POPULATION FLUCTUATION OF *Tetranychus urticae* Koch IN RELATION TO WEATHER PARAMETERS ON MARIGOLD (*Tagetes* spp.)

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ABSTRACT

Studies on population dynamics of Tetranychus urticae Koch on marigold revealed that incidence of T. urticae was started from the first week of April and increased gradually to reach its peak during fourth week of July (17.8 mites/cm^2 leaf area). The lowest population recorded in 5th standard week i.e. fifth week of January (0.4 mite/cm^2 leaf area). There was a highly significant positive correlation between population of T. urticae with minimum temperature, morning relative humidity, evening relative humidity and wind speed. The decreasing trends of bright sunshine hours had shown increasing trends of mite population in marigold and showed highly significant negative association with T. urticae population. The correlation study between mite population and maximum temperature indicated non-significant effect on mite population.

KEY WORDS: Correlation population dynamics, T. urticae,

INTRODUCTION

Marigold (*Tagetes erecta* Linnaeus) is one of the most important hardy flower crops grown commercially throughout the world. Both leaves and flowers of marigold are equally important from medicinal point of view. Leaf is used extensively against boils and carbuncles. Marigold flower contains abundant amount of a valuable antioxidant compound called lutein, which is a carotenoid pigment. It has been identified as valuable source of essential oils, which has bronco-dilatory, tranquillizing and anti-inflammatory properties, and is also used in high grade perfumes and cosmetics (Raghava, 2000). Marigold is also used as antagonistic crop in root knot nematode infested areas due to production of aromatic sulphur containing secondary compound mainly in roots known as ‘thiophenes’, which is known to be toxic to root knot nematode, *Meloidogyne* sp. (Raghava, 2000).

Marigold gets infested with various kinds of insect pests and mites. Among them the two spotted red spider mite *T. urticae* (Acarina: Tetranynchidae) is one of the most destructive pest of this crop both in open as well as protected conditions. Two spotted spider mite; *T. urticae* is being recorded worldwide infesting more than 150 different field and ornamental crops. It was observed that mobile stages of mites were found resting on the under surface of the leaves of the marigold plant. They were also found on entire leaf surface, tips of the plant, floral bodies in case of severe infestation. Initially it pierced their styletes inside the leaf tissue. Initially, it caused whitish streak on leaf which afterward appeared in pale yellowish patches. These patches coalescence to form a bigger patch, which ultimately gave a burnt appearance. The infested leaves were covered with the numerous mite colonies having all the stages under dense webbings and the dust particles were adhered to this webbing. Severally infested leaves dried up and withered away. The information on influences of abiotic factors on population dynamics is not documented under south Gujarat situations. Therefore, it is required to evaluate the effect of abiotic factors on fluctuation in mite population in marigold. The information provides a base in the sound eco-based management programme.

MATERIAL AND METHODS

The study on periodical incidence of spider mite, *T. urticae* on marigold was carried out throughout the year (April 2014 to March 2015) at N. M. Collage of Agriculture, Navsari Agricultural University, Navsari. Thirty to forty days old marigold seedlings were transplanted in the field with a spacing of 30 cm × 30 cm. The new plants were transplanted in the same plot with an interval of two months for maintaining continues plant stand during the entire study period. Periodically, the mature plants were uprooted from the field. Experimental area was kept free from plant protection umbrella throughout the year. The observation on the incidence of *T. urticae* was recorded at weekly interval, beginning from April 2014 and continued up to March 2015. For sampling, three random leaves representing top, middle and bottom canopy were selected from each of ten randomly selected plants. From each leaf one square centimeter area was observed for numerical mite counts from whole leaf through 10X hand magnifying glass. The observations on mite counts were recorded for a period of one year in case of each standing marigold plants under field condition. The data so obtained were summed up and converted to total population per one square centimeter area of leaf (irrespective of plant canopy) and statistically analyzed. Correlation studies between spider mite, *T. urticae* population and prevailing abiotic factors were made (Steel and Torrie, 1980). The impact of abiotic factors *viz*., maximum and minimum temperature, morning and evening relative humidity, wind velocity and bright sun shine duration at the time of observation were analyzed by calculating the simple correlation (r).

RESULTS AND DISCUSSION

Population fluctuation of T. urticae in relation to weather parameters

Observations on population of *T. urticae* (mobile stages) recorded at weekly interval during April 2014 to March 2015 are presented in Table 1 and illustrated in Figure1 to 3. The activity of *T. urticae* on marigold was found during the entire year under field conditions. The mite incidence was appeared throughout the year with gradual increment from 1st week of April and reached to peak during fifth week of July. It has started declining in the 32nd standard week i.e. first week August (16.00 mite/cm^2 leaf area) and gradually decreasing the population up to 5th standard week i.e. fifth week of January (0.4 mite/cm^2 leaf area). The results revealed that the mite was able to multiply faster at the high temperature. Overall, mite population was recorded high during the period of higher temperature and vice versa.

Sudhirkumar and Shelke (2008) reported that the population of *T. urticae* on rose increased from May and the first peak occurred in June. Mahato *et al.* (2008) reported that mite population in marigold increased with increasing weather temperature and lower mite population was observed during March. Patil and Nandihalli (2009) reported that in summer, *T. macfarlanei* in brinjal attained its peak in 28^{th} standard week. The revealed population of *T. urticae* on rose was increased gradually to reach its peak during first week of July (Toke, 2010). Similarly, Meena *et al.* (2013) determined very low population of spider mite in January and the population gradually increased and reached at its peak in the first fortnight of May and then again declined from the first fortnight of December. Therefore, the present investigation is more or less similar to the investigations made by above scientists.

Correlation with weather parameters

Data recorded on population of *T. urticae* correlated with weather parameters *viz*., maximum and minimum temperature as well as morning and evening humidity, sun shine hours and wind velocity (Table 2). The correlation study indicated highly significant association between mite population and minimum temperature ($r = 0.876$), morning relative humidity ($r = 0.415$), evening relative humidity ($r = 0.760$) and wind speed ($r = 0.707$). So this study clearly indicated that the mite population was found to increase with increase in minimum temperature as well as wind speed. The sunshine hours ($r = -0.454$) showed highly significant association with *T. urticae* population. The decreasing trend of bright sunshine hours had shown increasing trends of mite population in marigold under south Gujarat conditions. The correlation study between mite population and maximum temperature indicated non-significant effect on mite population (Figure 1 to 3). Dhar *et al.* (2000), Rajkumar *et al.* (2005) and Elham *et al.* (2011) reported positive correlation of temperature, with the population build up of red spider mite *T. urticae* on okra, jasmine and peach, respectively. The development of *T. urticae* in marigold was reached at its peak during brightest period of season (Mahato *et al*., 2008). Shah (2014) also reported significant positive correlation with *T. urticae* on gerbera under polyhouse conditions. Thus, the present finding is more or less in close agreement with the work carried out by the above scientists. On the contrary to present finding, the results of association between relative humidity and *T. urticae* was not tally with the work done by Hole and Salunkhe (1997) on gerbera, Rajkumar *et al.* (2005) on jasmine, Toke (2010) on rose, Bhusal (2011) on chrysanthemum, Meena et al. (2013) on orchid and Shah (2014) on gerbera. It needs further study in future for finding the impact of climate change with sound scientific reason.

Development of regression equations

Various abiotic factors have close association with pest incidence, means increase or decrease in such abiotic factors tends to increase or decrease the pest population. Here, those abiotic factors having significant influence on pest population can further be utilized to develop regression equation (Table 3). The multiple linear regression equation fitted to the data of mite population (mobile stage Y1) as dependent variable and weather parameters having significant correlations as independent variables was $\hat{Y} = -11.78 + 0.77\ (\text{Min. T}) - 0.03\ (\text{RH1}) + 0.08$

(RH2) - 0.10 (BSSH) + 0.46 (WS). These parameters i.e. minimum temperature, morning RH, evening RH, bright sun shine hours, wind speed played significant role on *T. urticae* population. The value of R2 was 0.8578, which explained 85.78 per cent variation in the *T. urticae* infestation due to various independent variables taken for regression.

CONCLUSION

The activity of *T. urticae* was remained high during summer and *kharif* season; however it was less active during winter season. The peak activity was recorded during 31st standard meteorological week (last week of July 2014).

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Table 1: Population fluctuations of *T. urticae* on marigold in relation to weather

Month	SMW	Mean Mite Population per cm^2 Leaf Area	Temperature (˚C)		RH (%)		BSS H (hr)	WS (km/hr)
			Max.	Min.	Morning	Evening		
April	14	08.80	35.1	19.8	88.8	34.7	8.8	1.6
	15	07.60	37.0	21.1	91.2	32.4	8.7	1.5
	16	10.20	33.0	20.3	87.0	43.8	9.3	1.7
	17	11.40	33.6	23.8	81.6	50.0	8.3	4.2
May	18	12.00	37.8	23.5	84.0	40.6	9.1	2.9
	19	12.40	34.0	24.6	88.1	55.9	8.4	4.8
	20	12.80	34.9	25.3	80.9	52.6	7.5	5.3
	21	13.00	35.2	25.6	82.8	50.8	9.5	4.2
	22	13.40	35.7	26.6	86.1	58.5	9.6	5.4
June	23	15.00	34.0	28.0	81.1	63.7	9.5	8.5
	24	15.20	34.3	28.9	85.0	64.5	9.0	9.5
	25	15.80	33.6	26.0	84.9	69.3	7.6	8.1
	26	16.20	32.4	28.3	81.6	65.7	6.1	11.6
July	27	16.60	33.8	28.2	76.0	59.3	8.7	7.3
	28	17.00	33.5	26.5	84.3	65.8	7.4	9.8
	29	17.20	31.0	25.1	91.8	74.9	4.8	7.9
	30	16.40	29.7	26.0	91.1	84.5	1.2	9.8
	31	17.80	29.7	24.9	87.2	86.2	1.6	10.4
August	32	16.00	28.6	25.7	93.4	86.4	1.8	8.8
	33	15.20	29.7	24.8	92.3	79.3	3.8	8.4
	34	14.20	30.1	25.3	89.2	77.4	3.6	8.5
	35	12.20	32.2	25.6	94.5	77.1	3.9	2.6
September	36	11.40	29.7	24.3	96.9	85.5	0.7	3.1
	37	10.80	29.8	25.3	93.1	83.0	3.5	9.4
	38	09.80	29.7	24.2	95.9	78.1	2.8	4.1
	39	09.40	32.0	24.3	90.5	70.4	6.4	3.6
October	40	08.20	34.4	24.6	89.8	68.2	6.4	2.7
	41	06.00	36.7	24.4	83.1	40.9	8.1	3.1
	42	04.80	36.4	22.5	85.5	42.2	8.6	3.4
	43	03.00	36.4	22.5	87.8	47.8	9.8	2.9
	44	02.80	34.6	21.3	75.4	36.2	6.7	3.1
November	45	02.40	35.3	19.4	89.5	42.3	9.0	2.3
	46	01.00	34.1	18.8	80.2	38.2	8.6	2.6
	47	00.60	32.7	22.7	90.0	58.2	5.4	2.7
	48	01.20	33.2	18.9	82.4	43.1	8.7	2.2
December	49	01.40	33.0	15.5	83.2	32.9	8.8	1.9
	50	00.80	32.6	15.7	69.4	37.0	8.8	3.0
	51	00.60	30.2	14.0	81.9	47.9	6.6	2.9
	52	01.00	29.3	13.2	70.5	47.8	7.6	5.0
January	1	00.60	29.0	13.0	68.7	33.2	8.0	3.9
	2	00.40	28.1	13.9	86.0	38,0	7.5	3.5
	3	00.80	30.1	9.8	72.0	32.0	9.0	3.0
	4	00.60	29.6	12.7	82.0	33.0	8.5	3.3
	5	00.40	28.0	14.5	83.0	46.0	7.0	4.5
February	6	01.20	29.8	14.0	78.0	37.0	8.9	5.1
	7	01.40	32.0	14.9	85.0	37.0	8.8	3.8
	8	01.00	32.4	13.8	86.2	40.5	9.8	2.8
	9	01.60	34.4	16.1	90.5	37.5	9.6	3.1
March	10	00.80	23.7	12.9	75.0	44.6	7.6	4.1
	11	01.00	32.7	16.2	81.5	41.6	8.9	3.8
	12	01.20	32.5	18.5	84.9	49.8	8.8	5.1
	13	02.00	33.1	19.0	82.8	39.5	9.1	3.8

Table 2: Correlation coefficient values of adults and damaged of mite with respect to weather parameters

N=52

Weather Parameters Characters	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)	Morning Relative Humidity (%)	Evening Relative Humidity (%)	BSSH	WS
Tetranychus urticae	0.135	0.876**	0.415**	0.760**	-0.454**	0.707**

Significant at 5% level of significance (r= 0.273)
Significant at 1% level of significance (r= 0.354)

Table 3: Regression equations for *T. urticae*

Pest	Regression equation	R2 Value	Multiple R
Mite (*T. urticae*)	$\hat{Y}$= -11.78+ 0.77 (Min. T) – 0.03(RH1) + 0.08 (RH2) - 0.10 (BSSH) + 0.46 (WS)	0.8578	0.9337

Where,

$\hat{Y}$ = expected mean value,
Min. T = Minimum Temperature,
RH1 = Morning relative humidity,
RH2 = Evening relative humidity,
BSSH = Bright sun shine hours, and
WS = Wind speed

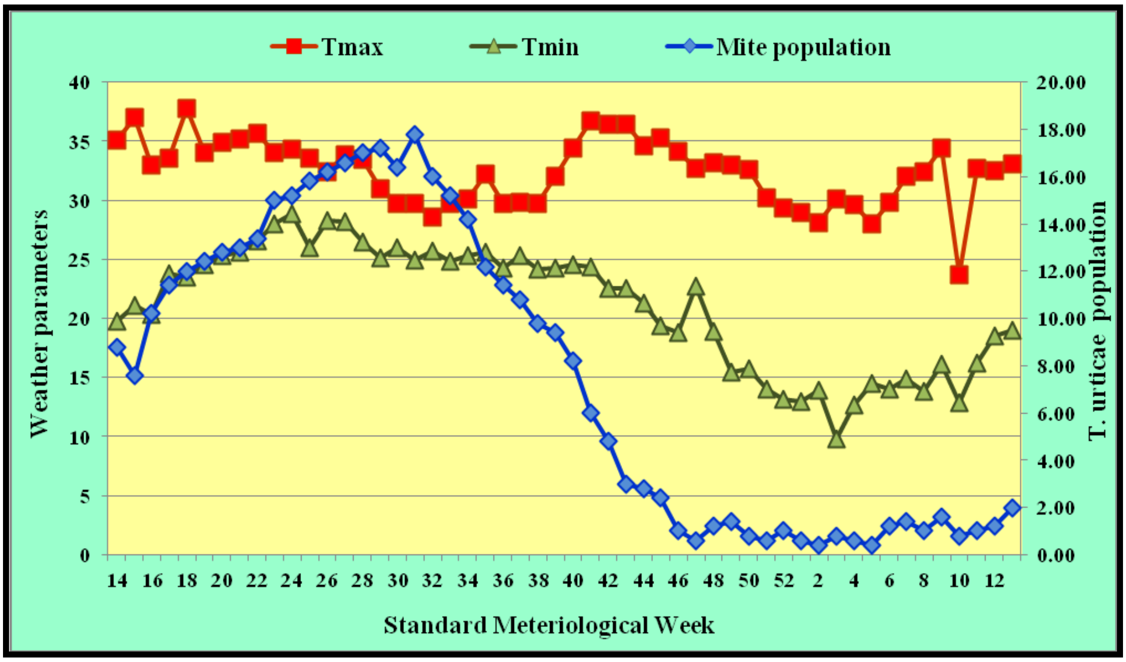

Figure 1: Population of T. urticae with minimum and maximum temperature

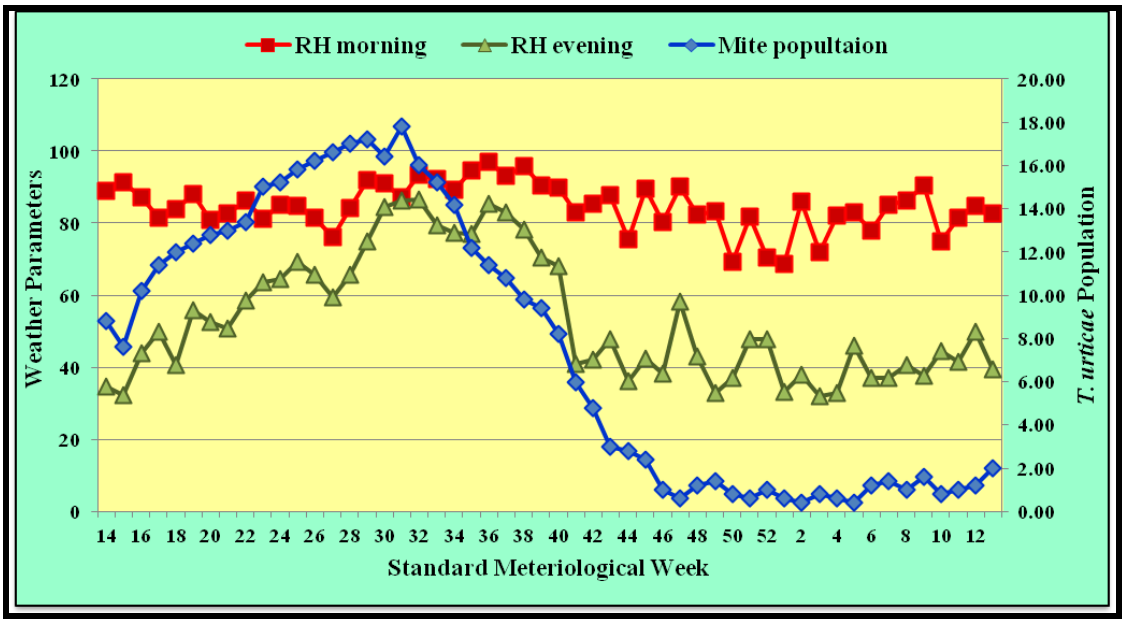

Figure 2: Population of T. urticae with morning and evening relative humidity

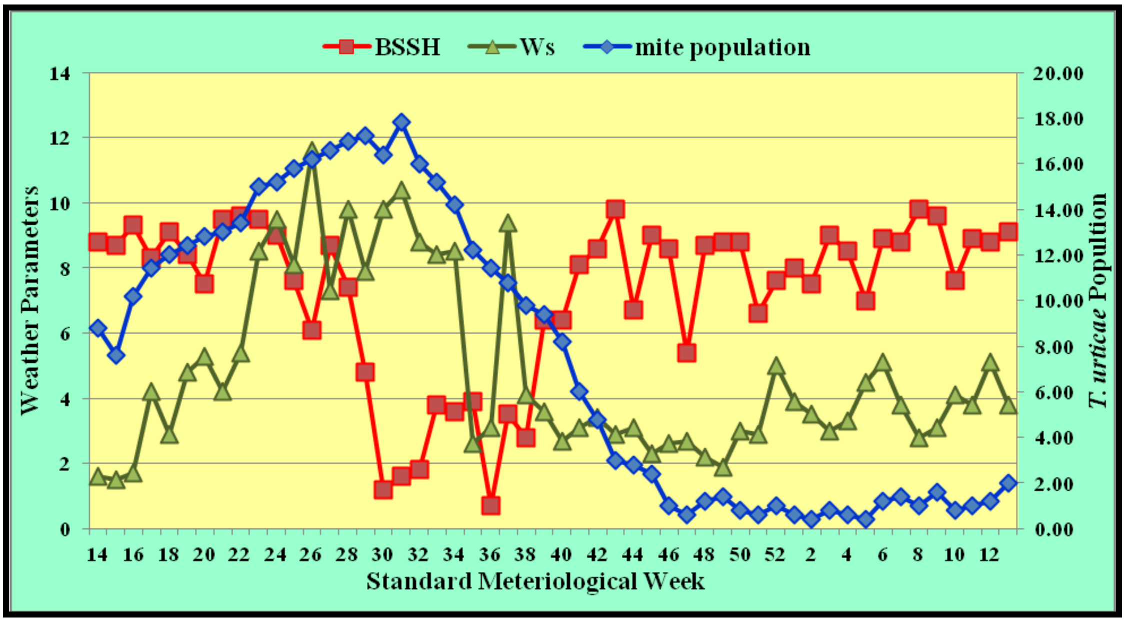

Figure 3: Population of T. urticae with wind speed and bright sun shine hours

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