Joge dumur, Custard apple, Papaya, Turmeric, Bougainvillea, Arjun, Coconut, Basak, Guava, Garlic, Shiuli, Ridge gourd, Cucumber, Ladies finger, Papaya, Bitter gourd, Pumpkin, <i>Anacardium occidentale</i> , <i>Annona squamosa</i> , <i>Catharanthus roseus</i> , <i>Calotropis gigantea</i> , <i>Areca catechu</i> , <i>Phoenix dactylifera</i> , <i>Terminalia arjuna</i> , <i>Emblica officinalis</i> , <i>Manihot esculenta</i> , <i>Pongamia pinnata</i> , <i>Butea monosperma</i> , <i>Vitex negundo</i> , <i>Ocimum sanctum</i> , <i>Abroma augusta</i> , <i>Abelmoschus esculentus</i> , <i>Ficus bengalensis</i> , <i>Ficus religiosa</i> , <i>Syzygium cumunii</i> , Koromcha, Custard apple, Giant lemon, Jackfruit, Sugarcane, Jamun, Sirish, Amla, Sapota, Ginger, White flower, Mulberry, Jhau, Sandle tree, Jackfruit, Tulsi, Banana, Nayantara, Pomegranate, Drum stick, Karipata (<i>Murraya koenigi</i>), Fig, Hibiscus, Gandharaj lemon, Jetropha, Suros flower, Lotus (upland), Jasmine, (<i>Nyctanthes</i> sp.) <i>Polyalthia longifolia</i> , <i>Abrus precatorius</i>	Nadia, 24PGS (N), 24PGS (S), Murshidabad, Malda, Hooghly, Burdwan, Jalpaiguri, Cooch Behar, Darjeeling, Bankura	<i>T. urticae</i> , <i>T. macfarlanei</i> <i>P. latus</i> <i>O. mangiferus</i> <i>Brevipalpus</i> sp. Eriophyidae
<i>Amblyseius brachycalyx</i> (Karmakar <i>et al.</i> , 2017)	Pitali, <i>Ficus benghalensis</i> , <i>Abrus precatorius</i> , Ghatu	Murshidabad, Hooghly, Malda, Bankura	<i>T. urticae</i> , <i>P. latus</i> Eriophyidae mite
<i>Amblyseius dahliae</i> <i>Amblyseius herbicolus</i> (Chant, 1959)	<i>Saraca asoca</i> Brinjal, Chilli, Bean, Tomato, Potato	Hooghly, Jalpaiguri, Cooch Behar	<i>T. urticae</i> , <i>P. latus</i> , Eriophyidae <i>P. latus</i> , <i>T. urticae</i>
<i>Amblyseius parbatabasii</i> (Karmakar <i>et al.</i> , 2017)	Brinjal, unknown forest plant	Darjeeling	<i>T. urticae</i> , <i>T. macfarlanei</i> Eriophyidae
<i>Euseius ovalis</i> (Evans, 1953)	Jute, Rose, Bel, Chilli, Dahlia, Bougainvillea, Custard apple, Broad bean, Papaya, Mango, <i>Anacardium occidentale</i> , <i>Phoenix dactylifera</i> , <i>Emblica officinalis</i> , <i>Butea monosperma</i> , <i>Abroma augusta</i> , <i>Ficus bengalensis</i> , <i>Syzygium cumunii</i> , <i>Artocarpus heterophyllus</i> , <i>Moringa oleifera</i> , Hibiscus, Jackfruit, Arjun, Macho fruit, Rose, Litchi. Siris, Tagror, Ber, Jackfruit, Sugarcane, Litchi, Mulberry, jhau, Banana, Jetropha, Suros flower, <i>Polyalthia longifolia</i>	Nadia, 24PGS (N), Malda, Murshidabad, Hooghly	<i>P. latus</i> <i>Brevipalpus</i> sp.
<i>Euseius alstoniae</i> (Gupta, 1975)	Segun (<i>Tectona grandis</i>), Mahogany, Fig, Papaya, Jetropha, Radhachura (<i>Peltophorum pterocarpum</i>), Tulsi (<i>Ocimum tenuiflorum</i>), <i>Lantana camara</i> , Papaya, Sugarcane, drumstick, Litchi, Arjun, Bitter gourd, Maize, Banana, Chilli, Hibiscus	Nadia, Malda, Murshidabad, Burdwan, Hooghly, Bankura, 24 PGS(S)	<i>S. spinki</i> , <i>T. urticae</i> <i>P. latus</i> , mealy bug
<i>Euseius arunachalensis</i> (Pramanik & Karmakar, 2016)	Mango, Chilli, unknown forest plants	Murshidabad, Darjeeling, 24 PGS(S),	<i>T. urticae</i> , <i>P. latus</i> Eriophyidae
<i>Euseius sajnekhalicus</i> (Karmakar & Kar, 2021)	Rose, Hibiscus, white flower, Carambola, <i>Polyalthia longifolia</i> , Jhau tree, Sandle tree, Guava, Jackfruit, Litchi, Arjun, Tulsi, Banana, Custard apple, Mango Kadam, Bougainvillea, Tomato, pitali, Papaya, Jamrul, Chilli, Brinjal	Murshidabad, Malda, Darjeeling	<i>T. urticae</i> , <i>P. latus</i> Pupa of whitefly, Eriophyidae mites

Contd.....

Order :Mesostigmata, Family:Phytoseiidae	Host habitat	Distribution in West Bengal	Associated arthropods
<i>Euseius sundarbanensis</i> (Karmakar & Bhowmik, 2018)	Sapota, Crambola, Jhau tree	Murshidabad, 24 PGS(S)	<i>T. urticae</i> , <i>P. latus</i> <i>B. phoenicis</i>
<i>Euseius sp.</i>	Mango, Tulsi, Pear	Murshidabad, Malda	<i>P. latus</i> , <i>T. urticae</i>
<i>Paraphytoseius orientalis</i> (Swirski & Shechter)	Rose, Jute, Brinjal, Tomato, <i>Mikania micrantha</i> , Wild Bhendi, Forest plants, Green gram, <i>Solanum</i> <i>melongena</i> , <i>Ricinus communis</i> , <i>Mentha piperita</i> , <i>Ocimum basillicum</i> , <i>Hibiscus</i> , <i>Abelmoschus</i> <i>esculentus</i> , <i>Nyctanthes arbor-tristis</i> , <i>Ixora sp.</i>	Nadia, Cooch, Behar, New Jalpaiguri, Murshidabad, 24 Parganas (N)	<i>T. urticae</i> , <i>P. latus</i> Eriophyidae
<i>Typhlodromips syzygii</i> (Gupta, 1975)	Rose, Coconut, Okra, Forest plants, Groundnut, Bitter gourd, Maize, Chilli, potato, Ash gourd, Vendi, Ridge gourd, Bottle gourd, groundnut, Guava, Mango, Sugarcane, Papaya, Mulberry, Jamun, Lemon, Seuilflower, Sirish, Ginger, Aster, Amla, White flower, Mango, <i>Pongammia pinnata</i> , <i>Psidium</i> <i>guajava</i> , jamun, <i>Aegle marmelos</i> , Litchi, Banana, Nayantara	Nadia, Burdwan, Murshidabad, 24 PGS(N), Malda, 24 PGS(S), Hooghly	<i>T. urticae</i> , <i>T. ludeni</i> <i>P. latus</i> , <i>Oligonychus sp.</i> , <i>Tenuipalpus sp.</i> Eriophyidae mites
<i>Scapulaseius asiaticus</i> (Evans)	Rose, Pointed gourd, Coconut, Okra, Forest plants, Joge dumur, Fig, Ridge gourd	Burdwan, Nadia, 24 PGS (N)	<i>T. urticae</i> , <i>P. latus</i> , Eriophyidae
<i>Scapulaseius morasei</i>	<i>Punica granatum</i> , <i>Ziziphus mauritiana</i>	24 PGS (N), Murshidabad, Nadia,	<i>T. urticae</i> , <i>P. latusthrips</i>
<i>Phytoseius jujube</i> (Gupta 1977)	Joge dumur, unknown plants, Brinjal, Bitter gourd, Guava, Fig, Brinjal, Litchi, Tulsi, <i>Ficus</i> <i>benghalensis</i> , Papaya, Ladies finger, Bean	Nadia, Murshidabad, Hooghly, 24 PGS (N), 24 PGS (S)	<i>T. urticae</i> , <i>P. latus</i> , <i>Brevipalpus sp.</i> mealy bug <i>Oligonychus sp.</i>
<i>Phytoseius kapuri</i> (Gupta, 1969)	Fig, Marigold, Hibiscus, Bitter gourd	Nadia, Hooghly, Burdwan, 24 PGS (S)	<i>T. urticae</i> , <i>P. latus</i> , <i>T. macfarlanei</i>
<i>Neoseiulus longispinosus</i> (Evans)	Jute, Vandi, <i>Cyperus rotundus</i> , <i>Ricinus communis</i> , Custard apple <i>Vigna unguiculata</i> , <i>Abelmoschus</i> <i>esculentus</i> , Rose	Nadia, Burdwan, 24PGS (N), Malda, Murshidabad, Hooghly	<i>T. urticae</i> <i>P. latus</i> , <i>Brevipalpus sp.</i> mealy bug
<i>Neoseiulus pranadae</i> (Karmakar & Gupta, 2014)	Drumstick, Bera tree, <i>Cyperus rotundus</i> , <i>Cynodon</i> <i>dactylon</i> , <i>Datura stramonium</i> , <i>Lantana camara</i> , pointed gourd, Groundnut, Hibiscus	Malda, 24PGS (N), Nadia, Hooghly	<i>T. urticae</i> <i>P. latus</i> , <i>Brevipalpus sp.</i> mealy bug
<i>Neoseiulus imbricatus</i>	<i>Oryza sativa</i> , <i>Cyperus rotundus</i>	Nadia, Burdwan, Hooghly, 24 PGS (N), Malda, Murshidabad	<i>T. ludeni</i> , <i>A. tulipae</i> <i>P. latus</i> , <i>Brevipalpus sp.</i> mealy bug
<i>Neuseiulus paspalivorus</i> (De León)	Pointed gourd	Nadia, 24 PGS (N)	<i>Oligonychus sp.</i> <i>T. ludeni</i>
<i>Asperoseius jujuba</i>	<i>Morus alba</i> , <i>Ixora sp.</i>	24PGS (N)	<i>T. macfarlanei</i> <i>Schizotetranychus</i> sp. Eriophyidae
<i>Indoseiulus ricini</i>	Garlic	Nadia	Eriophyidae
<i>T. (Anthoseius) sp.</i>	Litchi, Jackfruit, Ghatu, Chilli, Macho fruit, Fig, Kadam, Mango, Tomato, Jamrul, Pear, Banana, Bougainvillea, Mango, Mulberry Tulsi (<i>Ocimum</i> <i>tenuiflorum</i>), <i>Lantana camara</i> ,	Nadia, Burdwan, Murshidabad, Malda, Bankura, Hooghly, 24 PGS(N), 24 PGS(S), Nadia	<i>T. urticae</i> <i>Tenuipalpus sp.</i> <i>P. latus</i>
<i>Phytoscutus sp.</i>	Forest plants	24 PGS(S), Nadia	<i>T. urticae</i> <i>Brevipalpus sp.</i>

Order :Mesostigmata, Family:Phytoseiidae	Host habitat	Distribution in West Bengal	Associated arthropods
Order : Prostigmata Family: Tydeidae Genus: Tydeus sp.	Rice , Sirish , <i>Adhatoda vasica</i> , <i>Catharanthus roseus</i> , <i>Phoenix dactylifera</i> , <i>Lagenaria siceraria</i> , <i>Ficus benghalensis</i> , Mahogany, Banana, Tulsi, Unknown forest plant, Cucumber, Ash gourd, Cucumber,	Nadia, 24 PGS(N), Hooghly, Bankura, Jalpaiguri	<i>T. urticae</i> , <i>P. latus</i> , <i>Brevipalpus</i> sp. mealy bug
Family: Bdellidae Genus: <i>Bdellodes</i> sp.	<i>Solanum melongena</i> , <i>Solanum lycopersicum</i> , Rose, Litchi, Custard apple, Fig, <i>Ficus benghalensis</i> , Hibiscus, Jasmine, Ladies finger	Nadia, 24 PGS (N), Hooghly, Burdwan	<i>T. urticae</i> <i>P. latus</i> , <i>Brevipalpus</i> sp. mealy bug
Family:Cunaxidae <i>Cunaxa</i> sp.	<i>Ocimum sanctum</i> , <i>Hibiscus</i> , <i>rosa sinensis</i> , <i>Moringa</i> <i>oleifera</i> , Arjun, Jamrul , Tulsi, <i>Lantana camara</i> , Vendi, Pumpkin, Bitter gourd, Sugarcane, Sadafull, Amla , Hibiscus Lemon, Chilli, Custard apple, Areca nut, Guava, Coconut	24 PGS(N), Malda, Hooghly, Burwan, Murshidabad, Nadia, 24 PGS (S)	<i>T. ludeni</i> , <i>A. tulipae</i> <i>P. latus</i> , mealy bug <i>Brevipalpus</i> sp.
Family:Ascidae <i>Lasioseius parberlesei</i>	Sugarcane, Cucumber, Fig, <i>Ficus benghalensis</i>	Nadia, Malda, Burdwan, Hooghly	Eriophyidae <i>P. latus</i> , <i>T. urticae</i>
Family:Stigmaeidae <i>Agistemus inductani</i>	Sugarcane, Wild plant, Gandharaj lemon	Nadia, Hooghly	<i>Oligonychus</i> sp. <i>T. ludeni</i> whitefly
Family:Cheyletidae <i>Cheyletus</i> sp.	Jasmine	Hooghly, Burdwan, Bankura	<i>T. ludeni</i> , <i>A. tulipae</i> <i>P. latus</i> , <i>Brevipalpus</i> sp., mealy bug

Table 2: Relative abundance and diversity index for predatory mite fauna associated with different agro-horticultural crops in West Bengal

Species	Mean of mite species	Relative abundance
<i>Amblyseius largoensis</i>	480	20.87
<i>Amblyseius brachycalyx</i>	30	1.30
<i>Amblyseius dahliae</i>	05	0.22
<i>Amblyseius herbicolus</i>	27	1.17
<i>Amblyseius parbatabasii</i>	23	1.00
<i>Euseius ovalis</i>	145	6.30
<i>Euseius alstoniae</i>	165	7.17
<i>Euseius arunachalensis</i>	25	1.09
<i>Euseius sajnekhalicus</i>	65	2.83
<i>Euseius sundarbanensis</i>	18	0.78
<i>Euseius</i> sp.	12	0.52
<i>Paraphytoseius orientalis</i>	124	5.39
<i>Typhlodromips syzygii</i>	374	16.26
<i>Scapulaseius asiaticus</i>	48	2.09
<i>Scapulaseius morasei</i>	12	0.52
<i>Phytoseius jujuba</i>	60	2.61
<i>Phytoseius kapuri</i>	70	3.04
<i>Neoseiulus longispinosus</i>	59	2.57
<i>Neoseiulus pranadae</i>	48	2.09
<i>Neoseiulus imbricatus</i>	114	4.96
<i>Indoseiulus ricini</i>	8	0.35
<i>Neoseiulus paspalivorus</i>	12	0.52
<i>Typhlodromus</i> (<i>Anthoseius</i>) sp.	48	2.09
<i>Phytoscutus</i> sp.	20	0.87
<i>Tydeus</i> sp.	48	2.09
<i>Bdellodes</i> sp	55	2.39
<i>Cunaxa</i> sp.	48	2.09
<i>Lasioseius parberlesei</i>	62	2.70
<i>Agistemus inductani</i>	53	2.30
<i>Cheyletus</i> sp.	42	1.83
Total	2300	-

Table 3: Shannon's diversity index of predatory mite fauna associated with different agro-horticultural crops in West Bengal

Shannon's diversity (H^1)	=	3.46
Effective number of species (EVS)	=	16
Species evenness (E)	=	1.79
Species dominance (D)	=	0.95

Table 4: Phytophagous mite fauna associated with different agro-horticultural crops in West Bengal

Order: Prostigmata,	Host habitat	Distribution in West Bengal
Family: Tetranychidae <i>Tetranychus urticae</i> (Koch)	Rose, Pointed gourd, Papaya, Chandramallika, Bel, Lemon, Tomato, Potato, Snake gourd, Cucumber, Jatropha, Okra, Joge dumur, Sugarcane, Arecanut, Arjun, Radish, Guava, Broad bean, Black gram, Soybean, Groundnut, Turmeric, Sunhemp, Jute, Betelevine, Koromcha, Tagor, Bel, Mulberry, Seuilflower, Mango, Amla, Sandal tree, Custard apple, Brinjal, Chilli, Broad bean, Dahlia, <i>Karipata</i> , Debraru, Fig, Mulberry, Fig, Mango, Ghatu, Chilli, Lombu, Banana, jamun, Nayantara, Pomegranate, Litchi, Mecho fruit, Bera tree, Pear.	Nadia, Hooghly, Murshidabad, 24 PGS(N), Malda
<i>Eutetranychus orientalis</i> (Klein)	Lemon, Chilli, Snake gourd, Ber, Neem, Cotton, Fig, Radhachura, Tagor, Bougainvillea, Hibiscus, Unknown plant, Mulberry, Brinjal, Banana, pitali, Pear and Sugarcane	Nadia, Hooghly, Murshidabad, Malda
<i>Schizotetranychus andropogoni</i> (Hirst)		Nadia, 24 PGS, Malda, Murshidabad,
<i>Schizotetranychus cajani</i> (Gupta)	Pigeon pea	Hooghly, Nadia
<i>Oligonychus oryzae</i> (Hirst.)	Rice	Nadia
<i>Oligonychus indicus</i> (Hirst.)	Sugarcane, Kul, Betelvine, Tagor, Shiuli, Jhau, Lemon, Banana, Patabahar, <i>Karipata</i> , Soybean, Maize, Rice, Sorghum	Nadia, Malda, Murshidabad, Hooghly,
<i>Oligonychus mangiferous</i> (Rahman & Sapra)	Mango, Litchi, Banana	Malda, Murshidabad
<i>Aponychus corpuzae</i>	Bamboo	Nadia
<i>Porcupinychus</i> sp.	Papaya	Nadia
<i>Panonychus</i> sp.	<i>Carica papaya</i> , <i>Cucumis sativus</i> , Mulberry, Debdaru, Chilli	24PGS (N), Murshidabad Malda
Family: Tarsonemidae <i>Polyphagotarsonemus latus</i> (Bank)	Gladiolus, Tomato, Potato, Chilli, Potato, <i>Abelmoschus esculentus</i> , <i>Solanum tuberosum</i> , <i>Solanum melongena</i> , <i>Capsicum annum</i>	Nadia, Malda, Murshidabad, 24 PGS(N), Hooghly
<i>Stenotarsonemus spinki</i> (Smiley)	Rice, <i>Echinochloa colonum</i>	Hooghly, 24 PGS(N), Nadia, Burdwan
Family: Tenuipalpidae <i>Brevipalpus phoenicis</i> (Geisk)	Chandramallika, Rose, Pointed gourd, Brinjal, Betelvine, Forest plants, Thorn apple	Nadia, Hooghly, Burdwan, 24 PGS(N),
Family: Eriophidae <i>Aceria tulipae</i> (Keifer)	Rice, Garlic	Nadia, Hooghly, Burdwan
<i>Aceria guerreronis</i> (Keifer)	Coconut	Nadia, 24PGS(N)

Table 5: Relative abundance and diversity index of phytophagous mite fauna associated with different agro-horticultural crops in West Bengal

Species	Mean of species	Relative abundance
<i>Tetranychus urticae</i>	430	43.00
<i>Eutetranychus orientalis</i>	98	9.80
<i>Schizotetranychus andropogoni</i>	74	7.40
<i>Schizotetranychus cajani</i>	6	0.60
<i>Oligonychus oryzae</i>	25	2.50
<i>Oligonychus indicus</i>	44	4.40
<i>Oligonychus mangiferous</i>	22	2.20
<i>Aponychus corpuzae</i>	4	0.40
<i>Polyphagotarsonemus latus</i>	84	8.40
<i>Stenotarsonemus spinki</i>	70	7.00
<i>Brevipalpus phoenicis</i>	65	6.50
<i>Aceria tulipae</i>	36	3.60
<i>Aceria guerreronis</i>	42	4.20
Total	1000	-

Table 6: Shannon's diversity index of phytophagous mite fauna associated with different agro-horticultural crops in West Bengal

Shannon's diversity (H^1)	=	2.35
Effective number of species (EVS)	=	10.0
Species evenness (E)	=	2.15
Species dominance (D)	=	0.92

and species dominance was $D = 0.92$ (Table 6). However, predatory mites prey on different species of arthropods was investigated and presented in Table 1. In this context, *Amblyseius largoensis*, *Amblyseius brachycalyx*, *Amblyseius parvatabasii*, *Euseius ovalis*, *Euseius alstoniae*, *Euseius arunachalensis*, *Euseius sundarbanensis*, *Typhlodromips syzygii*, *Paraphytoseius orientalis*, *Neoseiulus longispinosus*, *Neoseiulus paspalivorus*, *Neoseiulus pranadiae*, *Scapulaseius asiaticus*, *Phytoseius jujuba*, *Asperoseius jujuba*, *Indoseiulus ricini*, *Tydeus* sp., *Bdelloides* sp., *Lasioseius parberlesei*, *Agistemus industani* and *Cunaxa* sp. more or less preyed on *Tetranychus urticae*, *T. macfarlanei*, *T. ludeni*, *Oligonychus mangiferus*, *Schizotetranychus andropogoni*, *Eutetranychus orientalis*, *Brevipalpus phoenicis*, *Tenuipalpus* sp., *Polyphagotarsonemus latus*, *Aceria tulipae*, *Aceria guerreronis*, mealy bug and pupae of whitefly. The present findings are in line with the finding of Karmakar and Gupta (2011), Karmakar and Gupta (2010), Bala *et al.* (2019) and Chakraborty, (2010) who found that *Amblyseius largoensis*, *Typhlodromips syzygii*, *Paraphytoseius orientalis*, *Euseius ovalis*, *Euseius alstoniae*, *Euseius arunachalensis*, *Euseius sajnekhalicus*, *Euseius sundarbanensis*, *phytoseius kapuri*, *Neoseiulus* sp., *Cheyletogenes* sp., *Cunaxoides* sp. and *Agistemus* sp. were accompanying with different agro-horticultural crops and predated upon *Polyphagotarsonemus latus*,

T. urticae, *T. ludeni*, *T. macfarlanei*, *Panonychus citri*, *Brevipalpus* sp., *Oligonychus* sp., *A. tulipae*, pupa of whitefly and mealy bug etc. The findings of this study are also similar to the observation of Escudero and Ferragut (2005); Naher *et al.* (2005); Onzo *et al.* (2012), Sharma and Chauhan, (2013) Binisha and Bhaskar, (2013), Singh and Chauhan, (2014), Bala *et al.* (2018) and Maheswary *et al.* (2015). They stated that phytoseiid mites were the most common predators associated with phytophagous mites in different crops as effective biological control agent against *Tetranychus urticae*, *Tetranychus ludeni*, *Tetranychus macfarlanei*, *Polyphagotarsonemus latus*, *Brevipalpus phoenicis*, *Tenuipalpus* sp., *Schizotetranychus andropogoni*, *E. orientalis*, *Aceria tulipae* and *Aceria guerreronis* etc.

CONCLUSIONS

Predatory mite was found effective against phytophagous mite and other soft bodied insect pests. The database generated on mite fauna will be helpful in developing future management strategies. So, the predatory mites should be conserved for natural suppression of harmful mite in order to minimize use of chemical pesticides. However, the outcomes of the present study will help as one of the important references for future faunistic studies of predatory as well as phytophagous mite.

ACKNOWLEDGEMENT

The authors are grateful to the coordinator, All India Network Project on Agricultural Acarology for providing necessary funds and facilities for conduction this study.

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