Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(4): 1557-1560

Received: 14-05-2018
Accepted: 15-06-2018

Mithra Mohan
Department of Agricultural Entomology, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

N Anitha
Department of Agricultural Entomology, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

Correspondence
Mithra Mohan
Department of Agricultural Entomology, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India

Antixenosis effect of tomato cultivars to American serpentine leaf miner *Liriomyza trifolii* (Burgess)

Mithra Mohan and N Anitha

Abstract
Antixenosis effect of tomato cultivars against American serpentine leaf miner *Liriomyza trifolii* was evaluated at College of Agriculture, Vellayani, Kerala during 2016-2017. A total of fifteen tomato cultivars were tested for the incidence of *L. trifolii* and their correlation with biophysical parameters. Leaf area exhibited a significant positive correlation with mean leaf damage (percentage), mean number of mines plant^{-1} and mean number of larvae plant^{-1} with correlation coefficients of 0.837, 0.822 and 0.833 respectively. It indicated that with increase in leaf area among the different cultivars, incidence of leaf miner was also increased. Length width ratio of leaves revealed a significant negative correlation with mean leaf damage (percentage) and mean number of mines plant^{-1} with correlation coefficients of -0.547 and -0.547 respectively whereas mean number of larvae plant^{-1} exhibited a non-significant negative relation.

Keywords: American serpentine leaf miner, *Liriomyza trifolii*, tomato, antixenosis

Introduction
Tomato, *Solanum lycopersicum* (L.), is one of the most important and demanding vegetable crops in the world that belongs to the family solanaceae. In India, it is cultivated in 8.82 lakh ha with an annual production of 18.74 lakh tonnes and productivity of 21.2 t ha^{-1} [1]. Even though, the area under tomato cultivation is supplementary, productivity is comparatively low in India due to various factors, in which pest infestation accounts for a significant portion. Out of the numerous pests, American serpentine leaf miner *L. trifolii*, an invasive pest, is considered as an important one which has established at various agro ecosystems in India after its introduction in 1991 [2].

The genus *Liriomyza* is composed of more than 300 species, out of which 23 are economically important which instigate severe damage in crop plants. Among the *Liriomyza* spp., *L. trifolii* is an important polyphagous pest, believed to be originated in United States of America and initially described as *Oscinis trifolii* (Burgess) observed from white clover [3]. Wide host range along with short life span, high reproductive potential, concealed larval stages and resistant populations made the management of *L. trifolii*, a strenuous task [4].

Indiscriminate use of highly toxic insecticides for the management of *L. trifolii* gives rise to pesticide resistance problems, reduction in natural enemy population, pest resurgence, secondary pest outbreak and pesticide residue problems which questions the uniqueness of conventional insecticides. Being a cultural control tactic, host plant resistance is considered as a safe alternative which enhance the effects of biological control strategies and upgrade the performance of pesticide applications for the management of major pests of crops [5].

Material and Methods
Fifteen tomato cultivars were screened for their field tolerance to *L. trifolii* at Instructional Farm, Vellayani, Thiruvananthapuram during 2016-2017. The trial was conducted in grow bags in completely randomized design with three replications. Observations on percentage leaf damage, number of mines plant^{-1}, number of living larva plant^{-1}, leaf area and length width ratio of leaves were recorded from five randomly selected plants of each cultivar starting from one month after transplanting. Leaf area was calculated by multiplying the total length and width of leaves with a constant 0.9 [6]. Length width ratio is calculated by dividing the length of a leaf with its width at the broadest point.

The obtained data were analyzed statistically using WASP software. The mean percentage leaf damage, mean number of mines plant^{-1}, mean number of living larva plant^{-1} were calculated

and were correlated with leaf area and length width ratio of leaf. Regression equation was worked out on significantly correlated values.

Results

Among the fifteen cultivars, Arka Abha was found to be more tolerant to *L. trifolii* infestation with lowest mean leaf damage of 10.12 percent and highest damage was observed in hybrid Swaraksha with a percentage leaf damage of 66.20 percent at one month after transplanting. At two months after transplanting, Arka Abha recorded the lowest percentage leaf damage (14.21) which was on par with Anagha (15.11), Akshaya (17.53), LE 20 (17.61), Pusa Ruby (18.45), Arka Meghali (18.72) and Arka Vikas (20.57). Hybrid NS-538 was severely damaged by *L. trifolii* with a leaf damage percentage of 66.26 percent which was on par with hybrid Swaraksha with a leaf damage of 66.09 percent. Highest mean leaf damage was observed in Swaraksha (66.15%) and lowest mean leaf damage was in Arka Abha (12.17%) (Table 1).

The number of mines plant^{-1} exhibited a significant difference among the fifteen tomato cultivars screened for field tolerance to *L. trifolii*. The number of mines plant^{-1} varied from 6.56 to 138.99 at one month after transplanting. Lowest number of mines plant^{-1} was recorded in Arka Abha (6.56) followed by Arka Vikas (9.44) which were statistically on par. Maximum number of mines plant^{-1} was observed in hybrid NS-538 (138.99) which was significantly different from all other varieties. Second highest infestation was recorded in hybrid Arka Rakshak with 94.88 mines plant^{-1} which was statistically on par with Arka Samrat (94.33) and Swarkasha (83.50 ^{1}). The number of mines plant^{-1} ranged from 8.22 to 153.44 at two months after planting. Arka Abha recorded the lowest number of mines plant^{-1} (8.22) followed by LE 20 (13.33) and Arka Meghali (13.77) which were statistically on par. Maximum number of mines plant^{-1} was recorded in NS-538 (153.44) which was significantly higher to all other cultivars. It was followed by hybrid Arka Rakshak (119.11) and Arka Samrat (107.77) and were statistically on par. Arka Abha recorded the lowest mean number of mines plant^{-1} (7.39) followed by Arka Vikas (12.72) and Arka Meghali (13.11) whereas the highest mean number of mines plant^{-1} was observed in NS-538 (146.22). Arka Rakshak (106.99), Arka Samrat (101.05) and Swaraksha (84.47) also recorded higher number of mines plant^{-1} (Table 1).

A significant difference was observed in the number of larvae plant $^{-1}$ among the different cultivars of tomato screened against *L. trifolii* at one month after transplanting. Number of larvae present on the plants varied from 0.11 to 8.55. Lowest number of larvae plant $^{-1}$ was reported from Arka Abha (0.11) which was on par with Arka Alok (0.33), Hissar Lalith (0.44), Arka Vikas (0.44), Manulekshmi (0.55), Anagha (0.55), LE 20 (0.55), Pusa ruby (0.66) and Aksahya (0.78). Maximum number of larvae were recorded in hybrid NS - 538 (8.55). It was followed by Arka Rakshak (5.33), Arka Samrat (4.78) and Swarkasha (4.67) which were statistically on par. There was a significant difference in number of larvae plant^{-1} among the fifteen tomato cultivars at two months after transplanting. Arka Abha recorded the lowest number of larvae plant^{-1} (0.22) which was statistically on par with cultivars Arka Vikas (0.33), Pusa Ruby (0.33), LE 20 (0.33), Arka Alok (0.33), Arka Meghali (0.55), Hissar Lalith (0.55) and Anagha (0.77). Maximum number of larvae plant^{-1} was observed in hybrid NS 538 (8.99) which was statistically on par with Arka Samrat (6.89) and Arka Rakshak (6.78). Mean number of larval population was highest in NS 538 (8.77) whereas lowest was in Arka Alok (0.33) (Table1).

Table 1: Incidence of *L. trifolii* on different tomato cultivars

Cultivars	Leaf damage (percent)			Number of mines Plant $^{-1}$			Number of larvae plant^{-1}		
	1MAT	2 MAT	Mean	1MAT	2 MAT	Mean	1MAT	2 MAT	Mean
Vellayani Vijai	57.45	41.46	49.46	66.55 (8.14)	68.22 (8.23)	67.39	3.22 (1.92)	4.27 (2.18)	3.75
Akshaya	17.97	17.53	17.75	15.99 (3.99)	36.55 (6.04)	26.27	0.78 (1.09)	1.11 (1.27)	0.95
Manulekshmi	29.17	26.45	27.81	24.22 (4.92)	31.33 (5.58)	27.78	0.55 (1.02)	1.44 (1.35)	1.00
Anagha	15.50	15.11	15.31	22.22 (4.69)	29.44 (5.40)	25.83	0.55 (1.02)	0.77 (1.12)	0.66
LE 20	16.78	17.61	17.20	16.78 (4.08)	13.33 (3.64)	15.06	0.55 (1.03)	0.33 (0.89)	0.44
Pusa Ruby	17.45	18.45	17.95	17.22 (4.12)	27.33 (5.20)	22.28	0.66 (1.08)	0.33 (0.89)	0.50
Swaraksha	66.20	66.09	66.15	83.50 (9.13)	85.44 (9.23)	84.47	4.67 (2.26)	5.78 (2.49)	5.23
NS-538	60.67	66.26	63.47	138.99 (11.75)	153.44 (12.34)	146.22	8.55 (3.00)	8.99 (3.08)	8.77
Arka Abha	10.12	14.21	12.17	6.56 (2.56)	8.22 (2.85)	7.39	0.11 (0.77)	0.22 (0.84)	0.17
Arka Meghali	18.62	18.72	18.67	12.44 (3.48)	13.77 (3.70)	13.11	1.11 (1.25)	0.55 (0.99)	0.83
Arka Alok	22.85	23.18	23.02	16.66 (4.08)	16.89 (4.07)	16.78	0.33 (0.91)	0.33 (0.91)	0.33
Arka Vikas	16.13	20.57	18.35	9.44 (3.08)	15.99 (3.95)	12.72	0.44 (0.96)	0.33 (0.89)	0.39
Arka Rakshak	58.40	51.65	55.03	94.88 (9.74)	119.11 (10.91)	107.00	5.33 (2.42)	6.78 (2.69)	6.06
Arka Samrat	59.44	48.69	54.07	94.33 (9.70)	107.77 (10.36)	101.05	4.78 (2.28)	6.89 (2.70)	5.84
Hissar Lalith	19.69	25.88	22.79	17.78 (4.18)	24.55 (4.95)	21.17	0.44 (0.95)	0.55 1.02)	0.50
CD(0.05)	5.179	6.519	-	0.899	0.995	-	0.338	0.403	-

*Figures in parenthesis are √x+0.5 transformed values

Table 2: Bio-physical parameters of different tomato cultivars infested by leaf miner, *L. trifolii*

Cultivars	Leaf area(cm^2)			Length width ratio of leaf		
	1 MAT	2 MAT	Mean	1 MAT	2 MAT	Mean
Vellayani Vijai	579.77	699.87	639.82	1.48	1.56	1.52
Akshaya	500.40	592.80	546.60	1.55	1.54	1.54
Manulekshmi	557.33	613.50	585.42	1.36	1.39	1.37
Anagha	440.43	513.53	476.98	1.57	1.54	1.55
LE 20	535.20	572.90	554.05	1.40	1.48	1.44
Pusa Ruby	530.90	573.07	551.99	1.55	1.51	1.53
Swaraksha	693.07	854.17	773.62	1.43	1.49	1.46
NS-538	695.40	891.91	793.66	1.39	1.45	1.42
Arka Abha	518.70	509.47	514.09	1.61	1.67	1.64
Arka Meghali	536.63	557.80	547.22	1.59	1.59	1.59
Arka Alok	643.03	712.98	678.01	1.42	1.44	1.43
Arka Vikas	619.99	724.53	672.26	1.55	1.46	1.50
Arka Rakshak	891.33	973.20	932.27	1.39	1.47	1.43
Arka Samrat	845.90	967.40	906.65	1.22	1.30	1.26
Hissar Lalith	475.43	632.30	553.87	1.53	1.37	1.45
CD(0.05)	43.027	46.557	-	0.172	0.153	-

Among the fifteen tomato cultivars, highest leaf area was observed in Arka Rakshak (891.33 cm^2) which was significantly superior to other cultivars. Lowest leaf area was observed in Anagha (440.33 cm^2) which was on par with Hissar Lalith (475.43 cm^2) at one month after transplanting. Lowest leaf area was observed in Arka Abha (509.47 cm^2) which was on par with Anagha (513.53 cm^2). Arka Rakshak and Arka Samrat possessed highest leaf area among the cultivars and found statistically on par (973.2 cm^2 and 967.4 cm^2 respectively) at two months after transplanting. Highest mean leaf area was recorded in Arka Rakshak (973.20cm^2) while the lowest was in Anagha (476.98 cm^2) (Table 2).

Length width ratio of leaf was observed to be highest in Arka Abha (1.61) followed by Arka Meghali (1.59). Lowest length width ratio was observed in Arka Samrat (1.22) at one month after transplanting. At two months after transplanting, highest length width ratio was observed in Arka Abha (1.67) followed by varieties Arka Meghali (1.59), Vellayani Vijai (1.56), Anagha (1.54) and Akshaya (1.54) which were statistically on par whereas the lowest length width ratio of leaves was observed in Arka Samrat (1.30) which was statistically on par with Hissar Lalith (1.37), Manulekshmi (1.39), Arka Alok (1.44) and NS-538(1.45). Mean length width ratio of leaf was observed to be highest in Arka Abha (1.64) and the lowest was in Arka Samrat (1.26) (Table 2).

On analyzing the correlation between mean leaf damage (percentage) and mean leaf area, a correlation coefficient of 0.837 was obtained which indicated a significant strong positive relationship. As the leaf area increased, an increase in leaf damage caused by *L. trifolii* was also observed. The regression equation obtained was Y= -42.195 + 0.114X, where Y is the leaf damage (percentage) and X is the leaf area. This equation explained that with every one square cm increase in leaf area, there was an increase in leaf damage (percentage) by 0.114. Leaf area showed a positive significant strong correlation with number of mines $plant^{-1}$ with correlation coefficient of 0.822. The regression equation obtained was Y= -4.964+ 0.071X which signified that every one square cm increase in leaf area, there was a 0.071 increase in number of mines $plant^{-1}$. Correlation of number of larvae $plant^{-1}$ with leaf area also revealed a significant positive strong relationship and the correlation coefficient was 0.833. The regression equation was Y=-1.363 + 0.004 X. It explained that with a unit increase in leaf area there was 0.004 unit increase in number of larvae $plant^{-1}$ (Table 3).

Length width ratio revealed a negative significant moderate relationship with percentage leaf damage with a correlation coefficient of -0.547. When length width ratio of leaf was increased there was a decrease in percentage leaf damage. The regression equation obtained was Y= 199.79 - 113.67 X, where Y is the leaf damage and X is the length width ratio of leaf. This equation explained that with every one unit increase in length width ratio, there was a decrease of 113.67 percent in leaf damage.

Table 3: Correlation co-efficient of different independent and dependent variables

Sl. No.	Correlation between independent and dependent variable	Correlation coefficient	Level of significance at 5%	Regression equation
1	Leaf area v/s mean leaf damage (percentage)	0.837	Significant	Y= -42.195 + 0.114 X
2	Length width ratio of leaf v/s mean leaf damage (percentage)	-0.547	Significant	Y= 199.79 – 113.67 X
3	Leaf area v/s mean number of mines $plant^{-1}$	0.822	Significant	Y= -4.964 + 0.071 X
4	Length width ratio of leaf v/s mean number of mines $plant^{-1}$	-0.562	Significant	Y= 32.415 – 17.795 X
5	Leaf area v/s mean number of larva $plant^{-1}$	0.833	Significant	Y= -1.363 + 0.004 X
6	Length width ratio of leaf v/s mean number of larva $plant^{-1}$	-0.507	Non-significant	-

Length width ratio of leaf showed a significant negative correlation with number of mines $plant^{-1}$ with a correlation coefficient of -0.562. The regression equation obtained was Y= 32.415- 17.795 X. The regression equation revealed that one unit increase in length width ratio resulted in reduction of number of mines to the tune of 17.795. There was a non-significant negative correlation observed in number of live larvae $plant^{-1}$ with length width ratio (Table 3). Arka Abha possessed highest mean length width ratio of leaf (1.64) and it recorded the least mean leaf damage (12.17 percent) indicated the non-preference of the cultivar by *L. trifolii.*

Discussion

From this study, it is clear that hybrid cultivars possessed highest leaf area and were severely damaged by leaf miner. When there was more leaf area, adult fly got more space for oviposition and larval stages were acquainted with more space for mining. Larvae of leaf miner were unable to shift their position from one leaf to another. So increased leaf area reduced the competition of *L. trifolii* maggots for nutrients and space which resulted in higher infestation. Similarly, experiments conducted for identifying the basis of resistance in tomato genotypes at Raipur, Utter Pradesh also revealed that leaf area was highly correlated with the pest incidence which may be due to the increased leaf surface for egg deposition and feeding [7]. An experiment to identify the varietal preference in cowpea accessions by *L. trifolii* disclosed that adult female flies identify suitable cultivar of host plant mainly based on the morphological attributes of the cultivars [8]. When the length width ratio of leaf increased, there was reduction of space for mine expansion and oviposition. The relation between leaf area and length width ratio of leaf with mean mine length in tomato cultivars by *L. trifolii* was studied and reported that leaf area exhibited a significant positive strong correlation whereas length width ratio exhibited a non-significant relation with mean mine length in leaves [9].

Conclusion

From the present study, it is concluded that leaf area exhibited a significant positive correlation with mean leaf damage (percentage), mean number of mines plant^{-1} and mean number of larvae plant^{-1} and length width ratio of leaf exhibited significant negative correlation with mean leaf damage (percentage) and mean number of mines plant^{-1} which highlighted the antixenosis effect of tomato cultivars to *L. trifolii*

Reference

1. NHB (National Horticulture Board). Indian Horticulture Database. National Horticulture Board, Haryana, 2015, 301.
2. Viraktamath CA, Tewari GC, Srinivasan K, Gupta M. American serpentine leaf miner is a new threat to crops. Indian Farming.1993; 43(2):10-12.
3. Spencer KA. Agromyzidae (Diptera) of economic importance. Series Entomologica. 1973; 9:1-418.
4. Pawar DB, Patil SK. Efficacy of insecticides and NSKE against American serpentine leaf miner, *Liriomyza trifolii* (Burgess) on cucumber (*Cucumis sativus* L). Pest Management in Horticultural Ecosystems. 2013; 19(2):251-253.
5. Teets GL. Adjusting crop management recommendations for insect-resistant crop varieties. Journal of Agricultural Entomology. 1994; 11:191-200.
6. Achnlither AA. Non -destructive leaf area estimation in sunflower. Agronomy Journal.1978; 70:141-142.
7. Sahu IK, Shaw SS, Mandawi NC. Basis of resistance in tomato genotypes against tomato leaf miner, *Liriomyza trifolii* (Burgess). Journal of Applied Zoological Researches. 2006; 17(1):95-97.
8. Reji GV. Management of the American serpentine leaf miner (*Liriomyza trifolii*, (Burgess) Dietars on cowpea, *Vigna ungiculata* (L.) Walp. M. Sc. (Ag) thesis, Kerala Agricultural University, Thrissur, 2002, 88.
9. Sahu IK, Shaw SS. Antixenosis effect of tomato genotype on mine length of serpentine leaf miner *Liriomyza trifolii* (Burgess). Journal of Soils and Crops. 2006; 16(1):52-57.