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Population dynamics of two spotted spider mite, *Tetranychus urticae* Koch on French bean (*Phaseolus vulgaris* L.)

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ABSTRACT

Studies on population dynamics of *T. urticae* on French bean cv. GUJARAT RAJMAH revealed that the two spotted red spider mite remained active throughout the crop season in open field condition. The incidence of *T. urticae* was started from the 1st SMW (first week of January), increased gradually and reached to its peak during 21st SMW (mid of May) (14.27 mite/leaf) in the open field condition. The maximum, minimum, average temperature, evening and average relative humidity had significantly positive correlated with mite population, while morning relative humidity had non-significant correlation with *T. urticae* population.

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INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is one of the important vegetable and pulse crop grown extensively in the tropical and sub-tropical areas of the world including India. With the rising living standards and increased demand for vegetables by the ever exploding population, greater emphasis for increasing the productivity of French bean laid in recent years as this crop forms an important source of proteins (22%) and carbohydrates (57%). In Gujarat, it is grown near the metros in green houses or open field for supply of fresh tender pods in cite malls. Among the limiting factors, mites of the family Tetranychidae are among the destructive pests of agricultural crops in many parts of the world. *Tetranychus urticae* Koch.is one of the most serious pest of many crops including French bean. 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 (Chiasson *et al*.,2004 and Van Leeuwen *et al*., 2005). The mites become serious pest 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 and 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 spider mite with the abiotic factors, 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 on French bean.

MATERIAL AND METHODS

The study on periodical incidence of spider mite, *T. urticae* on French bean were carried out in open field condition throughout crop season *i.e.* January 2015 to June 2015. The observations on the incidence of spider mite, *T. urticae* were recorded at weekly interval, beginning from January 2015 and continued upto June 2015. For sampling, three random leaves representing top, middle and bottom canopy were plucked from each of twenty five randomly selected plants. These leaves were held in separate properly labelled polyethylene bags and brought to the Acarology laboratory for numerical mite counts (live) from 2 cm^2 leaf bit under stereo-binocular microscope. The data were recorded separately considering canopy for different standing French bean plants. The observations on spider mite counts were recorded for the crop season. The data so obtained were summed up and converted to total population per leaf (irrespective of plant canopy and leaf surface). To understand the pattern of distribution of spider mites on French bean plants, the data recorded on mite counts were summed up separately considering plant canopy. Further, their distribution on plant canopy was also recorded separately.

Correlation studies between spider mite, *T. urticae*and prevailing abiotic factors were made (Steel and Torrie, 1980). The impact of abiotic factors *viz.*, maximum temperature, minimum temperature, average temperature, morning relative humidity, evening relative humidity and average relative humidity of open field were made by calculating the simple correlation co-efficient (r).

RESULTS AND DISCUSSION

Observations on seasonal activity of two spotted red spider mite, *T. urticae* was recorded from 1st standard meteorological week of January 2015 to 1st week of June 2015 at weekly interval are presented in Table 1 and summarised with different headings.

Seasonal activity of *T. urticae* in field condition:

It is evident from the Table 1 that the spider mite, *T. urticae* remains active throughout the crop season on French bean. The initial population of spider mite during 1st SMW (First week of January) was 4.73 mites per leaf (2 cm^2). The maximum, minimum and average temperature was 28.10, 13.90 and 21.00° C, respectively. While, morning, evening and average relative humidity during this period was 85.60, 38.40 and 62.00 per cent, respectively. The spider mite population then fluctuates at different time intervals and showed the first peak during 14th SMW (first week of April), where the spider mite population was 13.07 mites per leaf. The maximum, minimum and average temperature during this period was 32.20, 21.20 and 26.70°C, respectively. While morning, evening and average relative humidity during this period were 87.20, 55.20 and 71.20 per cent, respectively. The spider mite population then gradually again fluctuated between 15th SMW to 20th SMW (Second week of April to Second week of May). The second peak of spider mite population was observed during 21st SMW (third week of May). The spider mite population was 14.27 mites per leaf. The Maximum, minimum and average temperature during this period were 33.90, 28.40 and 31.10°C, while the morning, evening and average relative humidity were 78.80, 63.70 and 71.30 per cent, respectively. The spider mite population then gradually decreased and at the time of crop maturity the spider mite population was 11.80 mites per leaf. In past, Shah (2014) on gerbera and Pokle and Shukla (2015) reported *T. urticae* on crops like gerbera and tomato throughout the crop season. Thus, partially support the present findings.

Correlation between *T. urticae* and abiotic factors:

The data recorded on population of spider mite, *T. urticae* during the period of January 2015 to June 2015 in the open field conditions and correlated with various abiotic factors and its effect on the population build-up. For the open field condition, the data presented in (Table 2) revealed that the spider mite, *T. urticae* had significant positive correlation with maximum temperature (0.633), minimum temperature (0.951) and average temperature (0.904), while it had non-significant positive relation with morning relative humidity (r = 0.312), whereas with

evening and average relative humidity, the spider mite had significant positive correlation (r = 0.867 and r = 0.868), respectively. In past, Elham *et al.* (2011) reported that the spider mite, *T. urticae* had a significant positive correlation with maximum and minimum temperature on peach. Further, Bhusal (2011) also reported that spider mite,*T. urticae* had a significant positive correlation with maximum temperature on chrysanthemum thus, more or less support the present findings. The mite *T. urticae* showed a significant positive correlation with maximum temperature and evening and average relative humidity, while had a negative correlation with morning relative

Table 1: Population dynamics of *T. urticae* on French bean (CV GUJARAT RAJMAH)

SMW*	Distribution of mite on leaf canopy (cm^2)			Mean mite population per plant (2 cm^2)	Max. temp. (ºC)	Min. temp. (ºC)	Average temp.(ºC)	Morning R.H (%)	Evening R.H (%)	Average R.H (%)
	Top	Middle	Bottom							
01	4.40	8.00	1.80	4.73	28.10	13.90	21.00	85.60	38.40	62.00
02	3.00	8.40	1.660	4.33	30.10	9.80	19.90	72.10	32.40	52.20
03	2.80	9.20	1.40	4.47	29.60	12.70	21.20	82.40	33.20	57.80
04	5.60	12.80	2.20	6.87	28.00	14.50	21.30	83.00	45.90	64.40
05	3.00	12.60	2.40	6.00	29.80	14.00	21.90	78.40	36.60	57.50
06	2.80	13.40	2.00	6.07	32.00	14.90	23.50	85.10	37.10	61.10
07	3.60	13.60	2.00	6.40	32.40	13.80	23.10	86.20	40.50	63.40
08	4.40	13.60	2.20	6.73	34.40	16.10	25.20	90.50	37.90	64.20
09	5.80	14.40	2.00	7.40	23.70	12.90	18.30	75.00	44.60	59.80
10	7.20	14.60	2.00	7.93	32.70	15.20	24.00	81.50	41.60	61.50
11	8.00	15.80	2.60	8.80	32.50	18.50	25.50	84.90	48.90	66.90
12	8.20	17.00	2.20	9.13	33.10	19.00	26.10	82.80	39.50	61.10
13	10.40	21.80	2.40	11.53	35.30	21.50	28.40	90.10	44.30	67.20
14	11.20	24.60	3.40	13.07	32.20	21.20	26.70	87.20	55.20	71.20
15	12.60	22.80	3.00	12.80	30.50	22.20	26.40	89.10	54.00	71.60
16	10.20	24.80	2.20	12.40	36.70	23.80	30.20	87.40	46.00	66.70
17	11.40	23.80	2.220	12.47	33.50	24.40	29.00	87.50	59.10	73.30
18	12.80	23.40	3.60	13.27	34.70	24.20	29.50	85.60	61.00	73.30
19	11.660	24.80	3.660	13.33	36.40	25.30	30.80	84.70	47.10	65.90
20	11.60	25.00	3.80	13.47	35.50	26.60	31.00	82.70	56.80	69.80
21	13.20	25.60	4.00	14.27	33.90	28.40	31.10	78.80	63.70	71.30
22	11.00	24.40	3.40	12.93	33.50	28.00	30.80	80.50	63.10	71.80
23	9.20	22.60	3.60	11.80	34.50	25.70	30.10	84.50	62.20	73.30
Mean ± S.D.	8.0±3.70	18.13±6.10	2.59±0.77	9.57±3.04	32.30±3.07	19.41±5.67	25.86±4.06	83.72±4.56	47.35±10.07	65.53±5.85

*SMW: Standard meteorological week

Table 2 : Correlation matrix of *T. urticae* with abiotic factors

Abiotic factors	Correlation co-efficient
Maximum temperature (°C)	0.633*
Minimum temperature (°C)	0.951*
Average temperature (°C)	0.904*
Morning relative humidity	0.312
Evening relative humidity	0.867*
Average relative humidity (%)	0.868*

* indicates significance of value at P=0.05

Table 3: Distribution of *T. urticae* on French bean

	Top	Middle	Bottom	Mean
T. urticae	8.00	18.13	2.59	9.57

humidity on French bean under field condition.

Distribution of spider mite, *T. urticae* on French bean plant :

The data presented in (Table 3) showed the distribution of spider mite, *T. urticae* on French bean plant in open field conditions. In open field conditions however, it is quite different from poly house, the higher population of *T. urticae* was recorded on top strata (16.33 mites/2 cm^2 leaf) followed by middle strata (11.49 mites/ 2 cm^2 leaf) and bottom strata (7.17 mites/2 cm^2 leaf). The present findings are supported by the earlier work carried out by Shah (2014) on gerbera and Pokle and Shukla (2015) on tomato under poly house conditions, where spider mite population was higher in middle strata of crops, it may be due to availability of more nutrition on middle strata as compared to top and bottom strata. However, on French bean open field condition the mite population was more on top strata followed by middle and bottom strata. The present findings are closely supported by Gupta (1991) on brinjal, who also found more number of eggs and mobile stages of *T. urticae* on top strata in open field conditions. The distribution of spider mite was different in polyhouse and open field conditions may be due to different crop plants, their growing situations and crop varieties, etc.

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