

Studies on the distribution and role of phytoseiid predatory mites associated with rice ecosystem in West Bengal

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ABSTRACT

To explore the diversity of predatory mite fauna on rice plants an investigation was carried out in the District Seed Farm, BCKV, West Bengal. The predatory mite population associated with rice ecosystem was recorded in 15 varieties from basal and apical canopies on 3rd November, 2015. The predatory mite species *Neoseiulus*, *Lasioseius* and *Amblyseius* belonging to Phytoseiidae family were found. The genus *Neoseiulus* include occurrence of 2 predominant species namely *N. imbricatus* (Corpuz-Raros and Rimando) and *N. pranadae* Karmakar and Gupta while *Lasioseius Parberlesei* Bhattacharyya belonging to the family Ascidae was also observed. Some other predatory mites belonging to families Bdellidae, Ascidae, Tydidae were also recorded. The predatory mite most abundantly found in almost all the varieties was *N. imbricatus*. Among the four phytoseiid species documented on different rice plant canopies at various positions had different male to female ratio. The females of all the four different mites of phytoseiid group were found more abundant over the males.

Keywords : Biological control, *Neoseiulus imbricatus*, phytoseiid mites, rice ecosystem

Predatory mites deserve special mention in an agricultural based country like India, where agriculture is always under the threat of constant pest attack. Predatory mites of the family Phytoseiidae constitute a highly significant beneficial group on account of their vital role in the maintenance of pest population below economic injury level, known as biological control. Predatory mites are now valued with growers worldwide as natural enemies that provide effective pest control in greenhouses and on agricultural crops (Bjorson, 2008). Phytoseiid mites have received global attention since the 1950's due to their importance as natural predators of phytophagous mites and small insects and therefore are useful in the biological and integrated control of crop pests (Swirskii *et al.*, 1997). Rice (*Oryza sativa* L) is the most important food crop in the world and primary staple food for more than a third of the world's population (Zhao *et al.*, 2011) and for more than 70 per cent of the poor (Hijam *et al.*, 2017). India is the largest rice growing country in world, where the state West Bengal is the rice bowl of the country covering an area of 6.18 million hectare with the annual production of 15.024 million tons (Anon., 2014). Among the mite species encountered in association with rice the major ones belongs to the tetranychid mite, *Oligonychus oryzae* Hirst, *Oligonychus indicus* Hirst, *Schizotetranychus andropogonii* Hirst and tarsonemid mite, *Steneotarsonemus spinki* Smiley. The rice sheath mite, *Steneotarsonemus spinki* Smiley, was observed as a serious pest of rice in West Bengal affecting Kharif paddy (Karmakar 2008). It was reported that predatory mites of the family Phytoseiidae are the most common predators of phytophagous mites from the

Tetranychidae and Eriophyidae families. Predators have been used as components of integrated pest management programs to manage rice sheath mite (*Steneotarsonemus spinki*). In Asia, four predaceous mites of importance were identified during the 1977-1978 outbreak of *S. spinki*, including *Amblyseius taiwanicus* Ehara (Acari: Phytoseiidae) and *Lasioseius parberlesei* Bhattacharyya (Acari: Ascidae) (Lo and Ho, 1979). Other predatory mite species that have been found in association with *Steneotarsonemus spinki* include *Cheiroseius serratus* (Halbert) and *Cheiroseius napalensis* (Evans & Hyatt) (Acari: Ascidae) (Tseng, 1984). Mites in the family Phytoseiidae and predatory thrips (Thysanoptera) have been observed preying on *Steneotarsonemus spinki* in Dominican Republic (M. Pellerano, Pers. Obs.). In Cuba, several species of Phytoseiidae (*Galendromus alveolaris* (De Leon), *Galendromus longipilus* (Nesbitt), *Galendromus sp.*, *Neoseiulus paraibensis* (Moraes & Mc Murtry), *Neoseiulus baraki* Athias-Henriot, *Neoseiulus paspalivorus* De Leon, *Proprioseiopsisasetus* (Chant), and *Typhlodromus sp.* have been reported to prey on *Steneotarsonemus spinki* (Cabrera *et al.*, 2003 and Ramos *et al.*, 2005). Research studies on phytophagous and predatory mites species belonging to the family Phytoseiidae associated with rice ecosystem from four habitats *viz.* paddy leaf, stored paddy, paddy husk, associated weeds and accumulated water in paddy field have been identified and listed in table 1 along with their period of occurrence. Among the predatory mites, *Neoseiulus imbricatus* and *N. fallacies* were quite common and may be of some importance as bio-control agents against paddy leaf mite.

Table 1: Research studies on list of phytophagous and predatory mite species (Phytoseiidae) collected from different habitats in rice ecosystem along with period of occurrence.

Predatory group	Period of occurrence	Paddy husk	Stored paddy	Paddy leaf	Associated weeds	Accumulated water
Order:						
Mesostigmata						
Phytoseiidae						
<i>Neoseiulus imbricatus</i>						
Corpuz – Raros & Rimando	2, 3, 10,14, 15	–	–	+	–	–
<i>N. baraki</i> (Athias –Henriot)	2, 3, 9,14, 15	–	–	+	–	–
<i>N. longispinosus</i> (Evans)	3, 4, 5, 10,14, 15, 16	–	–	+	+	–
<i>N. fallacis</i> (Garman)	2, 3, 11,14, 15	–	–	+	–	–
<i>Euseius ovalis</i> (Evans)	5, 6, 12,15, 16	–	–	+	+	–
<i>Paraphytoseius bhadrakaliensis</i> (Gupta)	5, 6, 11,15, 16	–	–	+	+	–
<i>Paraphytoseius orientalis</i> (Narayan & Ghai)	5, 6, 10,15, 16	–	–	+	+	–
<i>Amblyseius largoensis</i> (Muma)	5, 6, 9,15, 16	–	–	–	+	–
Ascidae	1, 10, 13 –	–	+	–	–	–
<i>Blattisocius tarsalis</i> (Berlese)						
<i>Lasioseius mcgregori</i> Chant	2, 3, 11,14, 15	–	–	+	–	–
Fungal feeder Uropodidae						
<i>Fuscuropoda sp.</i>	2, 3, 12,14, 15	+	+	–	–	–

Note : Explanation of notations (numerical figures indicate the period of occurrence): [1 – Jan, 2014; 2 – Feb, 2014; 3 – Mar, 2014; 4 – Apr, 2014; 5 – May, 2014; 6 – June, 2014; 9 – Sep, 2014; 10 – Oct, 2014; 11 – Nov, 2014; 12 – Dec, 2014; 13 – Jan, 2015; 14 – Feb, 2015; 15 – Mar, 2015; 16 – Apr, 2015].

But this needs to be confirmed through future study. Gupta (2012) also reported *Neoseiulus fallacies*, *N. imbricatus* and *Euseius ovalis* occurring in paddy leaves. But, very limited studies have been done on the abundance of individual species of the Phytoseiidae family, against phytophagous mites in rice under Bengal basin. Thus the present study was conducted with the objective to study the distribution and role of phytoseiid predatory mites associated with rice crop and with a view to ecofriendly and sustainable management of the sheath mite.

The experiment was carried out in the District Seed Farm, D-Block, of BCKV, Kalyani, Nadia, West Bengal and the specimens were collected on 3rd November, 2015. This particular date was chosen for predatory population count and collection as it was near harvest period or matured crop stage when the phytophagous mite and (*Steneotarsonemus spinki*. Smiley) population was at pinnacle which gave a logical approach to encounter highest number of corresponding predatory population at this time. The predatory mite population associated with rice ecosystem was recorded for all the fifteen varieties separately. The predatory mites population was counted by following the “beating and jerking” method. The data was taken separately for each of rice cultivars

those were utilised in screening experiment from foliar and basal canopy of rice plant distinctly. The upper canopy of rice plant was jerked or beaten on dark porcelain tray and the predatory population for foliar canopy was counted, there after the foliar portion were cut with a knife and the basal plant part along with roots were uprooted and were beaten against the dark porcelain tray and again the mites were counted. Simultaneously the specimens were collected in air-tight vials filled 3/4th part with 70 per cent alcohol. Permanent slides were prepared to proceed for species identification in acarological laboratory in the Department of Agricultural Entomology. The mite fauna were collected by the author itself and identified by Dr. Krishna Karmakar, (Associate Professor in Department of Entomology at BCKV, Mohanpur, Nadia). Slide accession numbers are as mentioned: *Neoseiulus imbricatus* 5909 to 5967, *N. pranadae* 5968 to 5973 and *Lasioseius parberlesei* 5974 to 6009. Phytoseiid mites those were extracted from the rice cultivars were mounted on glass slide in Hoyers’ medium and were examined and identified using Olympus phase contrast microscope model (BX-41) equipped with drawing tube (Olympus optical company limited) following Chant and McMurty (2003).

The predatory mite population associated with rice

Table 2: Occurrence of predatory mites in association with rice and their canopy wise proportional distribution on different rice lines in West Bengal

Sl. no	NAME OF THE	RG- 182-2	BCKV 1	BCKV 2	BCKV 4	BCKV 6	BCKV 7	BCKV 8	IET 4786	MASOORI 253-3	RG- 271-5	RG- 376-3	GOVINDO BHOG 2-1	S-683-842-2	HS- 842-2	Total No.
PREDATORY																
MITE Sp.																
1.	<i>Neoseiulus imbricatus</i>	B	F	B	F	B	F	B	F	B	F	B	F	B	F	67
2.	<i>Neoseiulus pranadae</i>	B	F	B	F	B	F	B	F	B	F	B	F	B	F	8
3.	<i>Lasioseius parberlesei</i>	B	F	B	F	B	F	B	F	B	F	B	F	B	F	50
4.	<i>Amblyseius n. sp.</i>	B	F	B	F	B	F	B	F	B	F	B	F	B	F	01
5.	<i>Ascoid sp.</i>	B	F	B	F	B	F	B	F	B	F	B	F	B	F	02
6.	<i>Bdella sp</i>	B	F	B	F	B	F	B	F	B	F	B	F	B	F	03
7.	Tydeids	B	F	B	F	B	F	B	F	B	F	B	F	B	F	-
Total																131

ecosystem was recorded for all the fifteen varieties separately and separate data was collected for different canopies like basal and foliar canopies on a particular date *i.e.* 3rd of November, 2015. This particular date was chosen for this experiment as during this period the plants were matured and the host mite population *i.e.* *Steneotarsonemus spinki* Smiley and thus the predatory mite population were at pinnacle, so documentation and for specimen collection this time was most congenial. The predatory mite species belonging to Phytoseoid super family were found belonging to three genera *i.e.* *Neoseiulus*, *Lasioseius* and *Amblyseius*. Among the *Neoseiulus* genera two species namely *N. imbricatus* (Corpuz-Raros and Rimando) and *N. pranadae* Karmakar and Gupta were recorded and species of *Lasioseius* genera belonging to Ascidae family was *Lasioseius Parberlesei* Bhattacharyya. Some other predatory mites belonging to families Bdellidae, Ascidae, Tydidae were also recorded and collected. The predatory mite which was most abundantly found in almost all the varieties was *Neoseiulus imbricatus* (Corpuz-Raros and Rimando) *i.e.* 67 numbers per fifteen hills. Maximum population of this predatory mite was found on the foliar canopy rather than basal canopy of the rice plant. Highest population was observed in variety RG-376-3 (8nos per hill) and least was found in RG-253-3, RG-271-5 and S-683-2-1 as shown in table 2.

The second highest predatory mite population was identified as *Lasioseius parberlesei* Bhattacharyya *i.e.* 50 no. per fifteen hills and most of the population was found on basal canopy of rice plant. The cultivar which harboured maximum population of this predatory mite was BCKV 7, (14 no. per hill) and least or nil was observed in Masoori, RG-253-3 and RG-271-5. The next abundant predatory mite recorded was *Neoseiulus pranadae i.e.* 8 nos. most were found on the foliar canopy of rice plant. Other specimens collected were belonging to *Bdella sp.* (3 no.), *Ascoid sp.* (2 no.), *Amblyseius n.sp.* (1 no.) and Tydeids (nil) as revealed in (Table 2). The reason behind finding these other species on the foliar canopy is to predate upon some of the foliar phytophagus mite species but not the rice sheath mite.

The four phytoseiid species predominantly present as documented in this experiment on different canopies of rice plant had different male to female ratio (Table 3). The maximum specimen collected were females of all the four different mites of phytoseiid group. Among them *Neoseiulus imbricatus* (Corpuz-Raros and Rimando), altogether having 67 specimens out of which 63 were found to be females rest 4 were males. In case of *Lasioseius parberlesei*, 50 specimens were collected and 43 of which were females rest 07 were males. Likewise for *Neoseiulus pranadae* Karmakar and Gupta, out of 08 specimens all were females and only one *Amblyseius n. sp.* specimen was collected which was found to be female as illustrated in (Fig. 1).

The present findings regarding dominance of

Table 3: Occurance of phytoseiid mite species in rice ecosystem based on sex proportion of different species in West Bengal:

Sl. no	Predatory mite sp.	Total specimens	Male	Female
1.	<i>Neoseiulus imbricatus</i> (Corpuz-Raros and Rimando)	67	04	63
2.	<i>Lasioseius parberlesei</i> Bhattacharyya	50	07	43
3.	<i>Neoseiulus pranadae</i> Karmakar and Gupta	08	00	08
4.	<i>Amblyseius n.sp</i>	01	00	01

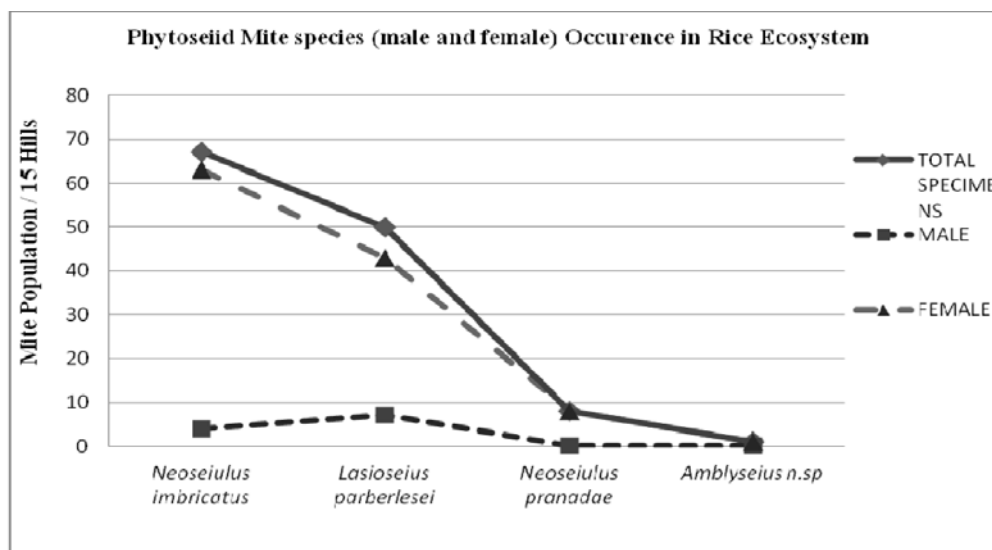


Fig. 1: Occurrence of different phytoseiid mite (Male and female) in Rice Ecosystem

Neoseiulus imbricatus on paddy crop was confirmatory with the findings of Gupta (2012) and Mukhopadhyay *et al.* (2015) stating that among the predatory mites, *Neoseiulus imbricatus* and *N. fallacies* were quite common and may be of some importance as bio-control agents against paddy sheath mite. Then according to Gupta (2012) *Neoseiulus fallacies*, *Neoseiulus imbricatus* and *Euseius ovalis* occurs in paddy leaves dominantly. Literature is also available regarding Predatory mites feeding on all life stages of many small arthropods and target pest spider mites (Patterson and Ramirez, 2012). The Phytoseiid mites, especially those belonging to genera like *Amblyseius*, *Neoseiulus* and *Euseius* have been considered as important predators of tetranychids, eriophyids, tarsonemids, thrips, white flies and so on as reported by (Mc Murty and Rodriguez, 1989).

From the above study it can be concluded that among the four phytoseoid species documented in this experiment on different canopies of rice plant having different male to female ratio the dominance of *Neoseiulus imbricatus* on paddy crop is maximum and female predatory mite population was much higher than

the male population and it may have some ecofriendly importance as bio control agents against paddy sheath mite.

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