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Population dynamics of serpentine leaf miner, *Liriomyza trifolii* (Burgess) on watermelon in middle Gujarat conditions

Rohit Ramesh, MR Dabhi, RG Parmar and DJ Parmar

Abstract
Studies on population dynamics of serpentine leaf miner, *Liriomyza trifolii* (Burgess) on watermelon was conducted at Agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat under field condition during late *Rabi* season 2018-19. The maximum population activity of the pest was observed during the last week of February. It was established that the prevalent temperature had profound effect on the incidence and abundance of *L. trifolii*. Both maximum and minimum temperatures had favourable impact on the abundance of the pest. It was also noticed that both morning and evening vapour pressure positively influenced the pest incidence. Variants like relative humidity showed a non-significant negative correlation with the pest whereas *L. trifolii* incidence exhibited a non-significant positive relation with bright sunshine hours and wind speed.

Keywords: population dynamics, serpentine leaf miner, *Liriomyza trifolii*, watermelon

Introduction
Watermelon, *Citrullus lanatus* (Thunb.), is a trailing annual vining plant that belongs to the family Cucurbitaceae. It is a native of West Africa. Its juice contains about 6% sugars, 0.2% proteins, 0.3% minerals and 92% water. It is also a rich source of vitamin C. (Anonymous, 2019) [5]. India occupies 25th position in watermelon production in world having 0.4% share in total production (Anonymous, 2016a) [6]. In India, watermelon is grown in about 91,000 ha, with a total production of 21,69,000 MT (Anonymous, 2017a) [2]. It is grown particularly as a major river-bed crop in states like Uttar Pradesh, Karnataka, West Bengal, Madhya Pradesh, and Rajasthan (Chadha, 2013) [8]. Watermelon requires warm climate for its growth. A temperature range of 24-27 ºC is ideal for the seed germination and growth of watermelon plants. A cool night would ensure ample development of sugars in the fruit. It is however, sensitive to frost and hence, it is grown in states like Haryana after the winter (Anonymous, 2017b) [3]. In Gujarat, it is grown in Kheda, Vadodara, Chhotaudepur, Sabarkantha and Banaskantha districts of state. The crop duration is about 75-100 days depending on the variety cultivated (Anonymous, 2016b) [7]. Its yield is both qualitatively and quantitatively deteriorated by a number of insect pests, among which the serpentine leaf miner, *Liriomyza trifolii* (Diptera: Agromyzidae). Initially, the pest was of little importance but since last few years, the pest has assumed serious dimensions damaging almost all crops during *Rabi* from almost all parts of the country. Various species of *Liriomyza viz.*, *L. trifolii* (American serpentine leaf miner), *L. huidobrensis* (pea leaf miner) and *L. sativae* (vegetable leaf miner) are often found together. Depending on the prevalent climatic conditions, presence of natural enemies and the fecundity rate on host crops, one species may replace the other (Abe and Tokumaru, 2008) [1]. The development of *L. trifolii* is strictly connected with temperature. Consequently, at a uniform temperature of 28 ºC, one generation cycle can be accomplished in 14-15 days, but at lower temperatures the time taken is progressively longer (Anonymous, 2018) [4]. It is an important summer season crop which fetches higher returns to the growers, but the damage due to the leaf miner, *L. trifolii* has been alarming in the recent past in the watermelon growing pockets and hence, for devising effective management strategies against the pest, it is necessary that the ecology of the pest is to be studied as well as its incidence and abundance in relation to the prevailing weather parameters.

Materials and Methods

The investigations on population dynamics of leaf miner on watermelon were carried out at Agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand during late *Rabi*, 2018-19. In order to know the seasonal abundance of *L. trifolii* on watermelon, the crop was dibbled in area of 360 sq. m. with spacing of 1.5 m x 1.0 m. All recommended agronomical practices were adopted to raise the crop in the experimental field. For observations, the whole plot was divided into six equal quadrates. Five plants were randomly selected from each quadrate and tagged for recording the observations. Numbers of mines per leaf present on the leaf of each tagged plant were recorded at weekly interval starting from two weeks after germination till harvest of the crop. Observations on leaf miner larvae were recorded on these 30 plants. Data thus obtained were correlated with weather parameters (temperature, relative humidity, vapour pressure, wind velocity and bright sunshine hours) to determine the correlation between leaf miner population and the various weather parameters. The observations on population of pest were recorded in the morning hours at weekly interval on visual basis starting from 15 days of sowing till harvest of the crop. A correlation study was carried out between various abiotic factors *viz.*, temperature (minimum and maximum), relative humidity (morning and evening), vapour pressure, bright sunshine hours, wind velocity and pest incidence. The weather data were utilized to work out the correlation coefficient. The infestation of *L. trifolii* was judged by recording the larval counts and damaged leaves at weekly interval.

Results and Discussion

The crop was sown in the second week of December and was monitored continuously for the infestation by *L. trifolii* after the emergence of the crop. The first sign of infestation was observed from the third week of sowing (Table 1 and Fig. 1) *i.e.*, 2nd week of January (3rd Standard Meteorological Week). During the 2nd week of January, an average count of 0.47 mines/ leaf was observed in the crop. The number of leaf mines showed a gradual increase thereafter, until it reached peak incidence during the end of February (9th SMW), where it registered an average of 9.91 mines per leaf. Thereafter, the number of leaf mines declined, but the pest was observed until the harvest of the crop. It was also observed that the pest was abundant towards the end of vegetative growth phase and the commencement of reproductive phase of the watermelon crop. These results are in close conformity with the reports made by Galande and Ghorpade (2010) [10] in Maharashtra, where they observed that the maximum activity of leaf miner was recorded from January to April with peak incidence noted in the month of February. A comprehensive population study made by Saradhi and Patnaik (2004) [12] in Bhubaneswar, Odisha established that the *L. trifolii* was observed throughout the year but the peak incidence was observed from January to April with peak incidence attained during the third week of February.

The correlation analysis of the *L. trifolii* incidence with the weather parameters (Table 2) revealed that the leaf miner incidence showed highly significant positive relationship with the minimum temperature (r = 0.811**) and morning vapour pressure (0.760**) while the parameters like maximum temperature (r = 0.660*) and evening vapour pressure (r = 0.304*) showed significant positive correlation. In contrary, bright sunshine hours (r = -0.127) and evening relative humidity (-0.256) showed a non-significant negative correlation with *L. trifolii* incidence, whereas the morning relative humidity (0.017) and wind speed (0.018) showed positive correlation with the pest incidence, though the correlation was non-significant. The above results are in accordance with the reports made by Tamilnayagan *et al.* (2017) [13], where they registered a significant positive correlation of temperature with *L. trifolii* incidence. Similar observations were made by Chaudhuri and Senapati (2004) [9] where they noticed significant positive relationship between *L. trifolii* incidence with prevailing weather parameters like temperature, minimum R.H and rainfall. Similar narrative was made by Reddy and Kumar (2005) [11] wherein a non-significant positive relationship between the pest incidence with maximum and minimum temperatures, was established. They also reported a non-significant correlation between the leaf miner incidence with the morning and evening relative humidity.

Table 1: Population fluctuation of *L. trifolii* on watermelon during 2018-19

Month	Week	SMW	Date of observations	No. of mines / leaf
December 2018	IV	52	26/12/2018	0.00
January 2019	I	1	02/01/2019	0.00
	II	2	09/01/2019	0.47
	III	3	16/01/2019	2.38
	IV	4	23/01/2019	2.96
	V	5	30/01/2019	3.47
February 2019	I	6	06/02/2019	3.96
	II	7	13/02/2019	5.73
	III	8	20/02/2019	8.74
	IV	9	27/02/2019	9.91
March 2019	I	10	06/03/2019	8.71
	II	11	13/03/2019	8.40
Average				4.56

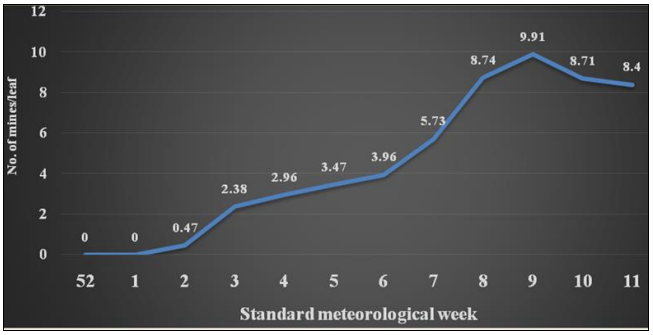

Fig 1: Population dynamics of *L. trifolii* on watermelon

Table 2: Correlation co-efficient between weather parameters and *L. trifolii* incidence on watermelon

Weather parameters	Correlation coefficient (r)
Maximum Temperature, ^{0}C (Max T)	0.660*
Minimum Temperature, ^{0}C (Min T)	0.811**
Morning Relative Humidity,% (RH_1)	0.017
Evening Relative Humidity,% (RH_2)	-0.256
Morning Vapour pressure, mm of Hg (VP_1)	0.740**
Evening Vapour pressure, mm of Hg (VP_2)	0.304*
Bright sunshine hours, hr day^{-1} (BSS)	-0.127
Wind Speed, kmhr^{-1} (WS)	0.018

*Significant at 5% level
**Significant at 1% level

Conclusion

From the above results it may be concluded that the maximum activity of the pest was observed during the last week of February on the watermelon crop. It was established that the prevalent temperature had profound effect on the incidence and abundance of *L. trifolii*. Both maximum and minimum temperatures had favourable impact on the abundance of the pest. It was also noticed that both morning and evening vapour pressure positively influenced the pest incidence. Variants like relative humidity showed a non-significant negative correlation with the pest whereas *L. trifolii* incidence exhibited a non-significant positive relation with bright sunshine hours and wind speed.

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