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Population dynamics of tomato leaf miner, *Liriomyza trifolii* Burges on tomato, *Solanum lycopersicum* L.

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Abstract
An experiment was conducted to study the effect of abiotic factors on the populations of leaf miner, *Liriomyza trifolii* Burges on Tomato, (*Solanum lycopersicum* L.) during 2017 and 2018 at research farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha. The results of the investigation on population dynamics of leaf miner, *L. trifolii* in relation to abiotic factors of both the years revealed that the pest commenced from 10th standard week, which remained till 26th standard week with its peak activity during 15th standard week. The correlation studies indicated highly significant and positive association between population of leaf miner and maximum temperature (0.120**), while, significant and negative correlation with relative humidity evening (-0.488*) and rainfall (-0.538*). The overall impact of abiotic factors on population build-up of leaf miner was 80.30 per cent.

Keywords: Leaf miner, population dynamics, correlation, abiotic factors, tomato, *Solanum lycopersicum*

1. Introduction
Tomato is an important vegetable crop all over the world and it is good in vitamins. Tomato rank third in priority after potato and onion in India but ranks second after potato in the world. India rank second in the area as well as in production of tomato. In India it occupies an area of 808.5 thousand hectare with production of 19696.9 thousand metric tonnes and productivity of 24.4 metric tonnes per hectare [1]. In Jammu and Kashmir, it was grown in an area of 3.58 thousand hectares with the production of 88.09 thousand metric tonnes. Tomato production in the current year is likely to be around 194 lakh tones as against 207 lakh tones in 2016-2017 which is about 3% higher than the last 5 year's average production. In Jammu and Kashmir, it was grown in an area of 801 hectares with the production of 22337 million tonnes in 2017-18 [2]. The major constraint in the successful production of tomato in Jammu region is the attack of several insect-pests and diseases at different growth stages of the plant which cause considerable damage resulting into the low production. Within the pests complex of tomatoes, leaf miners *Liriomyza* spp. (Diptera: Agromyzidae) cause substantial damage in tomato production [3]. According to), the major insect pests attacking tomato are fruit borer [*Helicoverpa armigera* (Hubner) Hardwick] army worm (*Spodoptera exigua* Hubner) whitefly (*Bemisia tabaci* Gennadius); leaf miner (*Liriomyza trifolii* Burgess) and spider mites (*Tetranychus cinnabarinus* Boisdual). Of these, leaf miner, *L. trifolii* (Agromyzidae: Diptera) has been found causing serious damage since last many years [4]. Leaf miner infestation is increasing every year at the alarming rate. This pest reduced the yield and fruit quality by direct feeding [5, 6]. The estimated loss due to infestation of *L. trifolii* was 46- 70 per cent loss to tomato seedlings. [7] 90 per cent loss to tomato foliage [8] and 70 per cent loss of tomato yield [9].
In view of the economic importance of tomato cultivation in Jammu and the magnitudes of the damage caused by the leaf miners, it becomes imperative to keep continuous vigil on the population dynamics of leaf miners. Therefore, keeping in mind the economic importance of the crop and the magnitude of the damage caused by the leaf miners, the study has been proposed.

2. Materials and Methods

An experiment was conducted to study the effect of abiotic factors on the population dynamics of leaf miner, *L. trifolii* on Tomato, *Solanum lycopersicum* during 2017 to 2018 at research farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu Chatha. All the recommended agronomic practices were followed to raise the crop except plant protection measures, which enable the buildup of insect pests and their natural enemies in a pesticides free environment.

The variety Saksham was raised in randomized complete block design with in experimental plot of 5 x 3 m^2 with 100 × 100 cms spacing to record the Population dynamics of tomato leaf miner in relation to abiotic factors and their natural enemies during the crop season.

Weekly observations were recorded from 5 randomly selected plants. With a view to study the impact of different abiotic factors on pest incidence, a simple correlation between population of pest and abiotic factors was worked out using Statistical Package for the Social Sciences (SPSS 16.0) software. Correlation analysis with various abiotic factors of the environment and the statistical analysis was worked out.

2.1 Regression model

The effect of various environmental factors under study on population of leaf miner on tomato was estimated by using multiple linear regression analyses with the prediction equations given as:

$$\text{Est. } Y_1 = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7$$

Where, Y_1 mean leaf miner population, 'a' is the constant (intercept) and b_1 to b_7 are the estimated regression coefficient associated with X_1 to X_7, respectively.

3. Results

Population dynamics of leaf miner on tomato in relation to abiotic factors at research farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu Chatha during 2017 and 2018. It is evident that incidence of leaf miner population was observed from 10th to 25th standard meteorological week (SW) in both cropping season 2017 and 2018 (Table 1). The result showed that the leaf miner population was first observed in 10th SW (0.83 leaf miner/plant) when mean temperature (maximum and minimum), relative humidity (morning and evening), sunshine, rainfall, and wind speed during the period were recorded to be 24.4 °C, 9.25 °C, 86 and 48per cent,6.75, 19.2 mm, 2.9 km/hr, respectively. The leaf miner population increases in 11th SW (1.33 leaf miner/plant) when mean temperature (maximum and minimum), relative humidity (morning and evening), sunshine, rainfall, and wind speed during the period were recorded to be 26.0 °C, 9.45 °C, 81 and 41 per cent, 6.75, 1 mm, 2.4 km/hr, respectively and reached its peak (6.60 leaf miner/plant) during 15th SW, when mean temperature (maximum and minimum), relative humidity (morning and evening), sunshine, rainfall, and wind speed during the period were recorded to be 32.5 °C, 14.1 °C, 74 and 34.5 per cent, 8.45, 1.9 mm, 3.2 km/hr, respectively. Then declined in 17th SW (4.60 leaf miner/plant) and again increases in 19th SW (6.00 leaf miner/plant). Thereafter, leaf miner population declined trend was observed and population of leaf miner reached to (0.37 leaf miner per plant) during 26th SW, when mean temperature (maximum and minimum), relative humidity (morning and evening), sunshine, rainfall, and wind speed during the period were recorded to be 34.4 °C, 25.3 °C, 75.5 and 55.7 per cent, 4.7, 94.2 mm, 3.5 km/hr, respectively.

The effect of key abiotic factors on the incidence of tomato leaf miner was studied using correlation matrix. The correlation studies showed that the population of leaf miner population was observed to be positive highly significant with temperature (maximum) (0.120**) and negative but significant correlation with relative humidity (evening) (-0.488*) and rainfall (-0.538*) and positive significant with sunshine (0.496*) whereas positive correlation with wind speed (0.338) and negative correlation with temperature (minimum) (-0.252) and relative humidity (morning) (-0.191). Table 2.

The value of multiple linear regression equations for tomato leaf miner was calculated to be $Y = -46.736 + 1.634\ X_1 - 1.308\ X_2 + 0.202\ X_3 - 0.17\ X_4 - 0.767\ X_5 + 0.013\ X_6 + 2.640\ X_7$. The corresponding correlation co-efficient of multiple determination (R^2) values worked out to be 0.803 was found statistically significant at 5% level of significance.

The overall impact of abiotic factors on population build-up of leaf miner was 80.30 per cent which reflects a positive correlation of leaf miner population with evening relative humidity, sunshine and rainfall negative correlation with other abiotic factors (Table 3).

4. Discussion

The present findings are in conformity with the findings obtained by Selvaraj *et al*. [10] revealed that the pest *L. trifolii* on tomato (*S. lycopersicum* L.) was first appearance in 8th and 9th standard meteorological week (SMW) i.e. (February and March), attain peak population in 14th and 17th SMW (April), respectively. Whereas, Ulubilir and Yabas (2000) [11] also more or less confirmed the results of the present investigation, who found that in tomato the adult population of leaf miner, *L trifolii* to be high during April and May, and decreasing in June. The adult population observed during autumn was at its peak in mid-November and then dropped down at the end of December.

Ashlata (2002) [12] recorded that leaf infestation (%) by leaf miner and pest population on leaf miner was correlated with meteorological parameters; she found that both positively correlated with maximum temperature and sunshine hours and negatively correlated with relative humidity and minimum temperature on tomato crop. Whereas, Bagmare *et al*. (1995) [13] reported that the maximum temperature and sunshine hours had a positive correlation with the population of *Liriomyza trifolii* on tomato, whereas rainfall and relative humidity had negative association with the population of leaf miners.

Table 1: Pooled data of two years on population dynamics of leaf miner, *L. trifolii* on Tomato

Standard week	Mean* leaf miner population /plant	Temperature (^{0}C)		Relative humidity (%)		Sunshine	Rainfall (mm)	Wind speed (kmh^{-1})
		Maximum	Minimum	Morning	Evening			
10	0.83	24.4	9.25	86	48	6.75	19.2	2.9
11	1.33	26.0	9.45	81	41	6.75	1	2.4
12	3.29	28.5	12.4	83	44	6.1	0.55	2.5
13	3.99	32.7	14.6	84	39	8.05	0	2.0
14	5.15	31.7	16.05	78	40	4.7	9.9	2.6
15	6.60	32.5	14.1	74	34.5	8.45	1.9	3.2
16	5.98	34.6	18.0	69.5	37	7.95	2.2	3.8
17	4.60	36.8	16.9	63.5	24	9.6	0.9	2.5
18	5.53	36.3	18.3	58	27	9.15	0.5	4.7
19	6.00	38.0	20.0	58.5	28	8.25	0.35	3.9
20	5.27	37.5	21.0	56	26.5	6.2	0.7	4.0
21	3.05	39.5	20.15	54.5	24	8.65	1.4	2.7
22	2.06	40.2	22.7	52.5	23.5	9.35	3.8	3.9
23	1.38	39.0	25.7	66.5	33.5	6.25	20.7	3.6
24	0.75	37.9	24.5	58.6	32.5	6.7	2.4	3.3
25	0.25	36.5	23.9	71.1	46.7	3.4	34	2.6
26	0.37	34.4	25.3	75.5	55.7	4.7	94.2	3.5
Range	0.83-6.60	24.4-40.2	9.25-25.7	66.5-86	33.5-55.7	3.4-9.35	0.0-94.2	2-4.7
Mean	3.32	34.5	18.37	68.8	35.5	7.11	11.39	3.20
S.Em(±)	0.54	1.12	1.27	2.73	2.31	0.43	5.67	0.17

*Mean of five plants

Table 2: Correlation coefficients and regression model between leaf miner population in relation to abiotic factors

Pest	Temperature (◦ c)		Relative humidity (%)		Sunshine	Rainfall (mm)	Wind speed (kmh^{-1})
	Maximum	Minimum	Morning	Evening			
Population of Leaf miner	0.120**	-0.252	-0.191	-0.488*	0.496*	-0.538*	0.338
**Significant at the 0.01 level *Significant at the 0.05 level							

Table 3: Regression equations and co-efficient of multiple determination (R2) of leaf miner in relation to abiotic factors (pooled)

Insect pest	Regression linear equations of leaf miner	Correlation co-efficient (r)	Co-efficient of determination (R^2)	Co-efficient of Variation (%)
Leaf miner population	Y=-46.736+1.634 X_1-1.308 X_2 +.202 X_3 -0.17 X_4- 0.767 X_5+0.013 X_6+2.640 X_7	0.896	0.803	80.30

Where,
Y=Mean No. of Leaf miner population/plant X1=Max Temp. X2=Min Temp. X3=RH Morning X4=RH Evening X5=Sunshine X6=Rainfall X7= Wind speed kmh^{-1}

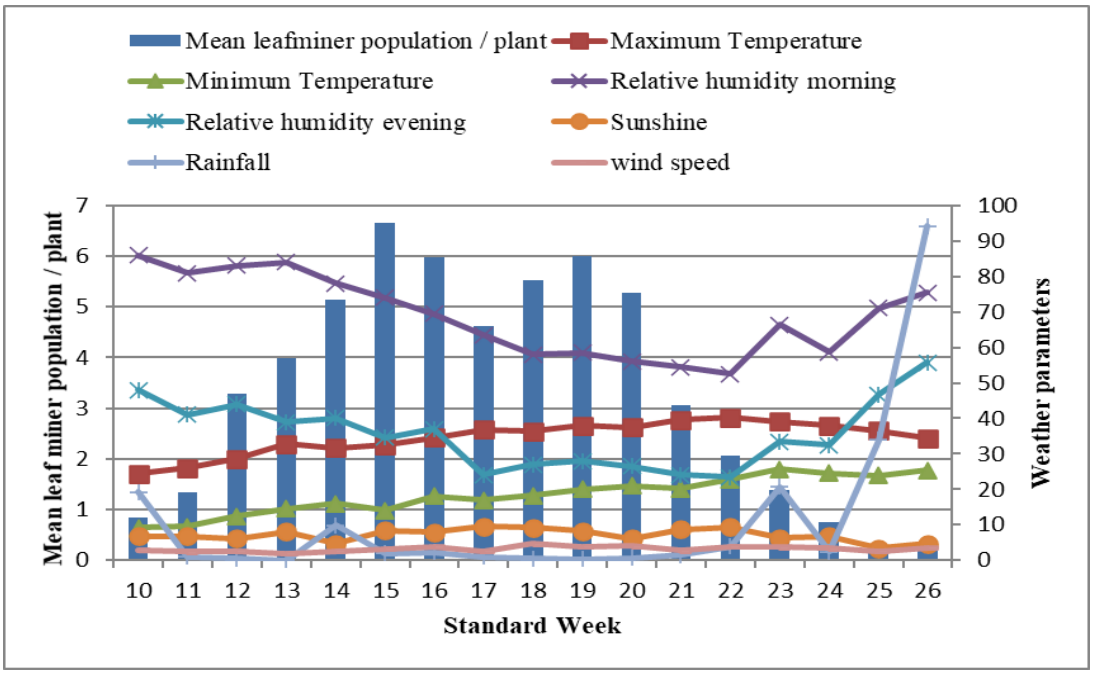

Fig 1: Population dynamics of leaf miner, *L. trifolii* on Tomato (pooled)

4. Conclusion

Tomato is a commercial crop for getting higher remuneration for the farming community. Since the sowing of seeds in nursery to harvesting of fruits, the crops have been ravaged by the magnitude of insect-pest. Among which leaf miners infestations are of major concern. In this context, the present study drew the conclusion that infestation based on mines (6.60 leaf miner/plant) attained the highest population during 15th S W. Coupled with the abiotic factors, the infestation and degree of damage enhances on crops and thereby reduction in yield potential. The present study will help in formulation of integrated pest management practices to mitigate the damage caused by leaf miners on right time.

5. References

1. Indian Horticulture Database. National Horticulture Board, Ministry of agriculture Government of India, Gurgaon, India. 2016-17.
2. Area Production Data – Directorate of Horticulture Kashmir, India. 2017-18.
3. Waterhouse DF, Norris KR. *Liriomyza* species (Diptera: Agromyzidae) leafminers, In: Waterhouse DF, Norris KR (eds). Biological control: Pacific prospects. Inkata Press,
4. Melbourne, Australia.1987, 159-176.
5. Nagaraju N, Venkatesh HM, Warburton H, Muniyappa V, Chancellor CB, Colvin J. Farmer's perceptions and practices for managing tomato leaf curl virus disease in southern India. International Journal of Pest Management. 2002; 48(4):333-338.
6. Bethke JA, Parrella MP. Effect of Tomato cultivar and fertilizer regime on the survival of *Liriomyza trifolli* (Diptera: Agromizidae) Entomologia Experimentalis et Applicata. 1985; 39:149-154.
7. Parrella MP. Biology of Liriomyza. Annual Review of Entomology, 1987; 32:201-224.
8. Pohronezny L, Waddill VH, Schuster DJ, Sonoda RM. Integrated pest management for Florida tomatoes. Plant Disease. 1986; 70:96-102.
9. Johnson MW, Welter SC, Toscano NC, Ting IP, Trumble JT. Reduction of tomato leaflet photosynthesis rates by mining activity of *Liriomyza sativae* (Diptera: Agromyzidae). Journal of Economic Entomology. 1983; 76:1061-1063.
10. Zoebisch TC, Schuster DJ, Gilreath JP. *Liriomyza trifolii:* Oviposition and development in foliage of tomato and common weed hosts. Florida Entomologist. 1984; 67(2):250-254.
11. Selvaraj S, Bisht RS, Ganeshamoorthi P. Seasonal Incidence of American Serpentine Leaf miner *Liriomyza trifolii* (Burgess), on Tomato at Pantnagar, Uttarakhand.
12. International Journal of Agriculture Sciences. 2016; 8(38):1777-1779.
13. Ulubilir A, Yabas C. Studies on population development of leafminer (*Liriomyza* spp.) and parasitation situation. Bulletin-OILB/SROP, France. 2000; 23(1):151-156
14. Ashlata. Seasonal activity and bioefficacy of some ecofriendly insecticide against the serpentine leaf miner *Liriomyza trifolii*. M.Sc. (Ag.) Thesis JNKVV. Jabalpur 2002
15. Bagmare A, Sharma D, Gupta A. Effect of weather parameters on the population build-up of various leaf miner species infesting different host plants. Crop Research. 1995; 10(3):344-395.