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Diversity of mite fauna associated with various agro-horticultural crops and forest plants in Orissa, India

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Abstract
A study was conducted in October, 2018 to explore and identify the predatory mites as well as phytophagous mite fauna from different agro-horticultural crops, weeds and forest plants in Orissa. A total of eleven species of predatory mites belonging to the order Mesostigmata viz., *Euseius alstoniae* (Gupta, 1975), *Euseius ovalis* (Evans, 1953), *Typhlodromus* (*Anthoseius*) sp., *Phytoseius kapuri* (Gupta, 1969b), *Paraphytoseius orientalis* (Narayanan, Kaur & Ghai, 1960), *Amblyseius largoensis* (Muma, 1955) and *Scapulaseius asiaticus* (Evans, 1953), *Scapulaseius* sp. nov. 1 *Scapulaseius* sp. nov. 2 *Neoseiulus paspalivorus* (De Leon, 1957), *Asperoseious* sp., and *Phytoscutus* sp. nov.1 were recorded which belong to the family Phytoseiidae. Among them, *Amblyseius largoensis* (Muma, 1955) was found as the predominant species in Orissa. The other important predatory mites belong to the families Tydeidae, Bdellidae, Ascidae and Cunaxides under the order Prostigmata was observed during the period of investigation. The phytophagous mite belong to the family Tetranychidae, (*Tetranychus urticae*, Koch, *Eutetranychus orientalis* Klein and *Oligonychus* sp.), Tarsonemidae, (*Polyphagotarsonemus latus*, Banks and *Steneotarsonemus spinki*, Smiley and *Brevipalpus phoenicis* (Geisk) belonging to the family Tenuipalpidae under the order Prostigmata were identified and found as a key mite pest plants in surveyed areas of Orissa.

Keywords: Predatory mite, phytophagous mites, host plants, survey, Orissa

1. Introduction
Soil and climatic conditions of the state Orissa is congenial for growing a large number of agro-horticultural crops as well as different important forest plants. However, the information regarding the available mite fauna on these crops is more important for identification of beneficial mite that could be used in biological pest control programme. Due to introduction of high yielding varieties and adoption of modern cultural practices, mite pest problem has been increasing day by day and affecting different crops as well. Therefore, mite pest has been appeared one of the major constraint in successful crops cultivation [4] in diverse agro-ecosystem in India. Among them, spider mite problem is a serious concern for commercial cultivation of solanacious and cucurbit vegetables [27, 37]. The average yield loss was estimated around 9.15-100% in vegetable crops due to severe infestation of spider mite [13, 27, 26, 25, 28, 39] in different agro-climate regions of India. Predatory mites belong to the family Phytoseiidae constitute a significant beneficial group of mite due to their notable role for maintaining the harmful phytophagous mites and insect pests population below the damaging level. However, the predatory mites are now being accepted by the farmers as a tremendous potential natural enemy in worldwide [3]. The predatory mites have received global attention since 1950 due to their significance as natural predators of phytophagous mites and small soft bodied insects. Therefore, they could be adopted in the biological control and integrated pest management strategies against different crop pests [38]. More than 190 phytoseiid have so far been reported from India [1, 2, 6, 7, 8, 10, 11, 12, 14,15, 19, 21, 22, 23, 24, 29, 30, 31, 32, 34, 33, 35, 36] from over 2280 species known from all over the globe [5, 18]. Biological control of phytophagous mites could be a substitute option instead of conventional chemical pesticide especially in green house crops [9]. Though, very little evidence is now available concerning predatory mite fauna on phytophagous mite in fruits, vegetables and ornamental crops in Orissa. Keeping this view, the present investigation was carried out to explore the diversity of phytophagous mite as well as their related predatory mite complex in Orissa province.

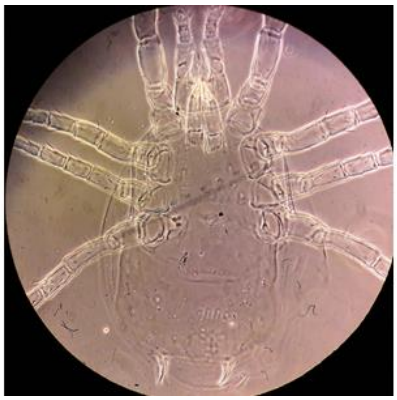
2. Materials and Methods

The mite fauna harbouring on different species of agro-horticultural crops as well as economical important forest plants were examined by making extensive surveys covering different locations of Orissa province during October, 2018. The presence of mites was confirmed with the help of hand lens (20X) and leaf infested with mites collected in individual polythene bag and brought to the laboratory for detailed studies. Phytoseiid mite generally bigger in size and fast moving in nature were collected directly from the plant with the help of fine camel hair brush and then preserved in 70% alcohol until permanent slides were prepared. Beside that direct beating method was adopted i.e. simply beating the plant parts over a black card board and collected the dislodged mite by using single hair brush. After that, the mite specimens were preserved in separate small plastic vial containing 70% alcohol mentioning the name of the host and the location. In laboratory, collected mite specimens were poured in a cavity block and mounted in a drop of Hoyer's medium as per method given by Jeppson *et.al*. [17]. Then the slides were dried in oven at 35-40 ^{0}C for 4-5 days. Clearing was done in 70% lactic acid for 4-6 hours in cavity block at 40-60 ^{0}C. Tetranychid mite specimen was cleaned by lactic acid and lignin pink in cavity block by placing it on electric slide warmer (40-60 ^{0}C) for 1-2 hrs [16]. Lactic acid inflated the body and lignin pink made the specimen translucent that enable the specimen visible clearly under binocular microscope and subsequently identification of the specimens was done under phase contrast microscope (Olympus BX 41).

3. Result and Discussion

In the present study different agro-horticultural crops as well as unknown important forest plants (*Oryza sativa*, *Capsicum annuum*, *Musa acuminate*, *Psidium guajava*, *Gossypium* sp, *Syzygium cumini*, *Tabernaemontana* sp, *Ficus carica*, *Jatropha curcas*, *cassia tora*, *Shorea robusta*, *Ziziphus Jujuba*, *Artocarpus heteophyllus*, *Polyalthis longifolia*, *Mikania micrantha*, *Minikara zapota*, *Mangifera indica*, *Mimosa pudica*, *Clerodendrum* sp.) were examined for the presence of predatory mites as well as their prey phytophagous mites. Three plant feeding mite species viz. *Tetranychus urticae*, *Eutetranychus orientalis* and *Oligonychus* sp. belong to the family Tetranychidae, two phytophagous mite species namely; *Polyphagotarsonemus latus*, Bank *and Steneotarsonemus spinki*, Smiley under the family Tarsonemidae and another phytophagous mite i.e *Brevipalpus phoenicis* (Geisk) belonging to the family Tenuipalpidae under the order Prostigmata were recorded from the above mentioned plants (Table 3). In addition to this, eleven species of phytoseiid mite belong to the genera, *Amblyseius*, *Typhlodromips*, *Euseius* and *Scapulaseius*, *Phytoseius*, *Paraphytoseius*, *Neoseiulus*, *Asperoseius* and *Phytoscutus* under the order Mesostigmata were identified (Table-1). Furthermore, two new species belong to the genus *Scapulaseius* and one new species belong to the genus *Phytoscutus* were recorded during the period of investigation. Moreover, under the genus *Amblyseius* one species, *Amblyseius largoensis* under the genus *Euseius*, two species viz. *Euseius alstoniae* and *Euseius ovalis* were recorded from the same order of phytoseiid mite. *Typhlodromus* (*Anthoseius*) sp. is the predatory mite specie that was recorded from the genus *Typhlodromips*. Similarly, *Scapylaseius asiaticus*, *Scapylaseius* sp. nov. 1 and *Scapylaseius* sp. nov. 2 are only the phytoseiid mites that were recorded form the genus *Scapulaseius* and *Neoseiulus paspalivorus* is only the phytoseiid mite that was recorded from the genus *Neoseiulus*. Likewise, under the genus phytoseius one species i.e *Phytoseius kapuri* and under the genus *Paraphytoseius* one species of phytoseiid mite *Paraphytoseius orientalis* was documented. One new species of phytoseiid mite i.e *Phytoscutus* sp. nov.1 was recognized from the surveyed areas in Orissa. Besides that, some predatory mites belonging to the family viz. Tydeidae, Bdellidae, Ascidae and Cunaxidae under the order Prostigmata were recorded during the period of investigation in association with various phytophagous mites in Orissa (Table 2). The present study revealed that the agro-horticultural flora in Orissa is harboured very diverse range of phytophagous as well as predatory mite but rich number predatory mite fauna occurred in Agri-horticultural crops and forest plant also. The major and predominant phytophagous mites are *Tetranychus urticae*, *Eutetranychus orientalis* and *Oligonychus* sp. were found in association with *Oryza sativa*, *Capsicum annuum*, *Musa acuminate*, *Gossypium* sp, *Syzygium cumini*, *Tabernaemontana* sp, *cassia tora*, *Ficus carica*, *Jatropha curcas*, *Artocarpus heteophyllus*, *Polyalthis longifolia*, *Mikania micrantha*, *Minikara zapota*, *Mangifera indica* and unknown forest plants (Table 3). The phytoseiid mites belonging to the genera *Amblyseius*, *Euseius*, *Typhlodromus* *Scapulaseius*, *phytoseious* and *Paraphytoseious* have been considered as important predator of *Polyphagotarsonemus latus*, *Tetranychus urticae*, *Eutetranychus orientalis*, *Brevipalpus phoenicis* as well as aphid, thrips, whiteflies [20] which is a confirmatory of the present findings.

Amblyseius largoensis



Eusieus ovalis

Eusieus alostoniae

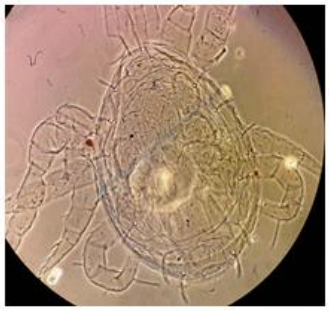
Scapulseius sp. *Nov*.

Typhlodromus (Anthoseius) sp.

Phytocsutus sp. *Nov*.

Phytoseius orientalis

Phytoseius kapuri



Asperoseius sp.

Neuseiulus paspalivorus

Table 1: Predatory mite fauna belong to the order Mesostigmata associated with diverse agro-horticultural crops in Orissa

Predatory mite order Mesostigmata, Family: Phytoseiidae	**Name of the prey mites**	**Host habitat**	**Distribution in Orissa**	**Geographical location**
Euseius alstoniae (Gupta, 1975)	*Polyphagotarsonemus latus, Tetranychus sp.*	*Tabernaemontana* sp *Gossypium* sp Forest plant	Chilka Lake	19° 42' 53.64" N 85° 11' 15.72" E
			Nandankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Euseius ovalis (Evans, 1953):	*P. latus, Tetranychus sp.*	*Tabernaemontana sp, Gossypium* sp, Forest plant	Chilka Lake	19° 42' 53.64" N 85° 11' 15.72" E
			Nandankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Typhlodromus (*Anthoseius*) sp1.	*P. latus Tetranychus sp.*	Forest Plant *Mimosa pudica Cassia tora* Forest plant	Nandankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Udaigiri	20° 11' 23.42" N 84° 26' 21.40" E
Phytoseius kapuri (Gupta, 1969b)	*P. latus, Tetranychus sp.*	*Ziziphus jujuba Mikania micrantha Clerodendrum infortunatum Musa* sp	Chilka	19° 42' 53.64" N 85° 11' 15.72" E
			Nandankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Amblyseius largoensis (Muma)	*Polypgagotarsonemus latus* (Bank), *Tetranychus* sp.	*Cassia tora Gossypium* sp *Polyalthis longifolia* Kocha plant *Mangifera indica* Forest plant *Mikania micrantha, Ziziphus jujuba Manikara zapota Syzygium cumini, Artocarpus heteophyllus,*	Chilka	19° 42' 53.64" N 85° 11' 15.72" E
			Nandankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E 19°
			Puri	48' 1.58"N 85° 49' 36.3" E
			Udaigiri	20° 11' 23.42" N 84° 26' 21.40" E
		Pisidium guajava, Musa sp *Ficus carica*		
Scapulaseius asiaticus (Evans)	*P. latus, Tetranychus sp.*	*Clerodendrum*	Chilka Lake	19° 42' 53.64" N

		infortunatum *Mimosa pudica* *Musa sp.*		85° 11' 15.72" E
			Nandankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Paraphytoseius orientalis (Narayanan, Kaur & Ghai, 1960)	*Tetranychus urticae, P. latus*	*Ziziphus jujuba,* *Musa sp* *Pisidium guajava*	Udaigiri,	20° 11' 23.42" N 84° 26' 21.40" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Neoseiulus paspalivorus (De Leon, 1957)	*Tetranychus urticae* *P. latus*	*Musa sp*	Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Asperoseious sp.	*Tetranychus* sp. *P. latus*	*Ziziphus jujuba* *Forest plant*	Udaigiri n	20° 11' 23.42" N 84° 26' 21.40" E
Phytoscutus sp. nov.1	*Tetranychus* sp. *P. latus*	*Syzygium cumini*	Nanadankana	20° 23' 23.49" N 85° 49' 28.70" E
Scapulaseius sp. *nov. 1*	*Tetranychus sp.* *P. latus*	*Gossypium* sp *Mikania micrantha,*	Chilka	19° 42' 53.64" N 85° 11' 15.72" E
			Nana Nanadan	20° 23' 23.49" N 85° 49' 28.70" E
Scapulaseius sp nov. 2	*Tetranychus* sp. *P. latus*	*Gossypium* sp *Mikania micrantha*	kandankanan	20° 23' 23.49" N 85° 49' 28.70" E

Table 2: Predatory mite fauna belong to the order Prostigmata associated with diverse agro-horticultural crops in Orissa

Predatory mite order: Prostigmata	**Name of the prey mites**	**Host habitat**	**Distribution in Orissa**	**Geographical location**
Family: Tydeidae Genus: *Tydeus* sp.	*T. macfarlanei P. latus* *A. mangiferae* *T. urticae* *Brevipalpus* sp	*Clerodendrum infortunatum* *Polyalthis longifolia Mikania micrantha* *Ziziphus jujuba,* *Artocarpus heteophyllus*	Chilka,	19° 42' 53.64" N 85° 11' 15.72" E
			Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Udaigiri	20° 11' 23.42" N 84° 26' 21.40" E
Family: Bdellidae Genus: *Bdelloides* sp.	*P. latus Brevipalpus* sp.	*Cassia tora, Syzygium cumini Shoea robusta*	Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
Family: Ascidae *Lasioseius sp* Bhattacharya	*S. spinki* *T. urticae* *P. latus* Mealy bug	*Cassia tora*	Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
Ascidae melichares	*T. urticae* *P. latus*	*Forest plant*	Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
Family: Cunaxidae *Cunaxoides* sp.	*T. urticae* *P. latus* *B. phoenicis*	*Clerodendrum infortunatum* *Tabernaemontana* sp, *Ficus carica*, Forest plant	Chilka,	19° 42' 53.64" N 85° 11' 15.72" E
			Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
			Udaigiri	20° 11' 23.42" N 84° 26' 21.40" E
			Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
			Pure	19° 42' 53.64" N 85° 11' 15.72" E

Table 3: Phytophagous mite fauna belong to the order Prostigmata associated with diverse agro-horticultural plants in Orissa

Order: Prostigmata, Family: Tetranychidae	**Host habitat**	**Distribution in Orissa**	**Geographical location**
Tetranychus sp (Koch)	*Syzygium cumini* *Forest plant* *Tabernaemontana* sp	Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
		Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Eutetranychus sp (Klein)	*Cassia tora* *Jatropha curcas* *Ficus carica* Forest plant *Tabernaemontana* sp	Chilka	19° 42' 53.64" N 85° 11' 15.72" E
		Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
		Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
		Puri	19° 42' 53.64" N 85° 11' 15.72" E
Oligonychus sp.	*Cassia tora* *Musa* sp.	Chilka	19° 42' 53.64" N 85° 11' 15.72" E
		Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E

Family: *Tarsonemidae*			
S. spinki	*Oryza sativa*	Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Polyphagotarsonemus latus (Bank)	*Capsicum annum*	Puri	19° 42' 53.64" N 85° 11' 15.72" E
		Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E
Family: Tenuipalpidae			
Brevipalpus phoenicis (Geisk)	*Jatropha curcas* *Polyalthis longifolia*	Nanadankanan	20° 23' 23.49" N 85° 49' 28.70" E
		Khandagiri	20° 15' 31.96" N 85° 47' 18.52" E

4. Conclusion

The present investigation shows that both the phytophagous and predatory mite fauna is accompanying with the agro-horticultural crops of Orissa. The potential of some predatory mites namely *Euseius alstoniae* (Gupta), *Euseius* ovalis, *Typhlodromus* (*Anthoseius*) sp., *Phytoseius kapuri*, *Paraphytoseius orientalis*, *Amblyseius largoensis* (Muma) and *Scapulaseius asiaticus* (Evans) *Neoseiulus paspalivorus* and *Phytoscutus* sp. belonging to the family phytoseiid were found as natural enemies of phytophagous mite pests. The other important predatory mites belong to the family Tydeidae, Bdellidae, Ascidae and Cunaxidae were also observed in employing natural suppression of harmful plant feeding mite pests in Orissa.

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