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Population dynamics of spider mite, *Tetranychus urticae* Koch on okra in relation to abiotic factors of Varanasi region

DHARMENDRA KUMAR, M. RAGHURAMAN* and JANARDAN SINGH

Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, BHU, Varanasi-221005, U.P. India.

**E-mail : raghu_iari@yahoo.com*

ABSTRACT

Field experiments were carried out to study the population fluctuation of phytophagous mite (*Tetranychus urticae* Koch) in okra and its relation with different weather variables during 2010 and 2011crop seasons under unprotected conditions Varanasi region. The results revealed that the mite population commenced from 9th and 10th standard week in 2010 and 2011 respectively. The highest population mites per 2.5cm^2 leaf area was recorded on 21st standard week (47.75) in 2010 while the maximum population was recorded in 18th standard week (45.99) during 2011. It was found that the mite infestation was heavy during May in both the years. The maximum number of predatory mites was recorded on 15th standard week (11.86) in 2010 while in 2011 population of predatory mite was highest in 18th standard week (15.98). The population of predatory mites, mean temperature, sunshine hours and wind velocity showed a significant positive correlation with the mite pest where as a negative correlation was established with relative humidity and rainfall.

Key words: Okra, Tetranychus urticae, predatory mite, abiotic factors.

Among the vegetables, okra is extensively grown in the country occupying a significant place in the diet of most of the consumers. Though it occupies maximum area of 0.49 m ha in the country, its productivity is comparably low (5.7 m t) (Indian Horticulture Database, 2011). The low yield is attributed to the attack of different pests from sowing to harvesting. Recently, there is a change in agricultural scenario and mites are becoming serious pest in most of the crops and okra is no exception. The spider mite, *Tetranychus urticae* Koch, poses serious threat to okra crop particularly during spring, summer and post rainy seasons. This crop is infested mainly by six different mite pest species, *viz*., *Tetranychus urticae*, *T. macfarlanei*, *T. ludeni*, *Brevipalpus phoenicis*, *Polyphagotarsonemus latus* and *Aceria lycopersici* (Gupta, 1985; Prasad and Singh, 2011). Out of these mite species, *T. urticae* is responsible for causing the loss of foliage of the crop plant resulting in reduction of the economic yield of fruits ranging from 20-45 % depending upon cropping season and agro-climatic conditions. *T. urticae* is well adapted to various environmental conditions, causing loss of quality and yield or death of plants by sucking out the contents of leaf cells (Mondel and Ara, 2006, Kumaran *et al*., 2007).

T. urticae causes direct damage in terms of loss of chlorophyll, stunting of growth, stippling, webbing, leaf yellowing, defoliation, leaf burning, reduction in size and quality of fruits, appearance of various types of plant deformities, followed by death etc. which severely affect the yield and in extreme outbreaks, plant death. Indirect effects of mite feeding may include decreased photosynthesis and transpiration. Due to high reproductive potential and extremely short life cycle, combined with frequent acaricide applications this mite has developed resistance to almost all conventional pesticides in vogue (Chiasson *et al*., 2004; Van Leeuwen *et al*., 2005). The mites become serious pests because they have several generations per season. Phytophagous nature, high reproductive potential and short life cycle contributed rapid resistance development to many acaricides even after few applications (Devine *et al.,* 2001; Stumpf and Nauen, 2001).

Since the degree of incidence of red spider mite changes with season, it is desirable to have a thorough understanding of the seasonal incidence of the mite, which will lead to the development of suitable management programmes. Hence, an attempt was made to correlate the effect of weather factors on the incidence and population dynamics of the spider mite in okra.

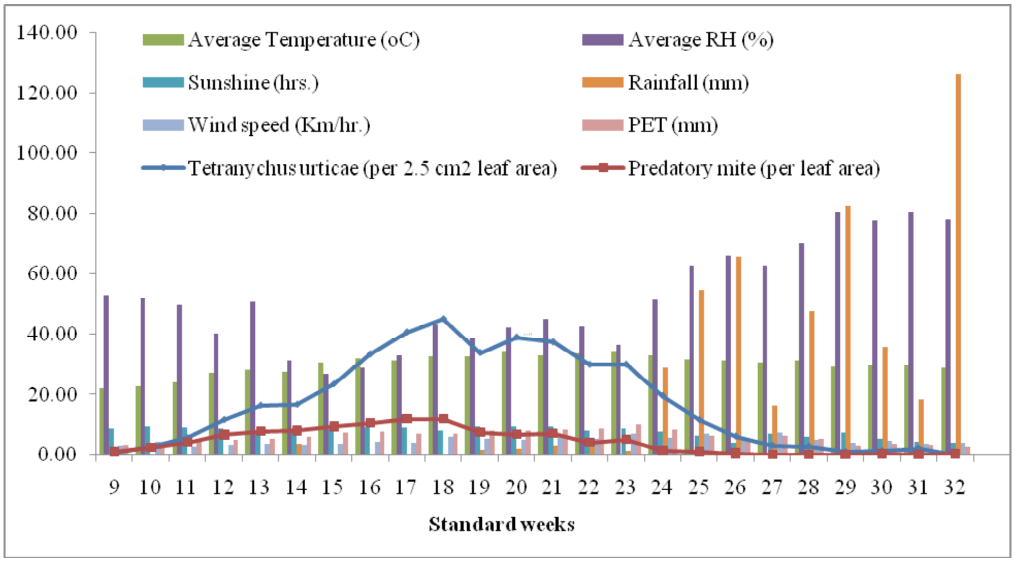

Fig.1 : Mean phytophagous mite (*Tetranychus urticae* Koch) and predatory mites infesting okra and influenced by weather factors during 2010 and 2011.

MATERIALS AND METHODS

The field experiments were conducted in the Banaras Hindu University vegetable farm during 2010 and 2011, at Varanasi with okra variety 'Parbhani Kranti', following the recommended agronomic practices for eastern U.P. region except plant protection measures. The plant geometry of okra was 45x30 cm^2, replicated thrice. From each plot, 10 plants were selected at random and sampled at weekly intervals to record the total number of mite population in 2.5 cm^2 area of the leaf. Observations on number of phytophagous mites and predatory mites was recorded on eight randomly selected plants from each replications (Total number of selected plants was 24) and three leaves selected one from top and two from middle portion of the plants at standard week intervals. The incidence of phytophagous and predatory mite's population was recorded as the number of mite's population per 2.5cm^2 leaf area while for predatory mite was counted as the whole area of leaf as described by Poe (1980). The meteorological data were collected from the observatory of Banaras Hindu University, Varanasi, and the correlation between phytophagous mites population and biotic (predatory mites) and abiotic (weather variables) were worked out with the help of SPSS® software following standard procedure.

RESULTS AND DISCUSSION

The present investigation was carried out during okra crop seasons of 2010 and 2011. Results of the present study revealed that phytophagous mites and predatory mites started appearing on the 9th Standard week. The average population of phytophagous mite (*Tetranychus urticae*) and predatory mite (*Amblyseius* sp.) was higher during 12th to 26th standard week and 13th to 23rd standard week in 2010 and 2011 respectively (fig. 1). It was observed that the mite population was increasing continuously during the entire period of crop growth coupled with congenial weather conditions.

The population buildup of mites was in a log phase from 9th to 21st standard week, except during 18th and 19th standard week where a short decline was seen due to some unfavourable weather conditions. From 12th to 21st standard week the mites proliferated profusely and the buildup of mites was observed to be increasing at increasing rate. After 21st standard week there was a gradual decline in the population and it started to decrease from 22nd to 26th standard week. The highest average population of *T. urticae* per 2.5 cm^2 leaf area was recorded 21st (47.75) followed by 20th and 19th (43.98) standard week while the predatory mite on whole leaf area was highest in 15th (11.86) followed by 17th (9.88) and 16th (9.33) standard week during 2010. Afterwards, it could be seen that there was a drastic reduction of mite population from 27th to 31st standard week and subsequently they could not be seen in the crop due to very high temperature and conditions which were not suitable for their buildup during 2010.

Whereas, in 2011 the mite's buildup started from 10th Standard week population was continuously increasing from 10th to 18th standard week, where it was the peak period

Table 1 : Correlation coefficient of incidence of phytophagous mite *Tetranychus urticae* with predatory mites and abiotic factors during 2010 and 2011 and pooled.

Sl. No.	Factors	2010	2011	Pooled
1.	Mean population of predatory mite	0.773**	0.857**	0.822**
2.	Mean temperature	0.614**	0.653**	0.642**
3.	Mean RH	-0.677**	-0.728**	-0.743**
4.	Sunshine hours	0.279	0.624**	0.589**
5.	Rain fall	-0.542**	-0.433*	-0.527**
6.	Wind speed	0.254	0.231	0.315
7.	Potential Evapotranspiration (PET)	0.746**	0.855**	-0.829**

** significant at the 0.01 level (2-tailed).

* significant at the 0.05 level (2-tailed).

Table 2 : Multiple Regression of incidence of phytophagous mite *Tetranychus urticae* with predatory mites and abiotic factors based on 2010 and 2011.

	Unstandardized Coefficients		**Standardized Coefficients**		
Parameters	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
Phytophagous mite	-76.238	19.792		-3.852	.001
Predatory mites	2.882	.672	.781	4.290	.001
Average_temp	.580	1.233	.129	.470	.645
Average_RH	.481	.309	.531	1.557	.139
Sun shine hours	1.705	1.072	.200	1.590	.131
Rainfall	.009	.051	.020	.176	.862
Wind velocity	-.787	1.478	-.070	-.532	.602
PET	4.597	3.246	.630	1.416	.176

of the mite population and the highest population were recorded. After 18th week the population of mites decreased at increasing rate up to 23rd standard week and then there was a steep decrease in mite's population in forthcoming weeks due to the drastic change in the weather factors and ultimately, the mites disappeared during 26th standard week from the plants. The highest population of *T. urticae* per 2.5 cm^2 leaf area was recorded in 18th (45.99) followed by 19th (43.98) and 23rd (38.88) standard week respectively, while the predatory mite on whole leaf area was highest in 18th (15.98) followed by 17th (13.94) and 16th (11.67) standard week.

The peak population of *T. cinnabarinus* was observed in the month of May and June and minimum population was observed in the month of September, and the population started to decrease from the last week of June. Increase in population was associated with period of high temperature and low humidity on okra (Singh and Singh, 1993). Similar trend was reported by Kumar and Sharma (1991) but the mites appeared in the 1st week of April during summer and reached a maximum second week of June on okra. The population increased gradually, and abrupt decrease in mite population was observed during 1st week of July, and mite disappeared completely during first fortnight of September. In places where okra is cultivated throughout the year, the mite was found year round with high populations in March-April, July and December. Predatory mites were maximum in number in March, July and September (Bhullar and Ghai, 2003). The predatory mites appeared in the first fortnight of June and their population increased in the subsequent months. The predatory mite population was maximum (6.23 mites/leaf) in the second fortnight of June when maximum temperature, minimum temperature, relative humidity, sunshine and rainfall were 36.3^{O}C, 27.8^{O}C, 70.9 per cent, 8.9 h and 3.1 mm, respectively. Populations of *T. cinnabarinus* did not show any relationship with the relative humidity while Predatory mite populations were positively correlated with both maximum and minimum temperatures. In okra sown in March 1998, phytophagous mites appeared at the mid of May and the population reached peak in June recording 2.82 mites/leaf when mean maximum temperature, minimum temperature, relative humidity and rainfall were 37.63^{O}C, 27.23^{O}C, 60.4 per cent and 2.4 mm, respectively. Few predatory mites were seen during this period. Similarly, Singh *et al*. (2004) reported that the mite, *T. cinnabarinus* appeared infesting okra in May and its population gradually increased. Although vegetable crops were found to be attacked by phytophagous mites almost throughout the year, the mite problem remained extremely severe during the summer months (April to July) followed by post-monsoon (September to October) periods. During the rainy season, mite species attained minor to mild pest status while during the winter season (December to February), their occurrence remained almost negligible and stray in general on commonly grown vegetables.

Correlation and multiple regression analysis

The correlation coefficient of *T. urticae* with predatory mite and weather variables were worked out during 2010 and 2011 are presented in Table1. Results showed that there was a significant positive correlation of *T. urticae,* r = 0.773** during 2010 and r = 0.857** during 2011 whereas the pooled was 0.822** with the predatory mites. The phytophagous mite showed a significant positive correlation with temperature during both the years (r = 0.614**and 0.653** during 2010 and 2011 respectively) and pooled is 0.642**. Similarly Potential evapotranspiration also was found to have a positive correlation with the population of spider mites (r = 0.746** and 0.855* during 2010 and 2011 respectively), While, The rainfall and relative humidity were showing a significant negative correlation at the 0.01 level in both the years with phytophagous mites, *Tetranychus urticae* Koch and the predatory mites. Similar relationships have been established with the multiple regression analysis (Table -2). In field, the occurrence of *T. urticae* on commenced from April and its peak activity was noticed during warmer month i.e., with a peak during May. Natural enemies *viz., Amblyseius alstoniae* (Phytoseiidae) and *Scolothrips indicus* (Thripidae) showed positive correlation with the phytophagous mites (Rai *et al.*, 1999). Higher temperatures favoured the population build up of both the predators, while rainfall adversely affected the population of mites as well as the natural enemies. This ill effect of rain may be attributed to washing out of nymphs and adults by the force of heavy downpours. Irrespective of the crop seasons, the mite population was found to be maximum during the months of April and May. Meena *et al.* (2013) also reported a similar relation of abiotic factors with yellow mite in chilli crop.

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