

Evaluation of Promising Tomato Cultivars against American Serpentine Leaf Miner, (*Liriomyza trifolii*, Burgess) in NorthWest plain of Uttar Pradesh, India

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Abstract- The field incidence of the serpentine leaf miner, *L. trifolii*(Burgess) was severe during the fruiting stage of the crop and infestation was higher on lower surface of leaf in comparisons of upper surface. On the basis of cumulative susceptibility index test varieties viz. HS-102, SEL-14, Pant T-4, PS-8, PT-28, NDT-44, BT-117-5-3-1, Pusa Ruby (Check), KS-118, Pant Bahar, CO-3, Pant Hybrid-1, BBs-109, NTH-337, BRH-01, ARTH-04, BS-2530, NDT-9, Meenakshi-H1, Punjab Chhuhara, NDT-96 were found to be resistant/less susceptible. Only nine test cultivars viz. BT-20-1-4, KS-2, PT-3, Sweet-72, Pant Hybrid-2, TH-2312, Ratna, Avinash, Sohali were found to be moderately susceptible/moderately resistant. No cultivar was found highly susceptible against leaf miner. No significant correlation could be established between the number of leaf mines and yield of tomato crop. Although yields differ significantly between different varieties, probably compensation for leaf injury played a major role in yield recovery.

Index Terms- Tomato cultivars, Serpentine leaf miner, *Liriomyza trifolii* (Burgess)

I. BACK GROUND

Vegetables are an essential part of daily diet in which tomato *Lycopersicon esculentum* (Mill.) is very important. In India, production of tomato increased considerably in recent years with the introduction of new hybrid varieties. These high yielding varieties have good shelf life with transportation quality. There are numbers of insect pests like, fruit borer (*Helicoverpa armigera*), aphids (*Aphis gossypii*, *Myzus persicae*), jassids (*Amarasca biguttula*), American serpentine leaf miner, (*Liriomyza trifolii*), root knot nematodes (*Meloidogyne sp.*) etc have been recorded as serious problem. American serpentine leaf miner, (*Liriomyza trifolii*, Burgess) (Diptera: Agromyzidae) invaded in India recently and poses a serious threat to Indian agriculture. This black fly with red eyes, a native of Florida is polyphagous in nature, whose infestation is increasing every year at an alarming rate.

The genus *Liriomyza* contains more than 300 species known in the world. In which, approximately 23 species of *Liriomyza* have been reported as being economically important in which *L. trifolii* is very dominating in vegetable crops like tomato, cucumber, vegetable pea etc. This insect has the potential to infest on 250 crop species in India (Sharma, 1994). All types of producers who grow vegetables, ornamental flowers and other horticultural and field crops are affected by one or more species of these polyphagous leaf miners. In tomato, the insect damages the crop by making feeding and oviposition punctures on the leaves and then by leaf mining by the maggot. The larvae tunnel inside the mesophyll and feed inside on the palisade mesophyll tissues. The destruction of chlorophyll containing tissues interferes with the photosynthetic activity of the plant as a result of which growth and yield of the infected plants in adversely affected. When one fourth of the leaf area was mined, photosynthesis decreased by <1% (Martens and Trumble, 1987). Photosynthesis rates in mined tissues were reduced by 62 percent as compared with those in unmined leaflets (Johnson *et. al.*, 1983).

Identification of sources of resistance to this pest will go a long way in the control and management of this pest under field conditions. Besides, such resistant varieties will continue to harbour the natural population of parasite, which bring about natural control of *L. trifolii*. Keeping the above facts in view and in order to identify the resistant/ tolerant genetic sources in tomato against *L. trifolii*, this experiment has been conducted in North West plain of Uttar Pradesh.

II. RESEARCH ELABORATIONS

Screening of promising tomato cultivars against serpentine leaf minor were conducted. For which thirty varieties i.e. HS-102, SEL-14, Pant T-4, PS-8, PT-28, NDT-44, BT-117-5-3-1, Pusa Ruby, BT-20-1-4, KS-2, KS-118, Pant bahar, CO-3, PT-3, Sweet-72, Pant hybrid-01, Pant hybrid-02, BSS-109, NTH-337, TH-2312, Ratna, BRH-01, Avinash, Sonali, ARTH-04, NTH-337, NDT-9, Meenakshi H₁, Panjab Chuhara, NDT-96 were selected along with check.

Experiment was conducted in summer two subsequent years i.e. year 2003-04 and year 2004-05 in north western plain of Uttar Pradesh, where followed all the recommended agronomical practices. Fifteen plants were selected at random from each of the two

replications and counted number of mines, on a single compound leaf taken from each of the upper as well as the lower portion of the plant. Empty as well as mines with larvae also counted. Observation will be taken twice of which first observation at flowering stage and second at the fruiting stage of crop growth.

Susceptibility index for tomato cultivar's screening against *L. trifolii* (Burgess):

Category	Mean number of leaf mines/ leaves
Least susceptible/ Resistant	5
Moderately susceptible/Moderately Resistant	5-10
Highly susceptible	>10

On the basis of this susceptibility index, rating of 30 germplasm / varieties were screen-out against serpentine leaf miner (*L. trifolii*). Yield also recorded to study the effect of leaf mining activity of *Liriomyza* on the photosynthesis as well as on the yield of the crop.

III. RESULT AND DISCUSSION

Thirty varieties of tomato were tested under open field condition for resistance against *L. trifolii*. These cultivars have been selected for yield characters; hence, their evaluation was felt necessary against the emerging pest of tomato. The data showing relative incidence of the pest at flowering and fruiting stage of the crop is given in Table 1, 2 and 3.

Perusal table no.1 reveals that mean number of leaf mines per 15 leaves is not significantly different for most of the varieties except KS-2, Aviash. The maximum incidence was 2.89 on variety BT-20-1-4 follow by Sohali (2.74), Ratna (2.7), BT-117-5-3-1(2.61), TH-23129(2.6) and minimum incidence was in variety Meenakshi H1(0.735)as compared to check variety Pusa Ruby(0.99). According to the susceptibility criteria all the varieties were least susceptible/resistant on the basis of number of leaf mine on upper leaves. The mean number of leaf mines was not significantly different in all the varieties. The maximum incidence was 2.845(var.Avinash) and minimum again in var. Meenakshi H1 (1.065), while check Pusa Ruby having mean number of leaf mines was 1.19. They showed that all promising cultivars were least susceptible or resistant.

It is evident from the data that infestations on lower leaves were higher than on upper leaves. The mines on lower leaves among all the cultivars were non significant. The maximum infestation 9.775 was recorded in BT-20-1-4 and minimum was 2.175 in NDT-9 while check (var. Pusa Ruby) having infestation upto3.64. The data of leaf mines per 15 leaves on lower leaves revealed that most of the cultivar was having non-significant difference except BT-20-1-4(8.61) and Sweet 72(8.31). The maximum infestation recorded in KS-2(9.34) and minimum in NTH-337(2.49) while check (Var. Pusa Ruby) showed 3.75 mean number of leaf mines per 15 leaves. Two year evaluation of mean number of leaf mines on lower leaves showed that HS-102,SEL-14,PS-8,PT-28,PusaRuby(check),KS-118,PantBahar,Co-3,Panhybrid-1,Panhybrid-2,BBS-109,NTH-337,TH-2312,Ratna,BRH-01,Avinash,Sohali,ARTH-04,NTH-337,NDT-9,NDT-96 were least susceptible/resistant while rest varieties like Pant-4,NDT-44,BT-117-5-3-1,BT-20-1-4,KS-2,PT-3,Sweet-72,MeenakshiH1,PanjabChuhara were moderately susceptible. No varieties were highly susceptible. (Table-1)

Perusal data of Table2 reveals that there were no significant differences among the cultivars with regards to whole plant damage of the fruiting stage of the crop of test cultivar. The maximum incidence was on var. Avinash (6.53) and minimum on NDT-96(2.75) while Pusa Ruby (Check) having less infestation (2.06). Most of test varieties were resistant and some varieties like BT-20-1-4, KS-2, PT-3, Sweet-72, TH-2312, Ratna, Avinash, Sohali were moderately susceptible. The data of second year shows that there were no significant difference among tested cultivars. The maximum incidence was with Avinash (6.405) and minimum with NDT-96(2.825), while check having least infestation. Most varieties were resistant and some varieties like BT-20-1-4, KS-2, PT-3, Sweet-72, TH-2313, Ratna, Avinash, Sohali, and Punjab Chuhara were moderately susceptible (Table-2). When the mean number of leaf mines per 15 leaves was studied for the whole plant, again there was no correlation between the yield and the number of leaf mines.

On the basis of mean number of leaf mines per 15 leaves, on the whole plant; the varieties can be more objectively categorized as given in table 2. It was observed that 21 test cultivars of tomato had shown resistant against *L. trifolii*. Only 09 cultivars were moderately resistant and no cultivar was highly susceptible as per the index adopted in this experiment. First year data of yield represented in Table3 showed no significant difference amongst test cultivars on tomato crop taken under the study. The maximum yield was with PT-3(590.42q/ha) followed by Sohali (568.05),TH-2312(559.5q/ha.), Ratna(559.3q/ha.), Avinash(553.1q/ha.) and minimum yield was recorded with varietyBT-117-5-3-1(133.45q/ha) while yield of check Pusa Ruby was 335.29q/ha.The second year result showed that the maximum yield of PT-3(599.4q/ha)followed by Sohali (582q/ha),PT-8(578.8q/ha), TH-2312(563q/ha), Avinash (558.9q/ha) and minimum yield was 139.2q/ha in BT-117-5-3-1 while check having yield of 333.9q/ha.

The effect of leaf mining activity of *L. trifolii* on the yield was not significant because no significant correlation between the mean number of leaf mines on lower leaves and yield could be established. The reason behind this might be that lower leaves do not play major role in photosynthesis as compared to upper leaves and infestation on upper leaves were less than on lower leaves. But for the lower leaves the infestation was non-significantly high to affect the yield. The amount of leaf area mined has an effect on photosynthesis that is complicated to analyze. Leaf miners often prefer shaded or older leaves that are less productive photo synthetically. Kotze and Dennill (1996) found that neither growth nor yield were negatively affected by the infestation level up to 1092 and 458 mined per plant in a glasshouse and field trials on tomato respectively.

Over all result of leaf mining and yield differed significantly between different varieties but some other factors were responsible for these yield differences not the *Liriomyza* infestation. It appears that tomato plants has inbuilt resistance against leaf miner activity, low to moderate level of mining activity was unlikely to cause yield loss. Since mining activity continued till fruiting, the resistance index based on cumulative number of leaf mines at fruiting could be a better index of susceptibility. Hence no definite conclusion regarding actual resistance can be drawn by number of leaf minis at flowering stage.

The data recorded of tomato crops regarding the mean number of leaf mines per 15 leaves on upper and lower leaves and whole plant indicate an increasing trends of *Liriomyza* infestation throughout the crop growth. The infestation was higher on the lower leaves of the plant than on the upper portion of leaves, it showed the insect prefer lower leaves of the plant to the upper leaves for feeding and oviposition. It was also observed that the shaded and older leaves prefer more by the insect. This is in conformity of the finding of Hileman and Lieto, 1981. Chaudhari *et. al.*, (2000) also conducted an experiment on evaluation of tomato varieties in Tarai region of west Bengal. Evaluation of tomato variety Pusa Ruby and 6 hybrids for yield and resistance to insect pests revealed that hybrids are more susceptible to leaf miner (*L. trifolii*) in which Avinash II recorded highest infestation, Rakshita showed more susceptibility and Arjuna & Rupali were moderately tolerant to this pest. Tendon and Bakthavatsalam (2002) evaluated tomato genotypes Anjali, 101 super, Varalakshmi, challenger-1, Arka Meghali, Arka Sourabh, Arka Vikas, Arka Ahuti, Arka Ashish and Pusa Ruby for their relative susceptibility to leaf miner in 1998-99. The percent of damaged leaves varied from 48.13 to 85.97. The highest number of damaged leaves was observed in hybrid 101- super (85.97%) followed by Anjali (83.09%), while lowest damage was recorded in Varalakshmi (48.13). the maximum number of mines per leaf (2.88) was recorded on Arka Meghali followed by challenger-1 (2.81) and Arka Vikas (2.74). the minimum number of mines was recorded on 101 super (1.24). in this experiment all the genotypes were found highly susceptible, except for Varalakshmi. The maximum damage was recorded on Arka Ahuti, followed by Arka Saurabh; Arka Ashish and Anjali. In the present study, it was observed that as the plant grows the upper leaves ultimately occupy a position on the lower part of the plant and become classified as lower leaves. As the infestation increases, the number of leaf mines increases and this causes reduction in photosynthesis of the leaflets, the finding was also reported by Johnson *et. al.*, 1983. But no significant correlation between yield and number of leaf mines could be established. The infestation was not up to the extent to cause reduction in yield. The present study is in conformity with the findings of Keularts and Lindquist (1989), who studied the effect of *Liriomyza trifolii* infestations on yield of greenhouse tomato and found that yield of marketable fruits either size or number in the fruit cluster were not significantly reduced. Kotze and Dennill (1996) examined the effect of various level of infestation on growth and yield of tomatoes and found that neither growth nor yield were negatively affected by infestation level up to 1092 and 458 mines per plant in a glasshouse and field trials respectively. Therefore, application of the chemical insecticides for its control may be avoided.

IV. CONCLUSION

The field incidence of the serpentine leaf miner, *L. trifolii*(Burgess) was severe during the fruiting stage of the crop. Infestation was higher on lower surface of leaf in comparisons of upper surface. The highest mean number of leaf mines per 15 leaves on the whole plant was 6.47 on variety Avinash. Field susceptibility of 30 cultivars against *L. trifolii* was evaluated on the basis of mean number of leaf mines per 15 leaves on upper and lower leaves at flowering as well as fruiting stage of the crop. Since mining activities of leaf miner continued till the fruiting so the resistance index based on cumulative number of leaf mines at fruiting stage was chosen as the index of susceptibility. On the basis of cumulative susceptibility index based on total number of leaf mines per 15 leaves on whole plant at fruiting stage, test varieties viz. HS-102, SEL-14, Pant T-4, PS-8, PT-28, NDT-44, BT-117-5-3-1, Pusa Ruby (Check), KS-118, Pant Bahar, CO-3, Pant Hybrid-1, BBs-109, NTH-337, BRH-01, ARTH-04, BS-2530, NDT-9, Meenakshi-H1, Punjab Chuhara , NDT-96 were found to be resistant/less susceptible. Only 09 test cultivars were found to be moderately susceptible/ moderately resistant viz. BT-20-1-4, KS-2, PT-3, Sweet-72, Pant Hybrid-2, TH-2312, Ratna, Avinash, Sohali. No cultivar was found highly susceptible against leaf miner. The number of leaf mines were higher on the lower leaves than on upper leaves in all the varieties.

No significant correlation could be established between the number of leaf mines and yield of tomato crop. Although yield differed significantly between different varieties, probably compensation for leaf injury played a major role in yield recovery.

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Table1: Relative field incidence of leaf miner, *Liriomyza trifolii* (Burgess) on upper and lower leaves of 30 cultivars at flowering stage of tomato crop

Sl.No.	Cultivar	Relative incidence of Leaf miner per 15 leaves ex-portion of leaves on flowering stage of crop			
		1 st Year		2 nd Year	
		Upper leaves	Lower leaves	Upper leaves	Lower leaves
1	HS-102	1.805	4.61	1.805	5.015
2	SEL-14	1.74	5.075	1.805	5.155
3	Pant T-4	1.6	5.405	1.685	5.01
4	PS-8	1.58	5.045	1.57	5.175
5	PT-28	1.58	4.785	1.675	4.765
6	NDT-44	2.1	6.65	2.24	6.085
7	BT-117-5-3-1	2.61	7.015	2.61	6.535
8	NDT-96	1.805	4.165	1.445	4.01
9	BT-20-1-4	2.89	9.775	2.805	8.61
10	KS-2	2.88	9.075	2.665	9.34
11	KS-118	1.725	3.67	1.72	3.67
12	Pant Bahar	2.42	5.05	2.52	4.965
13	CO-3	2.595	5.05	2.59	4.91
14	PT-3	2.53	7.125	2.59	7.06
15	Sweet-72	2.44	8.26	2.43	8.31
16	Pant Hybrid-1	1.89	3.57	1.765	3.46
17	Pant Hybrid-2	1.9	3.25	1.96	3.35
18	BSS-109	2.49	4.44	2.29	4.46
19	NTH-337	1.38	2.675	1.495	2.695
20	TH-2312	2.6	3.4	2.67	3.515
21	Ratna	2.7	4.24	2.74	4.25
22	BRH-01	1.54	2.39	1.505	2.59
23	Avinash	2.79	4.585	2.845	4.815
24	Sohali	2.74	3.75	2.73	3.86
25	ARTH-04	1.505	2.82	1.655	3.04
26	BS-2530	1.175	2.175	1.47	2.49
27	NDT-9	1.355	2.36	1.605	2.455
28	Meenakshi-H1	0.735	5.3	1.065	5.475
29	Punjab churaha	2.41	6.75	2.44	6.03
30	Pusa Ruby	0.99	3.64	1.19	3.75
	CD (5%)	0.105	0.135	0.079	0.075

Table2: Relative field incidence of leaf miner, *Liriomyza trifolii* (Burgess) on whole plant at fruiting stage of tomato crop of 30 cultivars and their rating index

Sl.No.	Cultivar	Relative incidence of leaf miner on Whole plant at fruiting stage			Rating Index
		1 st Year	2 nd Year	Mean	
1	HS-102	2.945	3.05	3.996667	Resistant
2	SEL-14	3.325	3.27	3.2975	Resistant
3	Pant T-4	3.56	3.7	3.63	Resistant
4	PS-8	3.8	3.91	3.855	Resistant
5	PT-28	3.975	4.06	4.0175	Resistant
6	NDT-44	3.75	3.59	3.67	Resistant
7	BT-117-5-3-1	4.725	4.61	4.6675	Resistant
8	NDT-96	2.75	2.825	2.7875	Resistant
9	BT-20-1-4	6.19	6.035	6.1125	Moderately Resistant

10	KS-2	6.225	6.24	6.2325	Moderately Resistant
11	KS-118	3.88	4.305	4.0925	Resistant
12	Pant Bahar	4.05	4	4.025	Resistant
13	CO-3	3.9	3.835	3.8675	Resistant
14	PT-3	5.605	5.655	5.63	Moderately Resistant
15	Sweet-72	5.56	5.445	5.5025	Moderately Resistant
16	Pant Hybrid-1	4.05	4.505	4.2775	Resistant
17	Pant Hybrid-2	5	5.33	5.165	Moderately Resistant
18	BSS-109	4.75	4.94	4.845	Resistant
19	NTH-337	3.5	3.61	3.555	Resistant
20	TH-2312	5.415	5.5	5.4575	Moderately Resistant
21	Ratna	5.795	5.735	5.765	Moderately Resistant
22	BRH-01	3.76	4.025	3.8925	Resistant
23	Avinash	6.53	6.405	6.4675	Moderately Resistant
24	Sohali	5.705	5.795	5.75	Moderately Resistant
25	ARTH-04	3.19	3.56	3.375	Resistant
26	BS-2530	3.225	3.76	3.4925	Resistant
27	NDT-9	3.485	3.54	3.5125	Resistant
28	Meenakshi-H1	4.77	4.78	4.775	Resistant
29	Panjab Churaha	4.68	5.06	4.87	Resistant
30	Pusa Ruby	2.065	2.19	2.1275	Resistant
	CD (5%)	0.0668	0.067		

Table3: Average yield of 30 tomato test cultivars during the incidence of leaf miner, *Liriomyza trifolii* (Burgess)

Sl.No.	Cultivar	Average yield (Q/ha)		Mean (Q/ha.)
		1 st year	2 nd year	
1	HS-102	300.25	301.3	300.775
2	SEL-14	268	267.9	267.95
3	Pant T-4	331.05	319.3	325.175
4	PS-8	375	578.8	476.9
5	PT-28	282.65	289.9	286.275
6	NDT-44	170.4	178.5	174.45
7	BT-117-5-3-1	133.45	139.2	136.325
8	NDT-96	218.63	220.7	219.665
9	BT-20-1-4	226.85	270.9	248.875
10	KS-2	256.97	251.5	254.235
11	KS-118	238.05	248.9	243.475
12	Pant Bahar	272.5	271.7	272.1
13	CO-3	375.45	390.9	383.175
14	PT-3	590.42	599.4	594.91
15	Sweet-72	210.13	209.5	209.815
16	Pant Hybrid-1	375.65	388.4	382.025
17	Pant Hybrid-2	353.28	356	354.64
18	BSS-109	471.5	472	471.75
19	NTH-337	481.75	478.4	480.075
20	TH-2312	559.5	563	561.25
21	Ratna	559.3	558.5	558.9
22	BRH-01	331.65	346.3	338.975
23	Avinash	553.1	558.9	556
24	Sohali	568.05	582	575.025
25	ARTH-04	419.25	442.9	431.075
26	BS-2530	228.75	227.6	228.175
27	NDT-9	359.38	307.6	333.49
28	Meenakshi-H1	470.93	471.8	471.365
29	Panjab Churaha	264.63	264.6	264.615
30	Pusa Ruby	335.29	333.9	334.595

	CD(5%)	9.9045	2.755	
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