

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1001.430>

Occurrence of Natural Enemies of *Tetranychus macfarlanei* on Okra at Vidarbha Region

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ABSTRACT

Keywords

Tetranychus macfarlanei,
Predatory fauna,
Vidarbha, Okra

Article Info

Accepted:
24 December 2020
Available Online:
10 January 2021

An experiment was carried out during Kharif, 2017 and 2018, at three different locations of Vidarbha region to get more information on the occurrence of bioagents to control red spider mite species, *Tetranychus macfarlanei* on okra crop at Vidarbha region. Number of general and specific predators were found in association with the *T. macfarlanei* in okra agro system. Predatory mite, *Amblyseius* sp. and predatory insect viz., *Scolothrip rhagebianus*, *Feltiella* sp., *Oligata* sp. and *Stethorus* sp. and grub of chrysopids were occurs abundantly. Predatory fauna showed significantly positive correlation with *T. macfarlanei*.

Introduction

Red spider mite, *Tetranychus* sp. (Tetranychidae: Arachnida) represent one of the most important group of phytophagous mites. Large population of this pest, causes heavy losses in yield. Farmers are using number of chemical pesticides on crops to fight the mite menace. But indiscriminate use of these pesticides has resulted in to the mite outbreak in many agro-ecosystems. Representatives of each major insecticide class viz., organochlorines, organophosphates, carbamates, etc. have been implicated in spider mite outbreaks. Researchers has

attributed resurgence in spider mite to the detrimental effect of pesticides on their natural enemies; increased fecundity in mites; changes in mite dispersal and feeding behavior (Huffaker, *et al.*, 1969; van de Vrie *et al.*, 1972, Singh *et al.*, 2014).

The high reproductive potential; short life cycle and arrhenotokous reproduction, combined with the frequent acaricide applications, facilitates rapid resistance build-up in spider mite (Chiasson, *et al.*, 2004; Van Leeuwen, *et al.*, 2005). In India, resistance was observed in spider mite against dicofol, abamectin, phosalone, phosphamidon,

dimethoate, and wettable sulphur in different vegetables (Kumar *et al.*, 2002; Shridhar and Jhansi, 2007). Development of resistance to acaricides in spider mites is often so rapid that, effective spider mite management is difficult in many agricultural systems (Jeppson *et al.*, 1975).

So, there is a need to look forward for other options to control this pest and natural enemies or predators can be a better option. In order to practically apply these natural enemies in mite control, initially one needs to study these predators which are present in association with the spider mite.

Predatory mites, as *Amblyseius longispinosus*, *Phytoseius minutes*, *Phytoseiulus persimilis*, *Amyseius alstoniae* and many insect predators, as *Feltiella* sp., *Stethorus pauperculus*, *Scolothrips rhagebianus*, *Scolothrips sexmaculatus*, *Oligota oviformis* and unidentified Anthocorid and Mirid bug, *Coccinella septempunctata* has been reported predaceous on the various species of spider mites (Moutia, 1958; Rachana *et al.*, 2009; Sarma, 2010; Siddhapara, 2015; Singh and Chauhan, 2016; Naga *et al.*, 2017).

Unlike the conventional chemical pesticides pest control by means of bioagents is eco friendly; there is no chance of resistance, and resurgence development in spider mites for bioagents. In view of all these positive side, a study was carried out to explore the natural enemies of spider mite in okra agroecosystem, and to know their abundance in okra crop-ecosystem in relation to biotic and abiotic factors.

Materials and Methods

A study on predatory fauna of okra red spider mite, *T. macfarlanei* was undertaken at three different agro-climatic zones of Vidarbha region viz., Akola (Plateau assured rainfall),

Gadchiroli (Eastern vidarbha high rainfall) and Nagpur (Central vidarbha moderate rainfall) during *Kharif*, 2017 and 2018.

All the recommended agronomical practices were followed in raising the okra crop (variety *Arka Anamika*), except plant protection. Weekly observations were taken on predatory fauna of red spider mite at Akola while, same observations was made at fortnight interval during different phenological stages of okra crop at Gadchiroli and Nagpur.

Ten plants were randomly selected from 10 x 10 m plot and three leaves from basal, middle and top canopy of each plant were observed for predatory fauna of red spider mite. Predatory fauna as well as spider mite population was counted on ventral surface of leaf on 2.5 cm² leaf area with the help of foldable magnifier hand lens (10 x). The influence of key meteorological parameters on the predatory fauna was worked out through simple correlation studies (Gomez and Gomez, 1984). Multiple regression equations were also developed.

Results and Discussion

Seasonal incidence of predatory fauna

A good number of natural enemies of red spider mite were observed during present study. Predatory mite, *Amblyseius* sp. and predatory insect viz., *Scolothrip rhagebianus*, *Feltiella* sp., *Oligata* sp. and *Stethorus* sp. and grub of unknown chrysopids were occurs abundantly (Plate.1).

Present finding on predatory fauna of *Tetranychus macfarlanei* is in close confirmation with previous workers as: Moutia (1958) who reported *Stethorus* sp., *Oligota* sp. and *Feltiella* sp. as predators feeding on *T. macfarlanei* in Mauritius.

Prasanna (2007) who reported predatory mites, *Amblyseius longispinosus* and *Phytoseius minutes*; insect predators, *Oligota* sp., *Scolothrips rhagebianus* and unidentified Anthocorid and Mirid bug feeding on tetranychus mites. Rachana *et al.*, (2009) found *Stethorus pauperculus*, *Amblyseius longispinosus* and *Phytoseiulus persimilis* dominant among other predators, feeds on tetranychus mite.

For the both year, the initiation and peak population of predatory fauna was synchronized with that of spider mite, indicated prey predator association. At Akola during, *Kharif*, 2017 and 2018, incidence of predatory fauna was initiated during 32nd MW. Peak population of predatory fauna was observed on 36th MW with 2.0 predators/plant. (Fig.1). During *Kharif* 2018, peak predatory fauna was recorded during 38th MW (Sept. 17-23) with 8.9 predatory fauna/ plant. Among the predators, *Feltiella* sp. and *Oligata* sp. were found dominantly (Fig 1).

At Gadchiroli during *Kharif* 2017 and 2018, predatory fauna appeared during 34th MW and reached to its peak during 42nd MW with 1.4 predatory fauna/ plant during 2017 and 2.7 predator/ plant during 2018 (Fig.2).

At Nagpur during *Kharif* 2017 and 2018, the predatory fauna was initiated during 32nd MW and reached to its peak on 42nd MW during 2017, while during *Kharif* 2018, highest population of predatory fauna was observed during 38th MW (Sept. 17-23) with 2.7 predators/ plant (Fig.3).

Present finding on predatory fauna of *Tetranychus macfarlanei* is in close confirmation with previous workers as: Siddhpara (2015) reported predatory beetle, *Stethorus* sp. and predatory mite *viz.*, phytoseiid mite and *Amblysius* sp. feeding on *T. urticae* during 2013-14. Naga *et al.*, (2017)

who observed that, predatory mite, *Amblyseius alstoniae* and *Coccinella septempunctata* appeared in the second week of August (33rd MW) and second week of October (41st MW) respectively and reached to peak in the third week of September (38th MW) during season.

Correlation and regression studies

At Akola, during *Kharif* 2017 and 2018, data showed a non-significant correlation of predatory fauna with maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall but, a significantly positive correlation of predatory fauna with red spider mite (“r” = 0.96). Linear regression drawn for *Kharif* 2017 and 2018 showed 93% variability in predatory fauna due to the spider mite. Data indicated that, with increase in 1 spider mite/ 2.5cm² predatory fauna increases in a tune of 0.13 predators/plant.

At Gadchiroli, data showed positive and significant correlation of predatory fauna with spider mite (r=0.96) and maximum temperature (r = 0.82) while, a non-significant negative correlation with minimum temperature (r= -0.43).

A significant but negative correlation was observed between predatory fauna and morning relative humidity (r= -0.94), even relative humidity (r= -0.82), and rainfall (r= -0.62). From the linear regression equations drawn for *Kharif*, 2017 and 2018, it could be inferred that, with increase of 1 unit of spider mite and maximum temperature there was proportionate increase of 0.11 and 0.32 per cent predatory population. Nevertheless for an increase in morning, evening relative humidity and rainfall by one unit there was a decrease in predatory fauna population 0.11, 0.10 and 0.02 per cent respectively.

Table.1 Correlation and regression studies of predatory fauna in relation with red spider mite and weather parameters at Gadchiroli

Year	Factors	r value	t value	R ²	Linear equation	Multiple equation
2017	Red spider mite	0.99**	14.43	0.98	Y=0.07+0.09*mite	Y= 1.65+0.11*mite -0.02*RHmorn +0.01 *Rainfall (R ² =0.99)
	Temp. (Max)	0.41	0.91	----	---	
	Temp (Min)	-0.46	-1.03	----	---	
	RH (Morn.)	-0.90**	-4.24	0.82	Y=13.73-0.14*RHmorn.	
	RH (Even.)	-0.57	-1.38	---	---	
	Rainfall (mm)	-0.93**	-5.07	0.87	Y=1.37-0.02*Rainfall	
2018	Red spider mite	0.97**	8.62	0.95	Y=0.01+0.12*mite	Y=-72.82+0.01*mite+1.47*Tmax -0.46*RHmorn+0.86*RHeven-0.15*Rainfall (R ² =1)
	Temp. (Max)	0.89*	3.89	0.79	Y=-10.07+ 0.35*Tmax	
	Temp (Min)	-0.60	-1.51	---	---	
	RH (Morn.)	-0.97**	-8.36	0.95	Y=10.91-0.11*RHmorn.	
	RH (Even.)	-0.92**	-4.81	0.85	Y=9.15-0.10*RHeven.	
	Rainfall (mm)	-0.84*	-3.09	0.71	Y=1.87-0.11*Rainfall	
Pooled	Red spider mite	0.96**	11.30	0.93	Y=0.01+0.11*mite	Y=6.76+0.08*mite-0.05*Tmax- 0.07*RHmorn+0.01*RHeven+0.004*Rainfall (R ² =0.97)
	Temp. (Max)	0.82**	4.51	0.67	Y=-9.16+0.32*Tmax.	
	Temp (Min)	-0.43	-1.53	---	---	
	RH (Morn.)	-0.94**	-8.50	0.88	Y=10.29-0.11*RHmorn.	
	RH (Even.)	-0.82**	-4.58	0.68	Y=8.83-0.10*RHeven.	
	Rainfall (mm)	-0.62*	-2.47	0.38	Y=1.28-0.02*Rainfall	

(t value- 0.05*=2.78, 0.01**=4.60) and (t value – 0.05*= 2.23, 0.01**= 3.17)

Table.2 Correlation and regression study of predatory fauna in relation with red spider mite and weather parameters at Nagpur

Year	Factors	r value	t value	R ²	Linear equation	Multiple equation
2017	Red spider mite	0.98**	10.62	0.97	Y=-0.06+0.18*mite	Y=18.82-0.27*mite+0.01*Tmax -0.78*Tmin-0.01*RHeven-0.001*Rainfall (R ² =0.99)
	Temp. (Max)	0.82*	2.87	0.67	Y=-6.75+0.22*Tmax.	
	Temp (Min)	-0.99**	-13.48	0.98	Y=8.41-0.36*Tmin.	
	RH (Morn.)	-0.55	-1.32	---	---	
	RH (Even.)	-0.89*	-3.91	0.79	Y=2.92-0.04*RHeven.	
	Rainfall (mm)	-0.85*	-3.20	0.72	Y=0.68-0.01*Rainfall	
2018	Red spider mite	0.98**	9.79	0.96	Y=0.03+0.18*mite	Y= -7.58+0.17*mite-0.02*Tmax +0.36*Tmin+0.01*Rainfall (R ² =0.98)
	Temp. (Max)	0.86*	3.33	0.74	Y=-11.11+0.39*Tmax.	
	Temp (Min)	0.93**	5.11	0.87	Y=-19.04+0.91*Tmin.	
	RH (Morn.)	-0.78	-2.51	---	---	
	RH (Even.)	-0.70	-1.97	---	---	
	Rainfall (mm)	-0.84*	-3.06	0.70	Y=2.34-0.03*Rainfall	
Pooled	Red spider mite	0.99**	18.34	0.97	Y=-0.047+0.19*mite	Y=-2.98+0.19*mite+0.06*Tmax +0.01*RHmorn+0.002*Rainfall (R ² = 0.98)
	Temp. (Max)	0.65*	2.70	0.42	Y=-10.04+0.34*Tmax.	
	Temp (Min)	0.49	1.77	---	---	
	RH (Morn.)	-0.69*	-3.00	0.47	Y=10.64-0.12*RHmorn.	
	RH (Even.)	-0.55	-2.07	---	---	
	Rainfall (mm)	-0.70*	-3.10	0.49	Y= 1.66-0.02*Rainfall	

(t value- 0.05*=2.78, 0.01**=4.60) and (t value – 0.05*= 2.23, 0.01**= 3.17)

Fig.1 Seasonal incidence of predatory fauna in relation with biotic and abiotic factors during *Kharif* 2017 and 2018 at Akola

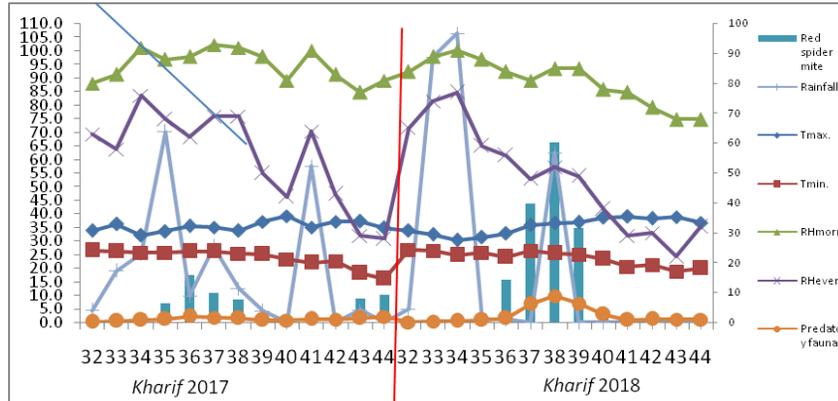


Fig.2 Seasonal incidence of predatory fauna in relation with biotic and abiotic factors during *Kharif* 2017 and 2018 at Gadchiroli

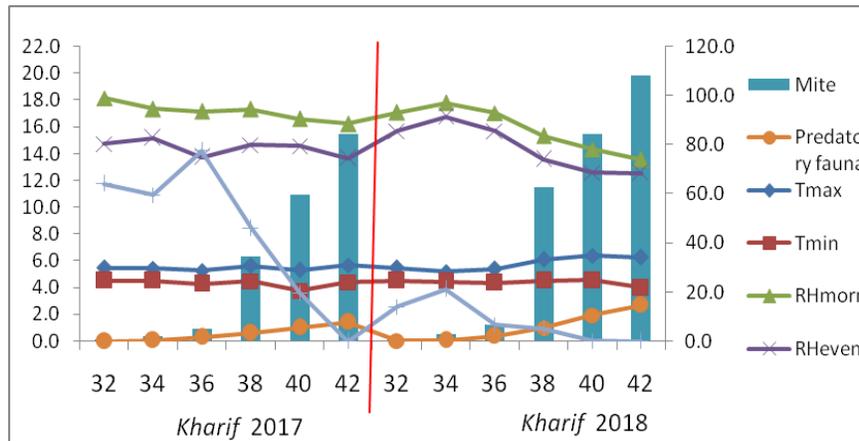


Fig.3 Seasonal incidence of predatory fauna in relation with biotic and abiotic factors during *Kharif* 2017 and 2018 at Nagpur

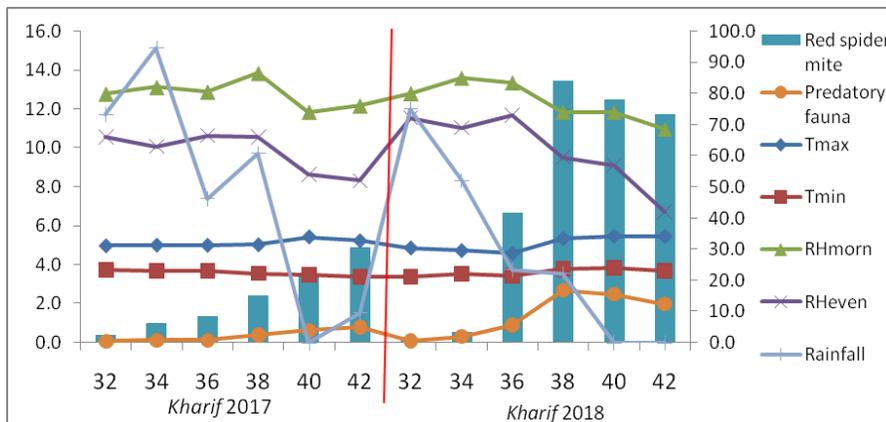


Plate.1 Predatory faunal diversity in okra crop on *Tetranychus macfarlanei*



Regression equation showed 93, 67, 88, 68, and 38 per cent of fluctuation in predatory faunal population contributed individually by spider mite, maximum temperature, morning relative humidity, evening relative humidity and rainfall respectively. During *Kharif*, 2017 and 2018, from multiple regressing equations, it can be concluded that meteorological factors together contributed 97 per cent variability in predatory population (Table 1).

At Nagpur during *Kharif*, 2017 and 2018, predatory fauna showed significant and positive correlation with spider mite ($r = 0.99$), maximum temperature ($r = 0.65$), minimum temperature (0.49) while, a significant but negative correlation with morning relative humidity ($r = -0.69$), and rainfall ($r = -0.70$). From the linear regression equation drawn for *Kharif*, 2017 and 2018, it could be put forward that, an increase of 1 unit in spider mite and maximum temperature resulted in increase of 0.19 and 0.34 predator/plant and contributed 97 and 42 % respectively in predatory fauna variability. Increase in one unit of morning relative

humidity and rainfall adversely affected predatory fauna with fall of 0.12 and 0.02 per cent and contributed 47 and 49% variability in predatory fauna respectively. Multiple regression equation revealed that the red spider mite, maximum temperature, morning relative humidity and rainfall together contributed 98% variability in predatory fauna (Table 2).

These findings are in line with the following workers as: Siddhapara (2015) showed highly significant and positive association of mite population with *Stethorus* sp. ($r = 0.92^{**}$ and 0.95^{**}) and predatory mites ($r = 0.92^{**}$ and 0.94^{**}), respectively during *Kharif* 2013 and 2014. Jadhav, *et al.*, (2016) reported highly significant positive association of mite population with *Stethorus* sp. and predatory mites during *Kharif* 2013 and 2014 in okra ecosystem. Singh and Chauhan (2016) reported that, the population of *T. ludeni* and *S. sexmaculatus* was positively correlated with temperature whereas negative correlation with relative humidity.

Prassanna (2007); Sekhar *et al.*, (2008); Chinniah *et al.*, (2009); Monica *et al.*, (2014); Siddhpara (2015); Jadhav, *et al.*, (2016); Naga *et al.*, (2017); Singh *et al.*, (2018) have documented the significant positive correlation between mite population and maximum temperature, whereas a negative correlation with morning, evening relative humidity; and rainfall. Contrary to this Mandal *et al.*, (2006) at Pusa, Bihar during summer, 2000 and 2001 reported that the, *T. telarius* in okra showed non-significant negative correlation with the maximum temperature ($r = - 0.52$ and $- 0.13$) during 2000 and 2001, respectively. They also found a significant positive association of mite with relative humidity while, a non-significant positive correlation of rainfall with the population of mites during both the years. Regression analysis explained 78-85 per cent variability due to meteorological parameters in *T. telarius*.

Chinniah *et al.*, (2009) inferred from regression equation data that, the increase in temperature by 1°C resulted into proportionate increase in mite population by 1.18 per cent; one unit increase in relative humidity resulted into decrease in mite population by 0.22 per cent; for every 1 mm increase in rainfall mite population decline by 0.19 per cent. Whereas, minimum temperature and wind velocity showed non-significant impact on spider mite in brinjal ecosystem.

Monica *et al.*, (2014) worked out multiple linear regressions by taking mite population as dependent variable (Y) and climatic factors as independent variables (x). Data revealed that, the coefficient of determination (R^2) was significantly high (73.50%).

In conclusion during the present study one predatory mite and five predatory insects were recorded to be predaceous on

Tetranychus macfarlanei in okra. Among these predators predatory thrip was identified at species level as *Scolothrip rhagebianus*. Data on seasonal incidence suggest that in Vidarbha region predatory fauna start to appear during 32nd MW which gradually reach to the peak during 36th, 38th and 42nd MW during the crop season. There is a synchronisation between peak population of spider mite and predatory fauna which suggest close prey predatory association between them. Data showed 93-97% variability in predatory population due to the biotic and abiotic factors.

Acknowledgement

Authors are thankful to Dr. Kaomud Tyagi, Scientist, Molecular Systematics Division, Zoological Survey of India for providing species level identification of predatory thrip.

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How to cite this article:

Archana N. Borkar, A. V. Kolhe, D. B. Undirwade, H. R. Sawai and Tambe, V. J. 2021. Occurrence of Natural Enemies of *Tetranychus macfarlanei* on Okra at Vidarbha Region. *Int.J.Curr.Microbiol.App.Sci.* 10(01): 3644-3653.
doi: <https://doi.org/10.20546/ijcmas.2021.1001.430>