Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(4): 3095-3099
Received: 20-05-2020
Accepted: 22-06-2020

NB Patel
Principal Research Scientist
AICRP on Biological Control of Crop Pests ICAR Unit-9, Anand Agricultural University Anand Gujarat, India

NA Bhatt
Assistant Research Scientist
Bidi Tobacco Research Station
Anand Agricultural University
Anand Gujarat, India

CC Patel
Retd. Research Scientist
Department of Entomology
B. A. College of Agriculture
Anand Agricultural University
Anand Gujarat, India

Corresponding Author:
NB Patel
Principal Research Scientist
AICRP on Biological Control of Crop Pests ICAR Unit-9, Anand Agricultural University Anand Gujarat, India

Effect of weather parameters on incidence of brinjal mite, *Tetranychus urticae* Koch and its predatory mite, *Amblyseius alstoniae* Gupta

NB Patel, NA Bhatt and CC Patel

Abstract
An experiment was carried out to evaluate the effect of weather parameters on incidence of *Tetranychus urticae* Koch on brinjal during *kharif-rabi* 2014-15 and 2015-16. Population of *T. urticae* revealed that infestation of mite started from 39th standard meteorological week (SMW) with lower number and then it gradually increased up to 44th SMW. Thereafter, population was fluctuating in the field up to 2nd week of February and reached to peak at harvesting (13th SMW). Population of phytoseiid predator, *Amblyseius alstoniae* Gupta was first observed during 42nd SMW with very low population and disappeared from the field during December to January. Thereafter, it gradually increased and reached to maximum during 12th SMW as the maximum temperature reached to more than 38 ^{0}C. The correlation studies on population of mite, *T. urticae* and its predator, *A. alstoniae* with weather parameters showed significant positive correlation with maximum, minimum and average temperature while, significant negative correlation with morning, evening and average relative humidity. There was a highly significant positive correlation between predatory mite, *A. alstoniae* and *T. urticae* (r= 0.929**) on brinjal crop.

Keywords: Brinjal, mite, *Tetranychus urticae*, *Amblyseius alstoniae*, weather parameters, correlation

Introduction
Brinjal (*Solanum melongena* Linnaeus) is known as a "King of vegetables" grown throughout tropical, sub-tropical and warm temperate areas of the world. It suffers severely due to the attack of various insect pests, which reduced its yield and quality of fruits. Butani and Verma (1976) [4] listed 36 insects, whereas Nayar *et al.* (1995) [10] recorded 53 insects attacking on brinjal. Patel *et al.* (1970) [11] recorded 16 pest species attacking brinjal crop in Gujarat. Of which shoot and fruit borer, *Leucinodes orbonalis* Guenee; jassid, *Amrasca biguttula biguttula* (Ishida); whitefly, *Bemisia tabaci* Gennadius; aphid, *Aphis gossypii* Glover and non-insect pests like mites especially two spotted spider mite, *Tetranychus urticae* Koch are the main bottle necks in brinjal productivity (Rizvi, 1996) [13]. Of these, red spider mite, *T. urticae* poses serious threat as a major pest next to shoot and fruit borer to the cultivation of brinjal (Basu and Pramanik, 1968) [3]. The reduction in yield due to mite infestation was up to 14 per cent at Bangalore and 31 per cent at Varanasi (Anonymous, 1996) [1]. Patil and Nandihali (2008) [12] estimated the yield losses in the range of 12.18 to 32.21 per cent due to infestation of mite at Dharwad. On an average 16.16 per cent yield loss in brinjal due to *T. urticae* was noticed in India (Anonymous, 2007) [2].

The two spotted spider mite, *T. urticae* is one of the cosmopolitan spider mite pest reported as serious pest on many plants like tomato, okra, brinjal, french bean, cucurbits, cotton, alfalfa, flowers, *etc*. (Manjulata *et al*., 2002) [9]. The mite generally feed on the lower surface of the leaves, as a result the infested leaves initially shows peckling and later turn yellowish, finally leading to defoliation. The mites spread to all parts of the plants as the population increases especially during day period and produce webbing over the entire plants. Moderate population may greatly affect crop production and heavy infestation results in death of the plant.

The basic information on population dynamic is necessary before deciding the strategy for management of any insect pest. Limited work has been done on population dynamics of mite, *T. urticae* on brinjal in relation to weather parameters. Hence, the present investigation was carried out.

Although, phytoseiid mites, *Amblyseius alstoniae* is known to be common predator of spider mite, *T. urticae* in brinjal ecosystem, but its interaction at different level of predator to prey with *T. urticae* on crops like brinjal is unknown. Therefore, an attempt was undertaken to investigate the correlation between the predatory mite, *A. alstoniae* and its host *T. urticae* on brinjal with different weather parameters was executed.

Materials and methods

In order to study the effect of weather parameters on incidence of mite, *T. urticae* in brinjal, an experiment was carried out during *kharif* and *rabi* season of two consecutive years (2014-15 and 2015-16).

The brinjal cultivar Doli-5 was transplanted in an area of 8 x 19 m during 2nd week of September by keeping distance of 90 cm between two rows and 60 cm within the rows. The whole experimental plot was kept free from any insecticidal application. For recording observations, whole plot was divided into five equal quadrates and 25 plants were selected randomly from each quadrate.

The observations on mite population were made from three leaves (upper, middle and lower) on randomly selected plants. The population was recorded in 4.0 cm^2 (2.0 × 2.0 cm) leaf area for spider mites and predatory mites per leaf. The observations were recorded at weekly interval starting from one week after transplanting till harvest of the crop. The population data were correlated with different physical factors of environment. The data on various weather parameters were collected from the Department of Meteorology, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat).

Results and discussion

Year 2014-15

The observations on population of *T. urticae* were recorded at weekly interval during *kharif* and *rabi* season of 2014-15 and 2015-16 are presented in Table 1 and 2 and graphically plotted in Fig. 1 and 2, respectively.

It is evident from the Table 1 and Fig. 1 that the spider mite, *T. urticae* remained active on brinjal crop throughout the crop season except 52nd to 5th standard meteorological week (SMW). The mite started its activity from 39th SMW with 2.27 mites per 4 cm^2 leaf. The maximum temperature during this week was 35.13 ^{0}C. Then the population of spider mite gradually increased and reached to the peak during 44th SMW *i.e.* first week of November. The mite population during this period was 4.57 per 4 cm^2 leaf at 35.86 ^{0}C maximum temperature. Thereafter mite population observed in decreasing trend and from 52nd to 5th SMW it was not found on brinjal crop *i.e.* last week of December to last week of January. The lowest (1.41 mites/4 cm^2 leaf) mite population observed during 51st SMW and during this week, maximum temperature was below 27 ^{0}C *i.e.* 26.33 ^{0}C. So, it was found that mite population disappeared from the field when temperature reached below 27 ^{0}C. However, the population of mite again appeared in the field of brinjal when temperature increased above 27 ^{0}C. Thereafter, population increased gradually with the increase in temperature and reached its maximum (11.15 mites/4 cm^2 leaf) during 12th SMW, when maximum temperature was 38.33 ^{0}C. It is seen from data that maximum temperature below 27 ^{0}C was not favourable for the development of the mite and hence, the pest disappeared from the crop during these periods. The data also clearly showed that development of mite was not affected by other environmental factors (minimum and average temperature as well as maximum, minimum and average relative humidity).

The population of phytoseiid predatory mite, *A. alstoniae* was recorded on brinjal during *kharif-rabi*, 2014-15 and data obtained are presented in Table 1 and also depicted in Fig. 1. The predatory mite, *A. alstoniae* first appeared during 42nd SMW when its population was 0.59 per leaf. The spider mite population was 1.76 mites per 4 cm^2 leaf during this period. The maximum temperature during the period was 37.04 ^{0}C. Thereafter, the population of predatory mite *A. alstoniae* gradually increased up to 44th SMW with the increase in spider mite population and then gradually decreased and disappeared during 48th to 5th SMW (last week of November to last week of January) from the crop. At that time, maximum and minimum temperature was 32.57 ^{0}C and 15.56 ^{0}C, respectively. However, when maximum temperature increased above 29 ^{0}C, the population of predatory mite was again observed (6th SMW) in the field with lower incidence (0.83/leaf) simultaneously with the appearance of the spider mite population. Thereafter, it gradually increased and reached to maximum 4.31 per leaf during 12th SMW as the maximum temperature reached to more than 38 ^{0}C.

Year 2015-16

The periodical data on population of *T. urticae* recorded during *kharif-rabi*, 2015-16 are presented in Table 2 and depicted graphically in Fig.2. The activity of mite (2.67 mites/4 cm^2 leaf) was started just after 3rd week of transplanting *i.e.* 1st week of October (41st SMW) on brinjal crop and continued till harvest of the crop *i.e.*, 4th week of March (13th SMW). Very next week it was slightly increased (3.55) and remained more or less equal up to end of November (48th SMW). More mite population (2.11 to 3.55) during November-December was found simultaneously with maximum temperature (32.09 to 35.77 ^{0}C). The mite population decreased from 2.11 (48th SMW) to 1.47 (49th SMW) as the maximum temperature went below 32 ^{0}C. Thereafter, the population remained static from first week of December (49th SMW) to second week of February (7th SMW) with maximum temperature decreased from 32.96 ^{0}C and remained in between 25.30 to 31.87 ^{0}C. The mite population started to increase from 3rd week of February and reached to peak at 8.63 during 4th week of March which was due to continuous increase in maximum temperature from 3rd week of February to the end of March during the study period. During the 2nd week of October, maximum temperature was 38.79 ^{0}C and predatory mite population was 0.69 per leaf. The population of predatory mite gradually increased up to 45th SMW with increase in spider mite population and maximum temperature. Thereafter it decreased gradually up to 49th SMW (0.49 per leaf) as the maximum temperature was 32.96 ^{0}C. Predatory mite disappeared from the brinjal crop from 50th to 6th SMW (1st week of February) when temperature reached below 29 ^{0}C. Thereafter, it reappeared in the crop from 7th SMW and remained up to harvest of the crop as the maximum temperature increased above 29 ^{0}C. As the maximum temperature and spider mite population was maximum, the predatory mite population was also found maximum (2.12) during 13th SMW. So, from the present investigation, it was found that the predatory mite *A. alstoniae* remained on brinjal when the spider mite population remained above 1.47. The average temperature and relative humidity were ranging from 22.25 to 29.74 ^{0}C and 43.21 to 61.29 per cent, respectively.

Correlation coefficient between weather parameters and spider mite, *T. urticae* as well as predatory mite, *A. alstoniae*

The data recorded on population of spider mite, *T. urticae* and its predator, *A. alstoniae* during *kharif-rabi*, 2014-15 and 2015-16 were correlated with the various abiotic factors to know their effect on population build up.

The data on correlation between spider mite and weather parameters during *kharif-rabi*, 2014-15 presented in Table 3 revealed that the spider mite, *T. urticae* had significant

positive correlation (0.611, 0.452 and 0.551) with maximum, minimum and average temperature. Further, the spider mite, *T. urticae* showed a significant negative relationship with morning, evening and average relative humidity (r= -0.656, -0.449 and -0.619), respectively. From the present findings, it revealed that when temperature increased, the population of spider mite was also increased, while as the relative humidity increased the population of spider mite decreased on brinjal crop.

In the present study, predatory mite *A. alstoniae* was found as one of the important predators of *T. urticae*. There was a significant positive correlation between predatory mite, *A. alstoniae* and *T. urticae* (r= 0.929) on brinjal crop. The effect of various abiotic factors like temperature and relative humidity showed that maximum and average temperature had a significant positive correlation with *A. alstoniae* (r= 0.482 and 0.386), whereas, minimum temperature (r= 0.266) had non-significant correlation. Further, the predatory mites had significantly negative correlation with morning, evening and average relative humidity (r=-0.661, -0.514 and -0.678), respectively.

There was highly significant positive correlation between population of *T. urticae* with maximum, minimum, average temperature as the coefficient values were 0.804, 0.744 and 0.788, respectively during *kharif-rabi*, 2015-16. The evening and average relative humidity had a significant negative correlation (r= -0.550 and -0.519) with spider mite, *T. urticae*, whereas, morning relative humidity had negative correlation (r= -0.345), but it was not significant.

In case of predatory mite, *A. alstoniae*, there was a highly significant positive correlation between predatory mite, *A. alstoniae* and *T. urticae* (r= 0.898) on brinjal crop. Among the different abiotic factors, there was highly significant positive correlation of predatory mites with maximum, minimum and average temperature (r= 0.752, 0.709 and 0.744), respectively indicating increase in temperature, there was increase in population however, it correlated negatively with morning, evening and average relative humidity (r= -0.450, -0.554, -0.582), respectively.

In past, Kumral and Kovanci (2005) [8] found that population of *T. urticae* was positively correlated with mean temperature, while negatively correlated with mean humidity. Further, Chinniah *et al.* (2009) [5] also reported that maximum temperature had significant positive correlation (r = +0.701) with two spotted spider mite population in okra, whereas, relative humidity (r = -0.471) had a significant negative correlation. Kanika *et al.* (2013) reported that *T. urticae* had significant positive correlation with maximum temperature (r = 0.564), while it was negatively correlated with relative humidity (r = -0.808). Kumar *et al.* (2015) [7] recorded that population of predatory mites, mean temperature, sunshine hours and wind velocity showed a significant positive correlation with mite, whereas a negative correlation with relative humidity.

Table 1: Population dynamics of *T. urticae* and predatory mite on brinjal during *kharif-rabi*, 2014-15

Month and SMW		Mites per leaf (4 cm^2)	Predatory mite per leaf (4 cm^2)	Temperature (^{0}C)			Relative Humidity (%)		
				Max.	Min.	Average	Morning	Evening	Average
September, 2014	39	2.27	0.00	35.13	26.77	30.95	93.29	55.57	74.43
October	40	2.69	0.00	36.93	24.07	30.50	86.43	45.86	66.14
	41	3.37	0.00	37.29	21.39	29.34	92.71	38.57	65.64
	42	1.76	0.59	37.04	19.19	28.11	99.71	39.71	62.50
	43	4.44	1.25	36.04	18.76	27.40	89.43	42.86	66.14
	44	4.57	1.40	35.86	19.36	27.61	87.57	36.86	62.21
November	45	4.01	1.01	34.97	17.70	26.34	86.43	38.14	62.29
	46	3.61	0.75	34.43	22.61	28.52	87.43	52.29	69.86
	47	2.79	0.40	33.47	16.47	24.97	93.14	36.00	64.57
	48	2.56	0.00	32.57	15.56	24.06	97.43	40.43	68.93
December	49	2.56	0.00	31.17	14.59	22.88	84.29	41.71	63.00
	50	2.11	0.00	28.61	12.34	20.48	88.57	69.29	78.93
	51	1.41	0.00	26.33	10.34	18.34	94.00	48.71	71.36
	52	0.00	0.00	23.76	8.64	16.20	75.38	31.00	53.19
January, 2015	1	0.00	0.00	26.26	12.13	19.19	96.43	49.86	73.14
	2	0.00	0.00	29.84	9.20	19.52	98.57	36.43	67.50
	3	0.00	0.00	26.94	11.94	19.44	88.43	58.00	73.21
	4	0.00	0.00	25.67	12.60	19.14	93.14	53.43	73.29
	5	0.00	0.00	28.24	10.51	19.38	92.00	38.86	65.43
February	6	2.89	0.83	29.44	13.41	21.43	85.00	43.57	64.29
	7	2.49	1.12	31.80	12.66	22.23	90.29	35.71	63.00
	8	5.27	2.13	35.34	16.26	25.80	86.86	35.57	61.21
	9	4.12	1.56	27.83	14.01	20.92	88.86	49.71	69.29
March	10	9.16	2.39	32.16	15.99	24.07	81.86	33.86	57.86
	11	10.12	3.16	32.81	16.81	24.81	81.71	42.14	61.93
	12	11.15	4.31	38.33	18.96	28.64	72.00	23.29	47.64
	13	10.41	2.85	38.70	21.64	30.17	77.43	33.86	55.64

SMW = Standard meteorological week

Table 2: Population dynamics of *T. urticae* and predatory mite on brinjal during *kharif-rabi*, 2015-16

Month and SMW		Mites per leaf (4 cm^2)	Predatory mite per leaf (4 cm^2)	Temperature (^{0}C)			Relative Humidity (%)		
				Max.	Min.	Average	Morning	Evening	Average
October, 2015	41	2.67	0.00	37.67	22.39	30.03	88.43	37.57	63.00
	42	3.55	0.69	38.79	20.69	29.74	98.43	35.43	58.79
	43	3.03	0.80	36.53	19.20	27.86	88.00	32.86	60.43
	44	2.85	0.93	33.91	17.14	25.53	77.57	39.86	58.71
November	45	3.55	1.21	35.77	16.91	26.34	91.86	30.71	61.29
	46	3.05	0.95	34.93	16.14	25.54	87.00	34.43	60.71
	47	2.65	1.07	33.74	18.27	26.01	67.71	36.43	52.07
	48	2.11	0.84	32.09	15.96	24.02	68.86	33.29	51.07
December	49	1.47	0.49	32.96	11.73	22.34	86.43	31.57	59.00
	50	1.01	0.00	28.59	10.53	19.56	85.29	32.43	58.86
	51	0.63	0.00	27.71	8.06	17.89	78.14	30.43	54.29
	52	0.79	0.00	25.30	8.25	16.78	68.63	28.25	48.44
January, 2016	1	1.09	0.00	31.87	10.66	21.26	94.14	36.43	65.29
	2	1.37	0.00	30.04	10.39	20.21	92.29	39.43	65.86
	3	1.49	0.00	27.54	10.19	18.86	90.29	44.00	67.14
	4	0.67	0.00	28.20	6.61	17.41	93.86	33.43	63.64
	5	1.85	0.00	30.39	13.19	21.79	88.00	40.43	64.21
February	6	1.87	0.00	29.93	11.07	20.50	76.71	31.14	53.93
	7	1.57	0.36	29.79	14.71	22.25	80.43	33.57	57.00
	8	2.85	0.67	32.99	15.43	24.21	79.00	38.43	58.71
	9	3.71	0.92	35.95	18.46	27.21	66.75	31.50	49.13
March	10	3.33	0.76	35.20	19.10	27.15	70.71	26.14	48.43
	11	4.09	1.20	34.94	19.83	27.39	71.71	28.71	50.21
	12	5.69	1.56	38.43	19.93	29.18	66.14	20.29	43.21
	13	8.63	2.12	38.90	19.84	29.37	73.71	22.14	47.93

SMW = Standard meteorological week

Table 3: Correlation coefficient (r) between weather parameters and population of spider mite as well as predatory mite in brinjal

Biotic and abiotic parameters	Spider mite, *T. urticae*		Predatory mite, *A. alstoniae*	
	2014-15	2015-16	2014-15	2015-16
A. Alstoniae	0.929**	0.898**	--	--
Maximum Temperature (^{0}C)	0.611**	0.804**	0.482*	0.752**
Minimum Temperature (^{0}C)	0.452*	0.744**	0.266	0.709**
Average Temperature (^{0}C)	0.551**	0.788**	0.386*	0.744**
Morning Relative Humidity (%)	-0.656**	-0.345	-0.661**	-0.450*
Evening Relative Humidity (%)	-0.449*	-0.550**	-0.514**	-0.554**
Average Relative Humidity (%)	-0.619**	-0.519**	-0.678**	-0.582**

* Significant at 5% level (r = 0.381); ** Significant at 1% level (r = 0.478) (Year 2014-15: n=27)

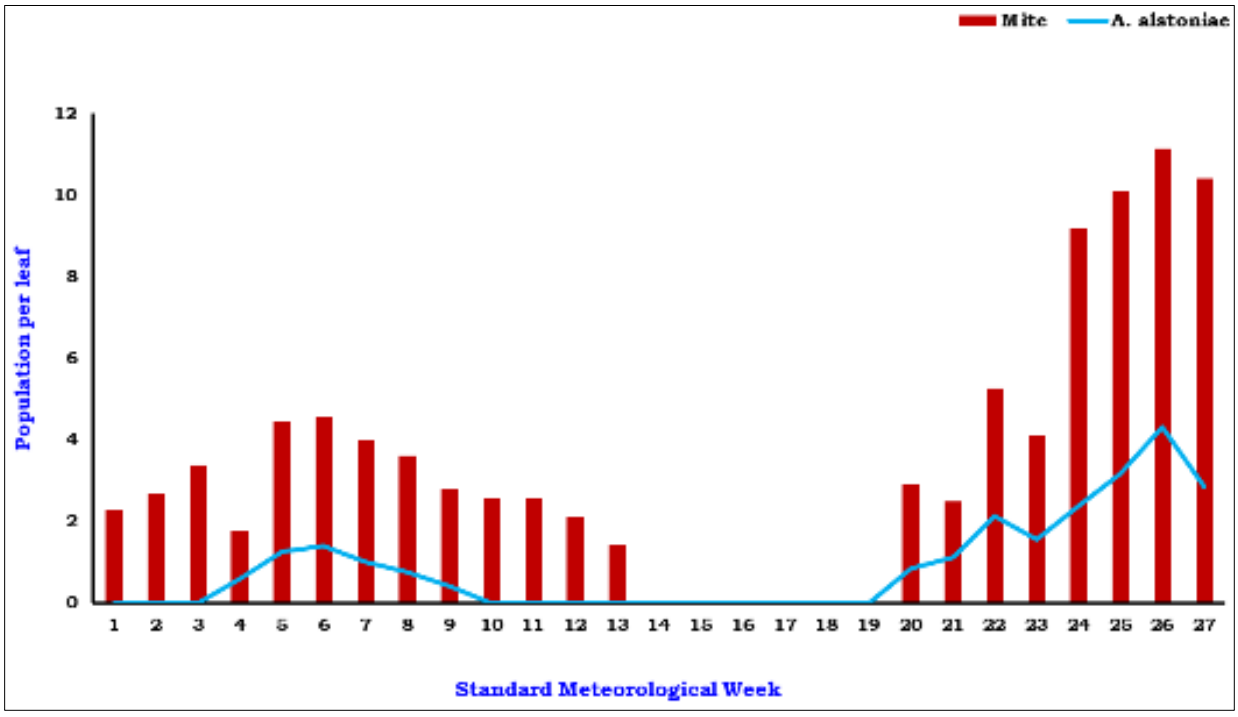

Fig 1: Population of *T. urticae* and predatory mite on brinjal during *kharif-rabi*, 2014-15

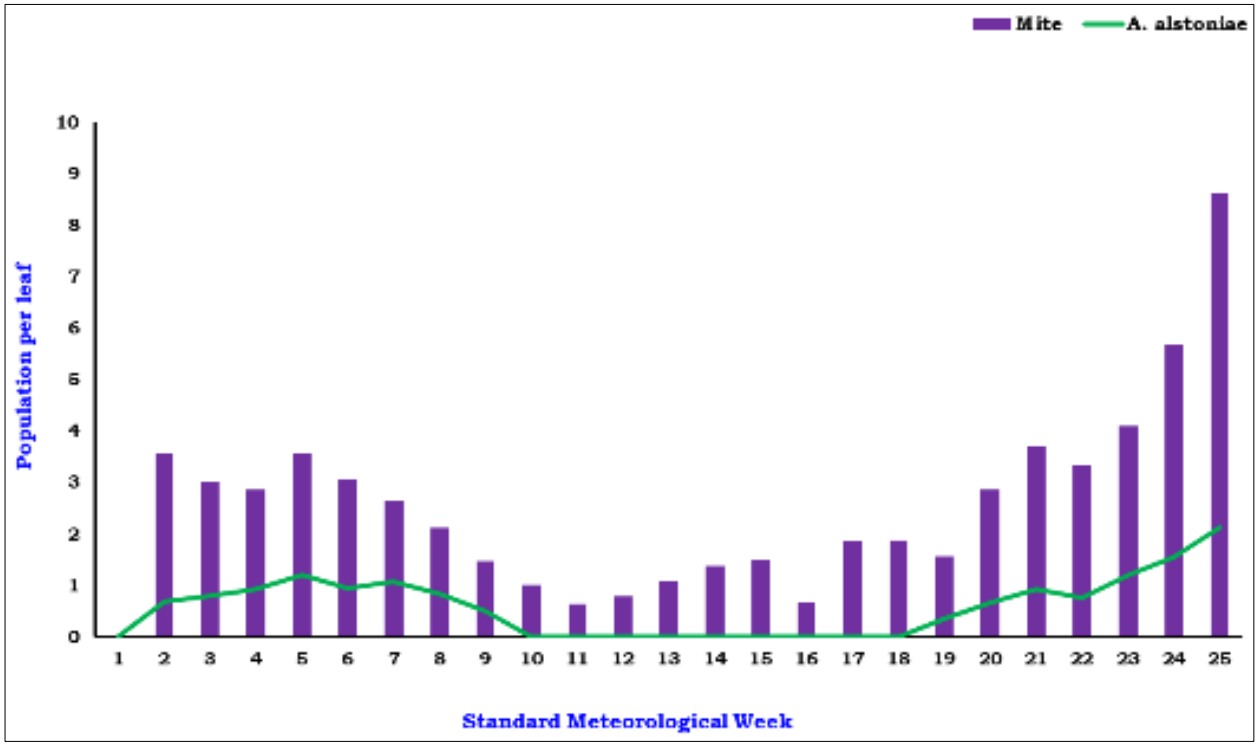

Fig 2: Population of *T. urticae* and predatory mite on brinjal during *kharif-rabi*, 2015-16

References

1. Anonymous. Progress Report for 1994-96. All India Coordinated Research Project on Agricultural Acarology, UAS, GKVK Bangalore, 1996, 35.
2. Anonymous. All India Network Project on Agricultural Acarology, 2007, 20-33.
3. Basu AC and Pramanik LM. Acaricidal tests of nine pesticides against two spotted spider mite, a serious pest of brinjal in West Bengal. Journal of Economic Entomology. 1968; 61:768-770.
4. Butani DK, Verma S. Pest of vegetable and their control-Brinjal. Pesticides. 1976; 10(2):32-38.
5. Chinniah C, Vinothkumar S, Muthiah C, Rajavel DS. Population dynamics of two spotted spider mite, *Tetranychus urticae* Koch in brinjal ecosystem. Karnataka Journal of Agricultural Sciences. 2009; 22(3-Spl. Issue):734-735.
6. Kanika T, Gulati R, Geroh M. Influence of abiotic stresses on population dynamics of two spotted spider mites (*Tetranychus urticae*) in cucumber ecosystem. Annals of Plant Protection Sciences. 2013; 21:242-246.
7. Kumar D, Raghuraman M, Singh J. Population dynamics of spider mite, *Tetranychus urticae* Koch on okra in relation to abiotic factors of Varanasi region. Journal of Agrometeorology. 2015; 17(1):102-106.
8. Kumral NA, Kovanci B. Seasonal population dynamics of the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) under acaricide constraint on eggplant in Bursa Province (Turkey). Acarologia. 2005; 45(4):295-301.
9. Manjulata K, Shashi B, Varma BR, Kapur M, Bhalla S. Pest risk involved in important of roses and its germplasm. Indian Journal of Entomology. 2002; 64(4):465-470.
10. Nayar KK, Anantha Krishnan TN, David BV. General and Applied Entomology. 11th edn. Tata McGraw- Hill pub. Co. Ltd. 4/12, New Delhi-110002, 1995, 557.
11. Patel HK, Patel VC, Patel JR. Catalogue of crop pests of Gujarat state. Tech. Bull. 1970; 6:17-18.
12. Patil RS, Nandihalli BS. Estimation of loss in brinjal due to red spider mites. Karnataka Journal of Agricultural Sciences. 2008; 21(3):456-457.
13. Rizvi SMA. Management of insect pests of okra and brinjal. Plant Protection and Environment, 1996,173-188.