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Diversity and Community Structure of Mite Fauna Associated with Pulse Crops in West Bengal

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ABSTRACT

Background: An exploratory survey programme was carried out to know the diversity and community structures of predatory and phytophagous mite fauna associated with pulses crops in West Bengal aiming for the development of a better and ecologically sound mite pest management strategy.

Methods: Mite samples were collected from different agro-climatic zones of West Bengal and the specimens were brought to the AINP on Agricultural Acarology Laboratory, BCKV, Mohanpur for mounting on glass slides by using modified Berlese's medium. The slides were then kept on slide wormer at 35-40°C for 5-7 days to process and then mites were examined with a phase contrast microscope.

Result: Altogether 13 species of Phytoseiid mites namely *Amblyseius largoensis, Amblyseius herbicolus*, *Amblyseius bengalensis, Amblyseius parbatabasii, Amblyseius dahlia, Euseius alstoniae*, *Euseius ovalis*, *Paraphytoseius orientalis, Typhlodromips syzygii*, *Scapulaseius asiaticus*, *Scapulaseius moraesi, Phytoseius kapuri* and *Neoseiulus pranadae* were recorded. Among them *Neoseiulus pranadae* was found as a predominant species associated with pulse crops, constituting 35.36% of the total Phytoseiid mite population followed by *Amblyseius largoensis* and *Typhlodromips syzygii* accounting 23.04 and 10.87 % of total phytosiid mite population, respectively. Phytoseiid family has been recognized as a beneficial group of mites that could be utilized for controlling harmful phytophagous mites as well as soft-bodied insect pests. Other predatory mites under the families Bdellidae, Ascidae, Stigmaeidae, Cunaxidae and Cheyletida were also recorded during the period of investigation. *Tetranychus urticae, Eutetranychus orientalis, Schizotetranychus baltazari* and *Schizotetranychus cajani* were identified as destructive phytophagous mite pests associated with pulse crops in West Bengal.

Key words: Diversity, Mite fauna, Pulse crops.

INTRODUCTION

India is the second largest producer of pulse crops after China, producing 133.84 lakh tons of pulses accounting 22 per cent of the world's production from an area of 223.91 lakh ha, constituting 33 per cent of world's areas (Bera and Nandi, 2010). Pulses are the cheapest source of dietary amino acids, vitamins and minerals. These have twice quantity of proteins than whole grains like rice, wheat, oats and barley, that's why pulses is considered as a poor man's meat (Cyanam, 2020). In West Bengal, significant pulse cultivation is mainly confined in the districts of Malda, Murshidabad, Nadia, Birbhum, Midnapore and North 24 Parganas contributing approximately 384 thousand metric tons of pulses in the year 2018 (Ray *et al.,* 2013). Various insect pests and mites like spider mite (*Tetranychus* spp.), aphid (*Aphis craccivora*), whitefly (*Bemisia tabaci*), thrips (*Megalurothrips distalis*), spotted pod borer (*Maruca vitrata*), gram pod borer (*Helicoverpa armigera*), plant bug (*Riptortus pedestris*), pod bug (*Clavigralla gibbosa*) and blue butterfly (*Catochrysops strabo*) have been identified as major threats to pulse crops in West Bengal condition (Biswas and Banerjee, 2019). The annual yield losses due to insect pests and diseases have been estimated about 18-20% and 8-10%, respectively (Dhar and Ahmad, 2004). Predatory mites from the Phytoseiidae family have been recognized as a beneficial group of mites that could be utilized for controlling of harmful phytophagous mites as well as soft-bodied insect pests (Bala *et al.,* 2019; Bala and Karmakar, 2021). Several authors have documented mite fauna associated with agro-horticultural crops (Bala and Karmakar, 2022a), fruit crops (Karmakar, 2018) vegetable crops (Bala and Karmakar, 2022b) and flowers (Bala and Karmakar, 2023) from West Bengal. But comprehensive reports on mite fauna associated with pulse crops are lacking in West Bengal. Hence to fulfil these lacunae, the present study was undertaken to explore the diversity of mite fauna associated with pulse crops in West Bengal condition.

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MATERIALS AND METHODS

Study area

Mite samples were collected from different agro climatic zones of West Bengal, mainly covering the districts of Nadia,

Malda, Murshidabad, Burdwan, North 24 Parganas, South 24 Parganas, Darjeeling, Jalpaiguri and Cooch Behar.

Collection and preservation of specimens

The mite fauna harboured in different pulse crops was examined by making an extensive survey covering different locations of West Bengal during the year 2021-2023. Different mite samples were collected and examined for identification. Phytoseiid mites are generally bigger in size and fast-moving in nature. They were collected directly from the plants with the help of fine camel hair brush (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 collecting the dislodged mites by using a single hair brush. The mite specimens were preserved in separate small plastic vials containing 70% alcohol mentioning the name of the host plant and the location.

Identification of specimens

The specimens were brought to the All India Network Project (AINP) on Acarology Laboratory, Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, West Bengal. The collected mite specimens were transferred in a cavity block and mounted on glass slides using modified Berlese's medium for identification. Slide preparation was done with the help of Stereozoom microscope. The slides were dried by keeping on a hot plate at 35-40°C for 5-7 days. The mites were examined under a phase contrast microscope (BX 53, Olympus, Japan) and the species were identified following the keys provided by Chant and McMurty (2007).

Statistical analysis

To understand the diversity and community structure of different Phytoseiid and Phytophagous mites in different locations, the number of specimens for each species was enumerated reflecting the species richness (S) and the diversity and evenness indices calculated based on the formula provided by Simpson (1949); Shannon-Weiner (1963) and Pielou's (1975).

Shannon's diversity index

$$(H) = - \sum_{i=1}^{S} p_i \ln p_i$$

Where,

P = Proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N),

In= Natural log.

Σ = Sum of the calculations.

'S' = Number of species.

The effective number of species (ENS) of each location was calculated taking the exponential of H.

Simpson's index

$$(D) = 1 \frac{N (N - 1)}{\sum_{i=1}^{S} n (n - 1)}$$

Where,

N = Total number of individuals in a community.

'n' = Number of individuals of a particular species.

Species evenness was calculated from Pielou's evenness index (E).

$$\text{Pielou's evenness index (E)} = \frac{H}{\ln (s)}$$

Where,

H = Shannon's diversity index.

's' = Total number of species in the surveyed area (Pielou, 1975).

RESULTS AND DISCUSSION

An exploratory survey programme was conducted during the year 2021 to 2023 to identify the mite fauna associated with pulse crops in West Bengal. Ten districts namely Nadia, Malda, Murshidabad, Burdwan, North 24 Parganas, South 24 Parganas, Darjeeling, Jalpaiguri and Cooch Behar of West Bengal were surveyed. Different pulse crops like lentils, green gram, black gram, pigeon pea, dolichos bean, Bengal gram, chick pea, lathyrus, garden pea, bean *etc*. were examined and near about 2180 mite specimens were collected. Altogether 13 species of Phytoseiid mites *viz.*, *Amblyseius largoensis, Amblyseius herbicolus*, *Amblyseius bengalensis, Amblyseius parbatabasii, Amblyseius dahlia, Euseius alstoniae*, *Euseius ovalis*, *Paraphytoseius orientalis, Typhlodromips syzygii*, *Scapulaseius asiaticus*, *Scapulaseius moraesi, Phytoseius kapuri, Neoseiulus pranadae* were recorded (Table 1). Moreover, under the genus *Amblyseius,* five species like *Amblyseius largoensis, Amblyseius herbicolus, Amblyseius bengalensis, Amblyseius parbatabasii* and *Amblyseius dhaliae* and under the genus *Euseius,* two species *viz. Euseius alstoniae* and *Euseius ovalis* were recorded. Similarly, under the genus *Scapulaseius,* two species like *Scapulaseius moraesi, Scapulaseius asiaticus* were recorded. Single species under the genera *Paraphytoseius (Paraphytoseius orientalis),Typhlodromips (Typhlodromips syzygii), Phytoseius (Phytoseius kapuri)* and *Neoseiulus (Neoseiulus pranadae)* were recorded. The Phytoseiid mite, *Neoseiulus pranadae* comprised 35.36 per cent of the total Phytosiid mite population followed by *Amblyseius largoensis* and *Typhlodromips syzygii* accounting 23.04% and 10.87% of total Phytoseiid mite population, respectively (Fig 1). The species*, Neoseiulus pranadae* was recorded as the dominant predatory mite found in surveyed areas. Similarly, *Amblyseius parbatabasii* was observed as a predominant species in the Darjeeling district, *Amblyseius bengalensis* and *Amblyseius herbicolus* were regularly found in Cooch Behar and Jalpaiguri districts, *Euseius alstoniae* and *Euseius ovalis* were abundantly found in Nadia, North 24 parganas, South 24 parganas, Malda, Murshidabad and Burdwan districts of West Bengal. Other important predatory mites belong to the families Bdellidae, Ascidae, Stigmaeidae, Cunaxidae

Table 1: Predatory mite fauna associated with different pulse crops in West Bengal.

Order: Mesostigmata Family: Phytoseiidae	Host habitat	GPS Coordinates		Distribution	Associated arthropods
		Latitude	Longitude		
Amblyseius largoensis (Muma)	Green gram,	23°29′ 18.24″N	88°28′8.983′E	Nadia	*Tetranychus* spp.
	Dolichos bean,	24°57′07.0″N	87°59′33.9″E	Malda	*Polyphagotarsonemus latus*
	Pigeon pea,	22°25′5.66″N	88°48′38.63″E	24 Parganas(N)	*Oligonuchus* spp.
	Black gram,	23°14′46.10′N	87°52′41.12″E	Burdwan (East)	*Brevipalpus* spp.
	Bengal gram	23°15′0.720′N	87°52′9.768″ E	Burdwan (West)	
	lentil	22°2′6.288″N	88°25′39.98″E	24 Parganas (S)	
Amblyseius herbicolus (Chant)	Bean,	26°31′15.88″N	88°43′38.78″E	Jalpaiguri	*Tetranychus urticae*
	Black gram				*P. latus*
					Eriophyid mites
Amblyseius bengalensis (Karmakar *et al*., 2017)	Green gram,	26°31′15.88″N	88°43′38.78″E	Jalpaiguri	*Tetranychus* spp.
	Bengal gram,	26°19′25.93″N	89°27′3.585″E	Cooch Behar	*P. latus, Brevipalpus*
	Lentil				sp.mealy bug
Amblyseius dahlia (Karmakar *et al.,* 2017)	Lentil	26°31′15.88″N	88°43′38.78″E	Jalpaiguri	*Polyphagotarsonemus latus Brevipalpus*
		26°19′25.93″N	89°27′3.585″E	Cooch Behar	spp.Eriophyid mites
		22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	
Amblyseius parbatabasi (Karmakar *et al*., 2017)	Black gram,	27°2′9.6252″N	88°15′45.62″E	Darjeeling	*Tetranychus* spp.
	Green gram				*Polyphagotarsonemus latus* mealy bug
Euseius alstoniae (Gupta, 1975)	Blackgram	22°59′15.3″N	88°25′30.9″E	Nadia	*Tetranychus urticae*
		24°24′55.5″N	88°15′43.6″E	Murshidabad	*Polyphagotarsonemus*
		22°25′5.66″N	88°48′38.6″E	24 Parganas (N)	*latus*
		24°57′07.0″N	87°59′33.9″E	MaldaBurdwan (East)	Eriophyid mites
		23°14′46.10″N	87°52′9.76″E		
Euseius ovalis (Evans 1953)	Dolichos bean,	26°31′15.89″N	88°43′38.78″E	Jalpaiguri	*Tetranychus urticae*
	Bean,	24°24′55.5″N	88°15′43.6″E	Murshidabad	*Polyphagotarsonemus*
	Chickpea,	22°59′15.3″N	88°25′30.9″E	Nadia	*latus*
	Lathyrus,	22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	Pupa of whitefly
	Black gram	23°14′46.10″N	87°52′41.12″E	Burdwan (East)	Eriophyid mite
		23°15′0.720″N	87°52′9.768″E	Burdwan (West)	
Paraphytoseius orientalis (Narayanan, Kaur and Ghai)	Dolichos bean,	22°59′15.3″N	88°48′38.63″E	Nadia	*Tetranychus urticae*
	Pigeon pea	22°2′ 6.288″N	88°25′39.98″E	24 Parganas (S)	*Polyphagotarsonemus*
		23°14′46.10′N	87°52′41.12″E	Burdwan (East)	*latus*
		24°24′55.5″N	88°15′43.6″E	Murshidabad	*Brevipalpus*
		24°57′07.0″N	87°59′33.9″E	Malda	*phoenicis*

Table 1: Continue..

Table 1: Continue..

Typhlodromips syzygii	Green gram,	22°59′15.3″N	88°48′38.63″E	Nadia	*P. latus,*
(Gupta, 1975)	Lathyrus,	24°24′55.5″N	88°15′43.6″E	Murshidabad	*Tetranychus* spp.
	Lentil,	22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	
	Black gram				
Scapulaseius asiaticus	Black gram	22°59′15.3″N	88°48′38.63″E	Nadia	*Tetranychus* spp.
		24°24′55.5″N	88°15′43.6″E	Murshidabad	*P. latus*
(Evans, 1953)		22°25′5.66″N	88°48′38.63″E	24 Parganas(N)	Eriophyid mite
Scapulaseius moraesi	Black gram	22°59′15.3″N	88°48′38.63″E	Nadia	*Tetranychus* spp.
		24°24′55.5″N	88°15′43.6″E	Murshidabad	*P. latus*
		22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	Eriophyid mite
		23°14′46.10″N	87°52′41.12″E	Burdwan (East)	
		23°15′0.72″N	87°52′9.768″E	Burdwan (West)	
Phytoseius kapuri	Black gram	22°59′15.3″N	88°48′38.63″E	Nadia	*Tetranychus* spp.
(Gupta, 1969)		24°24′55.5″N	88°15′43.60″E	Murshidabad	Tarsonemid mite
		23°14′46.10″N	87°52′41.12″E	Burdwan (East)	Eriophyid mite
Neoseiulus pranadae	Green gram	22°59′15.3″N	88°48′38.63″E	Nadia	*Tetranychus* spp.,
	Black gram	24°24′55.5″N	88°15′43.6″E	Murshidabad	*P. latus*
	Lathyrus	22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	Eriophyid mite
	Chickpea			*Tenuipalpus* spp.	
	Pigeon pea				
	Lentil				
Order: Prostigmata					
Family: Stigmaeidae	Chickpea,	22°59′15.3″N	88°48′38.63″E	Nadia	Tarsonemid mite
Agistemus indudtani	Lathyrus	24°24′55.5″N	88°15′43.6″E	Murshidabad	*Tetranychus* spp.
	Pigeon pea				
Family: Cheyletidae	Lentil,	24°24′55.5″N	88°15′43.6″E	Murshidabad	Tarsonemid mite
Cheyletus sp.	Green gram	24°57′07.0″N	87°59′33.9″E	Malda	*Tetranychus* spp.
	Pigeon pea	22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	Mealy bug
Family: Cunaxidae	Garden pea	22°59′15.3″N	88°48′38.63″E	Nadia	Tarsonemid mite
Cunaxa sp.	Pigeon pea	24°24′55.5″N	88°15′43.6″E	Murshidabad	*Tetranychus* spp.
	Chickpea	22°2′6.288″N	88°25′39.98″E	24 Parganas (S)	*Brevipalpus* spp.
	Lentil				
	Black gram				
Family:Bdellidae	Black gram	22°59′15.3″N	88°48′38.63″E	Nadia	Tarsonemid mite
Bdelloides sp.	Pigeon pea	22°25′5.66″N	88°48′38.63″E	24 Parganas (N)	*Tetranychus* spp.
		24°57′07.0″N	87°59′33.9″E	Malda	Eriophyid mite
		23°15′0.72″N	87°52′9.768″E	Burdwan (West)	

Table 1: Continue..

Table 1: Continue..

Family:Ascidae	Black gram				
Lasioseius parberlesei		22°59'15.3"N	88°48' 38.63"E	Nadia	Tarsonemid mite
		24°57'07.0"N	87°59'33.90"E	Malda	*Tetranychus sp.*
		23°14'46.10"N	87°52'41.12"E	Burdwan (East)	whitefly
		23°15'0.72"N	87°52'9.768"E	Burdwan (West)	Eriophyid mite

Shannon's diversity (H¹) = 2.26
Effective number of species (EVS) = 6
Species dominance (D) = 0.84

and Cheyletidae under the order Prostigmata were also noted during the period of investigation and *Cunaxa* spp. was the dominant one accounting 37% of the total prostigmatid predatory mite population (Fig 2). So far as the diversity is concerned, maximum diversity of Phytoseiid mite population in terms of H1 = 2.26, with effective number of species 5 and highest dominance D = 0.84 was calculated which reflected that pulse crops is highly congenial for survival of few Phytoseiid mite species but not so favourable for others. Phytophagous mites, *Tetranychus urticae* (Koch.), *Eutetranychus orientalis (*Klein), *Schizotetranychus baltazari* (Hirst). *Schizotetranychus cajani* were also recorded and fed upon lentil, black gram, green gram, cowpea, pigeon pea, chickpea, lathyrus and garden pea *etc*. (Table 2). Among them, *Tetranychus urticae* was the most common species comprising 55.67% of the total plant-feeding mite population followed by *Eutetranychus orientalis* accounting 22.34% Phytophagous mite population and causes damage (Fig 3). The present findings are agreed with the findings of Maheswary *et al.* (2015); Singh and Chauhan (2014) and Roy and Gupta (2016), they reported that *Tetranychus urticae*, *Eutetranychus orientalis*, *Schizotetranychus baltazari*. *Schizotetranychus cajani* infesting on many agro-horticultural crops and causing enormous damage. The maximum diversity of the phytophagous mite was calculated with a Shannon diversity index H_1 = 2.13, corresponding effective number of species 3. Additionally, the highest dominance value (D) =0.78. These findings suggested that pulse crops provide favorable environment for the survival of phytophagous mites.

Predatory mites prey up on different species of arthropods was investigated and presented in Table1. In this context, *Amblyseius largoensis, Amblyseius herbicolus, Amblyseius bengalensis*, *Amblyseius dahlia, Euseius ovalis*, *Euseius alstoniae*, *Typhlodromips syzygii*, *Paraphytoseius orientalis*, *Neoseiulus pranadae*, *Scapulaseius asiaticus*, *Phytoseius kapuri*, *Bdelloides* spp. *Lasioseius parberlesei*, *Agistemus industani, Cunaxa* spp. and *Cheyletus* spp. were preyed on *Tetranychus* spp., *Eutetranychus orientalis, Oligonychus mangiferus, Brevipalpus phoenicis, Polyphagotarsonemus latus,* eriophyoid mites*,* mealy bug and pupae of whitefly. The present findings are in line with the authors of Karmakar and Gupta (2011); Bala *et al.* (2018) and Bala and Karmakar (2021) found that *Amblyseius largoensis*, *Amblyseius herbicolus, Typhlodromips syzygii, Paraphytoseius orientalis*, *Euseius ovalis, Cheyletogenes* spp., *Cunaxoides* spp. *Agistemus* spp. were accompanying with agro-horticultural crops and predated upon *Tetranychus* spp., *Polyphagotarsonemus latus*, *Brevipalpus* spp., Eriophyid mite and mealy bug *etc*. The findings of this studies are also similar with the observations 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). They stated that Phytoseiid

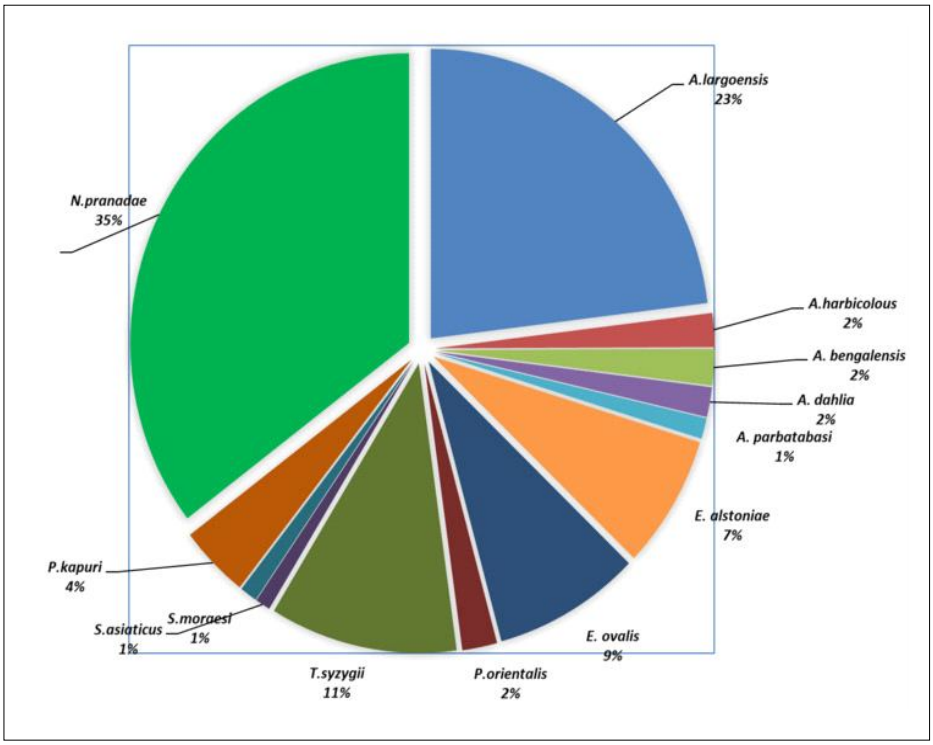

Fig 1: Relative abundance of phytoselid mite associated with pulse crops.

Table 2: Phytophagous mite fauna associated with different pulse crops in West Bengal.

Order: Prostigmata, Family: Tetranychidae	Host habitat	GPS Coordinates		Distribution
		Latitude	Longitude	
Tetranychus urticae	Black gram, Green gram, Broad bean, Cowpea, Mung bean, Lentil, Pigeon pea, Chickpea, Lathyrus Garden pea	22°59′15.3″N	88°48′38.6″E	Nadia
		23°14′32.0″N	87°53′47.2″E	Burdwan
		22°09′29.4″N	88°26′07.7″E	24 parganas (S)
		24°24′55.5″N	88°15′43.6″E	Murshidabad
		24°57′07.0″N	87°59′33.9″E	Malda
		22°25′5.66″N	88°48′38.63″E	24 Parganas (N)
Eutetranychusorientalis	Pigeon pea	22°59′15.3″N	88°48′38.63″E	Nadia
		23°14′46.10′N	87°52′41.12″E	Burdwan (East)
		23°15′0.72′N	87°52′9.768″E	Burdwan (West)
		22°2′6.28″N	88°25′39.98″E	24 Parganas (S)
Schizotetranychus baltazari	Pigeon pea	22°59′15.3″N	88°48′38.63″E	Nadia
		22°2′6.288″N	88°25′39.98″E	24 Parganas (S)
Schizotetranychuscajani	Pigeon pea	22°59′15.3″N	88°48′38.63″E	Nadia
		24°24′55.5″N	88°15′43.6″E	Murshidabad
		24°57′07.0″N	87°59′33.9″E	Malda,
		22°25′5.66″N	88°48′38.63″E	24 Parganas (N)
Shannon's diversity (H^1)	= 2.13			
Effective number of species (EVS)	= 3			
Species dominance (D)	= 0.78			

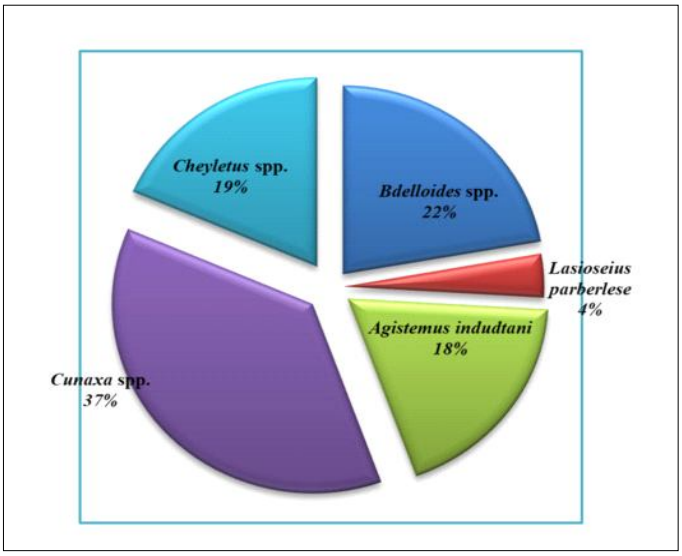

Fig 2: Relative abundance of predatory mite (Prostigmata) associated in pulse crops.

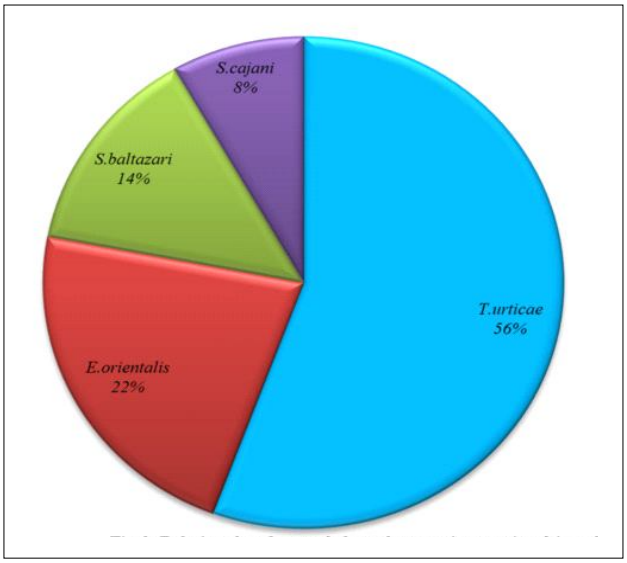

Fig 3: Relative abundance of phytophagus mite associated in pulse crops.

mites were most common predators associated with phytophagous mites and serve as effective biological control agent against plant feeding mites.

CONCLUSION

Phytophagous mites are a serious concern for successful pulse cultivation in West Bengal. Predatory mites were found effective against phytophagous mites and other soft-bodied insects and they could be utilized for a biological control programme to minimize use of chemical pesticides.

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Conflict of interest

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