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Seasonal incidence of two-spotted spider mite, *Tetranychus urticae* Koch infesting okra

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Abstract
The mite population ranged from 0.70 to 14.45 mites/2 cm² of leaf area. Initially, during the 36th standard meteorological week (3rd WAG), the population was at 0.70 mites/2 cm² of leaf area. Mite population reached at its peak during the 43rd standard meteorological week (10th WAG) at 14.45 mites/2 cm² of leaf area. Subsequently, pest activity declined during the 44th standard meteorological week (11th WAG). The mite population continued to decrease each week, reaching lowest population during the 49th standard meteorological week (16th WAG) with a pest activity level of 4.15 mites/2 cm² of leaf area when the last picking was completed. The correlation study between the incidence of okra mites and weather parameters revealed highly significant negative correlations with morning relative humidity (r = -0.768), evening relative humidity (r = -0.841), mean relative humidity (r = -0.838), wind speed (r = -0.774), and vapor pressure (r = -0.649, -0.795). However, it showed a significant positive correlation with maximum temperature (r = 0.574) and bright sunshine hours (r = 0.607). Weather parameters such as minimum temperature, mean temperature, rainfall, and rainy days demonstrated non-significant negative correlations with the mite population (r = -0.509, -0.087, -0.289, -0.406, respectively).

Keywords: Seasonal incidence, mite, weather parameter

Introduction
Okra (*Abelmoschus esculentus*), a popular and delicious vegetable from the Malvaceae family, has uncertain origins. It is grown globally, including in countries such as India, Iran, Pakistan, and Brazil. India is the leading producer and cultivates okra extensively across states like Andhra Pradesh and Gujarat. In Gujarat, okra is grown year-round, providing farmers with a reliable income and high market prices due to vegetable shortages. In India, okra is cultivated on approximately 0.5 million hectares with production of 6 million tonnes (Anon., 2020) [1]. In Gujarat, key okra-growing districts include Surat, Gandhinagar, and Junagadh, among others, covering 94,000 hectares and yielding 114,800 tonnes of okra (Anon., 2023) [2].

Okra crop harbours to a large number of insect pests including vectors (Showkat *et al*., 2010) [3]. Nearly, 72 insect species have been recorded on okra (Srinivasa and Rajendran, 2003) [4]. The major pests those attack okra crop include aphid, *Aphis gossypii* Glover; leafhopper, *Amrasca biguttula biguttula* Ishida; whitefly, *Bemisiatabaci* (Gennadius); red spider mite, *Tetranychus* spp. and shoot and fruit borer, *Earias vittella* Fab. Which cause damage to okra plants results into yield losses. Among them, mite is found in all states and very common in Bihar, Mysore, Rajasthan, Uttar Pradesh, Punjab, Haryana, and Gujarat. It is a polyphagous pest that feeds on 183 species of plants including vegetables. Both nymphs and adults cause damage by sucking the cell sap from the under surface of leaves and produce white spots which later get covered by a thick web. It results in discoloration of infested leaves, which turn bronze and dry up. Severely infected plants remain stunted with reduced flowering and fruiting. A copious web is formed on the leaves by giving an unhealthy appearance as well as a thick sheath of webbing that covers the entire plant and soil particles also filled with webs (Butani and Mittal, 1992) [5]. In various crops loss is reported as 10 to 15 percent in rice, 15 to 20 percent in tea, 10 to 25 percent in sugarcane as well as 13 to 31, 20 to 25 and 27 to 39 percent loss in brinjal, okra and chilies, respectively (Rachna, 2004) [6].

Studying seasonal incidence is crucial for understanding mite populations in okra crops. By correlating these pests with various weather parameters-such as bright sunshine (BSS),

rainfall (RF), wind speed (WS), temperature (maximum and minimum), relative humidity (morning and evening), and vapor pressure (morning and evening)-we can gather valuable insights. This information can be used to develop a predictive model for forecasting mite occurrences, enabling farmers to implement effective plant protection strategies.

Materials and Methods

To study the seasonal incidence of mites in okra, the crop was sown at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, during the *kharif*, 2023. The okra was sown in 15 x 12 meters plots with 60 x 30 cm spacing and divided into 20 quadrates of 1.8 x 1.8 meters each. Agronomical practices followed recommendations, and the crop was kept pesticide-free. For recording observation, five plants were selected randomly from each quadrate. Mite population was recorded from three (upper, middle and lower) leaves of 2 cm^2 of each randomly selected plant in each quadrate. Observation was started from one week after germination and continued till the removal of the crop at a weekly interval.

Correlation study

The weekly meteorological data was obtained from the meteorological observatory of Junagadh Agricultural University, Junagadh. With a view to study the impact of different abiotic factors *viz*., bright sunshine, rainfall, wind speed, temperature (maximum and minimum), relative humidity (morning and evening), vapour pressure (morning and evening) and rainy days etc. on pest population, a simple correlation between pest population and weather parameters was worked out.

Results and Discussion

The data on mite population of the *kharif*, 2023 are (Table 1 and illustrated in Figure 1.) indicated that mite incidence was started from 36th standard meteorological week (3rd WAG) with 0.70 mite/2 cm^2 leaf area. The pest multiplied approximately in multiple of 2.5 from 36th standard meteorological week (3rd WAG) to 40th standard meteorological week (7th WAG). After appearing on okra crop, the mite activity was found in gradually increasing trend from 41th standard meteorological week (8th WAG) to 43th standard meteorological week (10th WAG), when it reached to a peak level (14.45 mites/2 cm^2 leaf area). The pest activity reduced during 44th standard meteorological week (11th WAG). During 49th standard meteorological week (16th WAG) the pest activity was 4.15 mite/2 cm^2 leaf area when last picking was completed.

More or less similar observations taken by Ghosh (2013) [7] who found that highest population (7.56/leaf) was found on the 42nd standard meteorological week. Patel and Ghetiya (2016) [8] revealed that the incidence of *T. urticae* on marigolds attain its peak during 45th SMW (19.80 mites/ cm^2 leaf area). Ghosh and Hasan (2021) [9] founded that after rainy season; pest population increased and reached highest population (22.87/leaf) on the 42nd SMW (First week of October).

Correlation of mite population with weather parameter

The mite population (Table 2) was showed highly significant negative correlation with morning relative humidity (r = -0.768), evening relative humidity (r = -0.841), mean relative humidity (r = -0.838), wind speed (r = -0.774) and vapour pressure (r = -0.649, -0.795). Maximum temperature (r = 0.574) and bright sunshine hours showed a significantly positive correlation with mite activity. While, other weather parameters *viz*., Minimum temperature, mean temperature, rainfall and rainy days showed non-significant negative correlation with mite population (r = -0.509, -0.087, -0.289, -0.406 respectively).

Patel and Ghetiya (2016) [8] revealed that there was a highly significant association between mite population and maximum temperature. Ghosh and Hasan (2021) [9] founded that the mite population had significantly positive correlation with temperature where as non-significant negative correlation with rainfall. Patidar *et al*. (2023) [10] observed that the mite population increase was associated with high temperatures and low humidity on brinjal.

Table1: Seasonal incidence of mite infesting okra in relation to weather parameters (*kharif*, 2023)

WAG	SMW	No. of mites/2 cm^2 leaf area	Temperature (°C)			Relative Humidity (%)			BSS (hr/day)	Rainfall (mm)	Rainy days	WS (km/h)	VP (mm in Hg)	
			Max T	Min T	Mean T	RH Morning	RH Evening	RH Mean					1 VP	2 VP
1	34	0.00	30.8	25.2	28.0	89	74	82	0.8	6.8	0.0	6.7	24.0	23.3
2	35	0.00	32.8	24.6	28.7	84	62	73	4.1	0.0	0.0	5.7	23.4	22.3
3	36	0.70	34.4	25.1	29.8	81	57	69	6.8	0.0	0.0	5.0	23.2	22.2
4	37	1.15	34.0	25.3	29.7	85	56	71	6.1	0.0	0.0	5.9	24.1	20.9
5	38	1.22	31.2	24.8	28.0	91	77	84	2.5	199.6	3.0	5.5	24.8	24.0
6	39	1.08	33.7	25.3	29.5	83	63	73	4.1	16.1	2.0	4.1	23.3	23.6
7	40	1.92	35.5	23.0	29.3	84	41	63	9.7	0.0	0.0	3.9	21.8	16.9
8	41	4.45	34.7	23.0	28.9	79	46	63	9.3	53.4	1.0	3.7	21.8	18.7
9	42	10.21	35.1	23.1	29.1	74	39	57	9.1	0.0	0.0	3.6	19.0	16.0
10	43	14.45	36.6	21.8	29.2	70	31	51	8.6	0.0	0.0	2.6	18.1	13.8
11	44	12.74	36.3	19.7	28.0	72	28	50	8.7	0.0	0.0	2.0	16.3	12.0
12	45	11.50	36.2	20.7	28.5	70	30	50	8.0	0.0	0.0	2.3	16.0	13.0
13	46	10.70	34.3	18.0	26.2	60	23	42	8.2	0.0	0.0	3.7	12.4	8.5
14	47	6.30	33.5	17.0	25.3	70	33	52	7.9	0.0	0.0	2.9	13.7	12.8
15	48	3.10	29.5	18.6	24.1	86	58	72	7.0	19.0	2.0	5.6	15.7	16.3
16	49	4.15	30.0	20.4	25.2	68	44	56	6.8	0.0	0.0	6.6	13.6	13.5

Note: WAG- Weeks After Germination, SMW-Standard Meteorological Week, Max T- Maximum temperature, Min T- Minimum temperature, BSS- Bright sunshine, WS- Wind speed, VP- Vapour Pressure

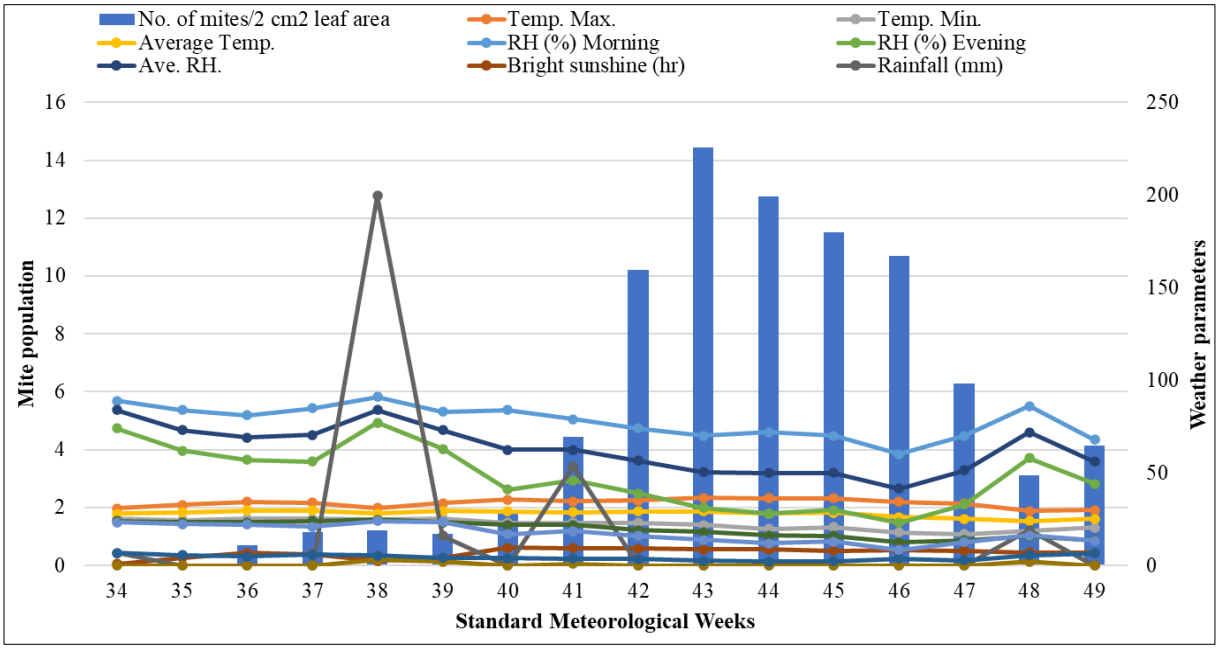

Fig 1: Influence of abiotic factors on mite infesting okra during *kharif*, 2023

Table 2: Correlation co-efficient between weather parameters and mite activity in okra (*kharif*, 2023)

Sr. No.	Weather parameter	No. of mites/2 cm^2 leaf area
1	Maximum temperature (°C)	0.574*
2	Minimum temperature (°C)	-0.509
3	Mean temperature (°C)	-0.087
4	Morning relative humidity (%)	-0.768**
5	Evening relative humidity (%)	-0.841**
6	Mean relative humidity (%)	-0.838**
7	Bright sunshine hours (hrs/day)	0.607*
8	Rainfall (mm)	-0.289
9	Rainy days	-0.406
10	Wind speed (kmph)	-0.774**
11	Vapour pressure 1 (mm in Hg)	-0.649**
12	Vapour pressure 2 (mm in Hg)	-0.795**

Note: *Significant at 5% (r = ±0.514)
** Significant at 1% (r = ±0.641) n =15

Conclusion

The peak population of mite (14.45 mites/2 cm^2 leaf area) was observed in 43th standard meteorological week (10th week after germination). The correlation analysis reveals that the population of mite/2 cm^2 leaf area exhibited highly significant negative correlations with morning relative humidity, evening relative humidity, mean relative humidity, wind speed, and vapor pressure. However, maximum temperature and bright sunshine hours showed significant positive correlation with mite population while, other weather parameters such as minimum temperature, mean temperature, rainfall, and rainy days demonstrated non-significant negative correlations with the mite population.

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