Influence of major abiotic factors on the population trend of *Tetranychusurticae* Koch on okra at Samastipur, Bihar

Abstract:

Field experiments were conducted to study of populationfluctuation of phytophagous mite(*Tetranychusurticae*Koch) in okra and its relation with different abiotic factors during 2023 crop seasons under unprotected conditions at Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar.The findings on populationfluctuation*Tetranychusurticae*of okra revealed that mite were commenced first fortnight of March and reached its peak of 34.60 mites/ 2.5cm^2 leaf area on first fortnight of June. A simple correlation (r) was established between population of mite and weather parameters in okra . It was observed that there was a positive and significant correlation with maximum temperature (r= 0.779**) and minimum temperature (r= 0.699*) and then it was observed that there is a negative and non significant relation with relative humidity (r= –0.375 morning 700 hrs) and (r= –0.068 evening 1400 hrs), positive non-significance with rainfall r=0.306^{NS}.

Keyword: Seasonal incidence, okra mites, Correlation

Introduction:

Okra, *Abelmoschus esculentus* (L.) Moench (family: Malvaceae**),** is one of the world's oldest, traditional cultivated vegetables. Its primary centre of origin in Africa probably Ethiopia and is grown in many Asian countries and other parts of the world. Within India, its cultivation occurs during both the summer and rainy seasons. It is commonly farmed as a summer crop in Northern India and is also prevalent as a winter crop in states like Gujarat, Andhra Pradesh, Karnataka, and Tamil Nadu. (Lal and Sinha, 2005). Out of that okra have area 0.531 million hectares and production is 6.47 million tons in India (Anonymous, 2020-21).

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, *Tetranychusurticae*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.*, *Tetranychusurticae*, *T. macfarlanei*, *T. ludeni*, *Brevipalpusphoenicis*, *Polyphagotarsonemus latus* and *Acerialycopersici*(Gupta, 1985; Prasad and Singh, 2011). Out ofthese 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 withfrequent 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 mitechanges 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.

Materials and Methods:

Field trials were conducted during summer, 2022-23 at Vegetable Research plot of Dr Rajendra Prasad Central Agricultural University, Pusa, Bihar. The plot selected had uniform topography with well drained sandy loam soil. Latitude, longitude and altitude of the place are 85.67^0 E 25.98^0 Nand 52.92 m respectively. Climate in this region is hot dry summers with mild winter. Other climatic factors such as rainfall, temperature, humidity in this region are highly favourable for growth of vegetables and other crops in all seasons with proliferation of mite infesting a variety of crops.

A bulk-plot was raised to conduct research on the populationfluctuation of major mite associated with okra.The population of mites were recorded at fortnight intervals. The meteorological data were taken from university observatory. After that, these abiotic parameters werecorrelated with corresponding pest population. Okra cultivar was selected as a test variety “Kashi Kranti” and sown on 3rd February,2023. The crop was cultivated by following appropriate agricultural practices and managed without the application of any insecticide.

Sampling and Observations

Population Fluctuation of two spotted mites, *Tetranychusurticae* Koch was found more injurious to the vegetables crop in the Samastipur district, Bihar. The investigations on population dynamics were carried out during the period from March 2023 to July 2023, on okra at vegetable research plot of Dr.RPCAU. The population was recorded from first fortnightly of March to second fortnightly of July. Five places were selected for each host and three leaves plucked randomly from host plants for recording population. All the leaves were mixed, labeled and were brought to the laboratory Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar for counting the mites. Care was taken to avoid disturbance to the natural population of mites on the leaf. All the mites were counted under a stereo binocular microscope. Whole population was recorded on 2.5cm^2 areas at four spot per leaves and mean population was recorded. The weather records were collected from the meteorological section, Dr Rajendra Prasad Central Agricultural University, Pusa, Bihar.

Correlation study

To investigate the effect of abiotic factors on the population of mites in this region. The observation for abiotic factors were recorded at fortnightly interval, used to compute the simple correlation coefficients (r) values of dependent (mite population) and various independent variables (abiotic factors i.e., temperature, relative humidity, and rainfall). For testing the significance of simple correlation coefficient ‘t’ test was applied which is expressed as-

$$t = \frac{\sqrt[r]{n-2}}{\sqrt{1-r^2}}$$

Where, ‘r’ is the simple correlation coefficient and ‘n’ is total number of observation. The multiple regression coefficients and multiple correlation coefficient (R) of mite population in relation to abiotic factors were also computed.

The ‘t’ value was compared with tabulated ‘t’ on (n-2) degrees of freedom. The significance of all the multiple correlation coefficients (R) was tested for their significance by applying ‘F’ test as -

$$F = \frac{R^2}{1-R^2} x \frac{n-k-1}{k}$$

Where, ‘n’ is the total number of observation and ‘k’ is the total number of independent variables. The calculated ‘F’ was compared with the tabulated ‘F’ on “k’ and (n – k –1) degrees of freedom. The value of coefficient of determination (R^2) was calculated highlight the joint contribution of independent variables on mite population. The correlation and regression analysis was done with the help of scientific calculator and personal computer (PC).

A linear regression of mite population on each variable (abiotic factors) was separately fitted. Regression equation is useful for the purpose of predicting (Y) when independent variables were assigned values. The purpose of trying out different regression was, to have an idea of which regression had a better fit. This is as fallow-

Linear regression Y = a + bx

Results and Discussion:

The present investigation was carried out during okra crop seasons during 2023. Results of the present study revealed that phytophagous mites *Tetranychusurticae*Koch was recorded on okra at different months during 1st fortnight of March to 2nd fortnight of July in 2023 is presented in table 1 and fig 1. The mite population started increasing from March 2nd fortnight and reached its peak during the summer months. Maximum population of mite were recorded in the month of June 1st fortnight (34.57) during 2023 where the maximum, minimum temperature (^{o}C), relative humidity (%) Maximum and Minimum, and total rainfall (mm) were 40.26^{o}C,23.88^{o}C,71.66%,34.20%,0.00mmand May 2ndfortnight (33.63) in 2023. The populations of mite were gradually reduced from June 2nd fortnight in 2023 and July

1st fortnight in 2023 with decrease in temperature. Minimum incidence of mites were recorded in the month of March 1st fortnight (0.37) in years 2023

The present findings are somewhat consistent with that of Mandal *et al.* (2006) who observed that red spider mite populations on okra fluctuated significantly between 2000 and 2001, peaking during the 15th standard meteorological week and decreasing until the 24th SMW. The population wasincreased gradually from March to July.

Kumar*et al.* (2015) observed the variation in population of red spider mite on okra during the crop seasons of 2010 and 2011 in the Varanasi region. The findings indicated that mite infestation was high in May while the temperature of that was also high.

Veerendra *et al* (2015) examined the population dynamics of the red spider mite *T. urticae* in grape vineyards, focusing on its relationship with abiotic factors and a predator. The infestation began in November 2012 and increased until April 2013.

Correlation of *T. urticae*in okra with weather parameters during summerseason 2023.

A simple correlation (r) was established between population of mite and weather parameters in okra (Table 2). It was observed that there was a positive and significant correlation with maximum temperature (r= 0.779**) and minimum temperature (r= 0.699*) and then it was observed that there is a negative and non significant relation with relative humidity (r= –0.375 morning 700 hrs) and (r= –0.068 evening 1400 hrs), positive non-significance with rainfall r=0.306.The significant correlation of both the temperature showed that there was a less difference in maximum and minimum temperature. The regression equation for the data, with a population(Y) as the dependent variable and weather factors as the independent variables, was as follows a determined coefficient of determination and (R^2) and regression model(Table 2):

$$Y = -184.644 + X_1 (1.129) + X_2 (4.626) - X_3 (1.333) - X_4 (0.810) - X_5 (0.107)$$

X_1 =Maximum temperature, X_2 = Minimum temperature, X_3 = Maximum relative humidity, X_4 = Minimum relative humidity, X_5 = Rainfall.

Based on the calculation, the coefficient value (R^2) derived as 0.7456which suggests that 74% of the fluctuations in the red spider mite population were attributed to the impact of abiotic factors. In other words, R^2 value indicates that per cent of variation in the red spider mite population were influenced by abiotic factors.

This finding are somehow inconsistent with my results Mohanasundaram and Sharma (2011)who recorded correlation between mite infestations with important weather parameters revealed that population had non-significant positive correlation with temperature (maximum, minimum and average), maximum relative humidity and weekly total rainfall where as significant positive correlation with minimum and average relative humidity.

The results obtained from my study differ slightly from these findings of Singh *et al.* (2018),the results of the finding revealed that mite population fluctuation showed a highly significant negative correlation with minimum temperature moreover, a significant negative correlation was observed with maximum temperature and rainfall.

These findings obtained are inconsistent with my results where Ghosh (2019) findings of correlation analysis between mite infestations and key weather parameters revealed that the mite population exhibited a statistically significant positive correlation with various temperature measures (maximum, minimum, and average). Additionally, there was a significant positive correlation with both minimum and average relative humidity.

CONCLUSION

These findings indicated that population of two spotted mites,*Tetranychusurticae*Koch was observed in the experimental field during 1st fortnight of March 2023 and reached its peak during 1st fortnight of June 2023 *i.e* 34.57/ 2.5 cm^2 leaf area. Positive significant correlation was observed in maximum temperature and minimum temperature and also observed negative non significant correlation in relative humidity.

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Table 1:Population fluctuation of*Tetranychusurticae*on okra during the crop period 2023

Interval	***Mean populationof *T.urticae* mites/2.5cm^2 leaf area**	**Temperature (℃)**		**Relative humidity (%)**		**Total Rainfall (mm)**
		Maximum	**Minimum**	**Maximum**	**Minimum**	
1st Fortnight March	0.37	31.11	14.67	93.33	48.67	0.00
2ndFortnight March	2.53	30.18	16.73	89.06	50.56	18.00
1st Fortnight April	8.23	35.67	16.20	76.80	27.46	0.00
2nd Fortnight April	13.43	35.80	20.73	71.06	34.27	0.00
1st Fortnight May	30.10	35.71	19.93	75.07	37.20	1.40
2nd Fortnight May	33.63	35.20	22.52	82.56	52.18	16.80
1st Fortnight June	34.57	40.26	23.88	71.66	34.20	0.00
2nd Fortnight June	29.67	36.27	25.36	86.20	55.20	92.60
1st Fortnight July	25.30	33.22	19.70	89.20	50.40	59.40
2nd Fortnight July	6.20	32.45	20.20	85.30	51.20	24.00

*** Mean of 5 plants per plot, 3 leaves of leach plant and one leaf 2.5 cm^2 areas of four spot.**

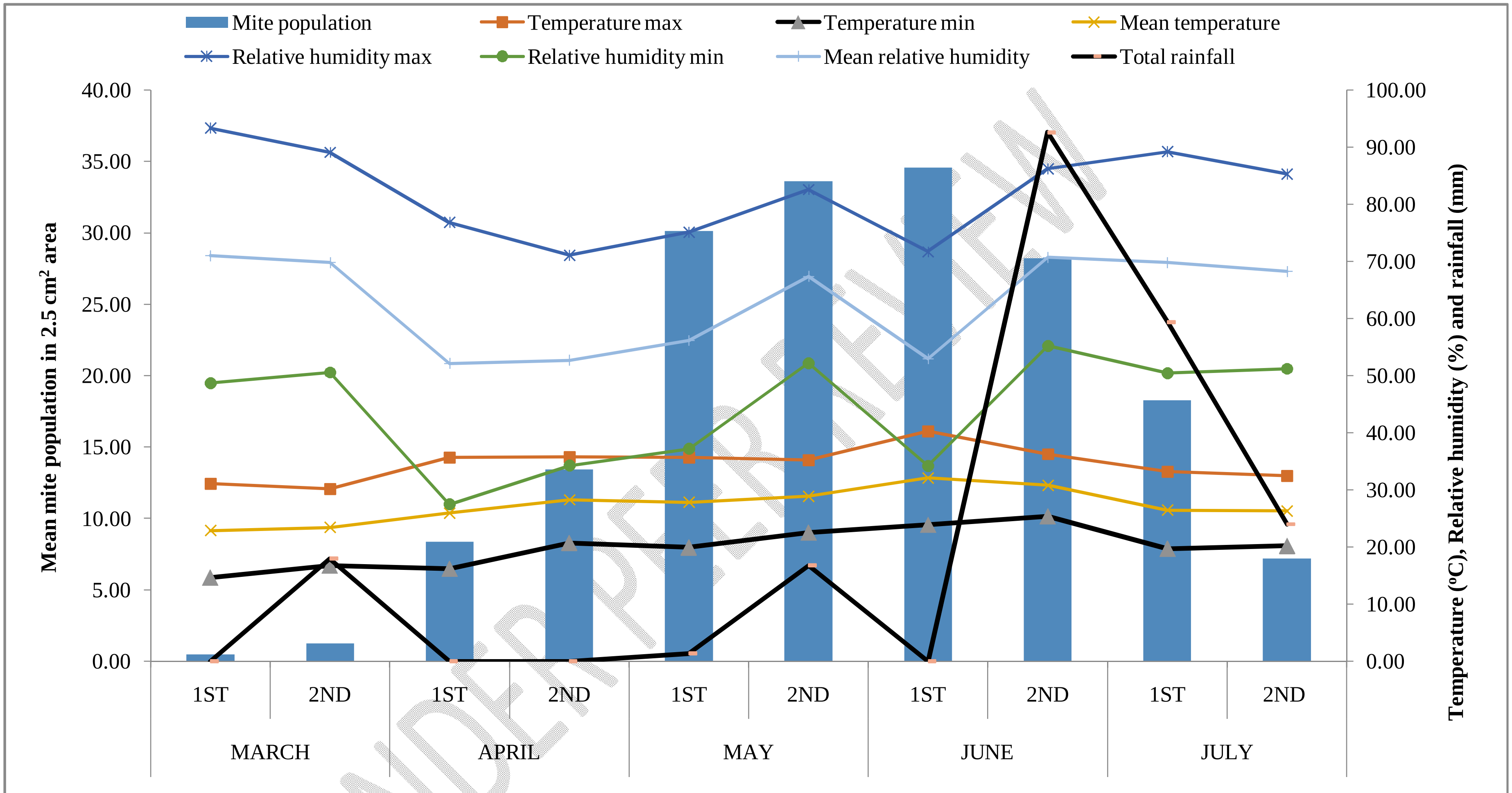

Fig 1-Influence of weather parameters with *Tetranycusurticae* on okra crop during 2023

Table 2: Correlation coefficients and regression equation of phytophagous mite with weather parameters on okra crop during crop period 2023

Correlation Factor	Temperature (℃)		Relative humidity (%)		Rainfall
	Maximum	Minimum	Maximum 700hr	Minimum 1400 hr	
Red spider mite	0.779**	0.699*	-0.375^{NS}	-0.068 ^{NS}	0.306^{NS}
Regression factor	**Regression equation**			**Multiple R^2 Value**	**R^2 Value**
Red Spider Mite	Y= -184.644 +X_1 (1.129) + X_2 (4.626) -X_3 (1.333) -X_4 (0.810) -X_5 (0.107)			0.8751	0.7456

**Correlation is significant at the 0.01 level   *Correlation is significant at the 0.05 level.

X_1- Maximum temperature, X_2- Minimum Temperature, X_3-Relative humidity 700hrs, X_4- Relative humidity 1400hrs, X_5- Rainfall, R_2- Coefficient of Determination