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EFFECT OF SEED TREATMENT WITH METHYL JASMONATE ON INCIDENCE OF LEAF MINER (*LIRIOMYZA TRIFOLII*) IN TOMATO

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ABSTRACT

The lab and field experiment were conducted at Kittur Rani Channamma College of Horticulture, Arabhavi to study the effect of seed treatment with methyl jasmonate (MeJA) on incidence of leaf miner (*Liriomyza trifolii*) in tomato (*Solanum lycopericum*) during the year 2023-24 with nine treatments and three replications. The results revealed that at 25 DAS treatment UHSB - POP recorded lowest per cent leaf damage (6.04%) and number of live mines (0.12 mines/leaf) it was followed by the treatment MeJA at 3 mM, 2.5 mM and 2 mM concentration and they were statistically on par with each other (10.89% and 0.33 mines/leaf, 11.21% and 0.34 mines/leaf, 11.44% and 0.35 mines/leaf, respectively). Additionally, at transplanted field, UHSB - POP recorded lowest per cent leaf damage (9.34%) and number of live mines (0.48 mines/leaf), it was followed by the treatment MeJA at 3 mM and it was statistically on par with 2.5 mM and 2 mM concentration (21.01% and 1.07 mines/leaf, 21.14% and 1.08 mines/leaf, 21.34% and 1.09 mines/leaf, respectively).

Keywords: Tomato, Methyl jasmonate (MeJA), Seed treatment, Leaf miner (*Liriomyza trifolii*)

Introduction

Tomato is the second most important vegetable crop in the world after potato (NHB, 2023) which is extensively grown for its nutritive and economic value and tomato belongs to family Solanaceae having diploid chromosome number 2n=24 (Jenkins, 1948) and it is originated in Peru and Ecuador region (Rick, 1969).

Tomato is infested by various insect pests like Fruit borer, *Helicoverpa armigera* (Hubner), Tobacco caterpillar *Spodoptera litura* (Fabricus), Serpentine leaf miner, *Liriomyza trifolii* (Burgess) and Tomato pin worm, *Tuta absoluta* (Meyrick), Whitefly, *Bemisia tabaci* (Gennadius) and Thrips, *Frankliniella schultzei* (Trybom), *Ferrisia virgata* (Cockerell) which cause greater economic damage. Hence, enhancing host plant resistance in insects is necessary for the improvement of the crop yield by reducing insect pest damage and in turn decreases the need of the insecticides (Shanmugam *et al*., 2024).

Plants had a variety of defensive mechanisms to protect themselves from herbivore attacks in that activation of the plant defenses by multiple signalling cascades. Among which the phytohormones jasmonic acid (JA) plays a key role in inducing resistance mechanism against herbivorous arthropods and necrotrophic pathogens (Ghorbel *et al*., 2021; Nouri Ganbalani *et al*., 2018). It is mainly characterized by the induction of multiple defensive traits, including secondary metabolites, proteins, leaf trichomes, as well as indirect induction mechanisms such as the production of plant volatiles. Consequently, the artificial manipulation of these JA-associated defenses by natural or synthetic elicitors has proven to confer enhanced resistance against multiple insects and diseases. Therefore, it is regarded as a valuable component in pest management programs (Mouden *et al.*, 2020). Hence, present study on "Seed treatment with methyl jasmonate on incidence of leaf miner (*Liriomyza trifolii*) in tomato (*Solanum lycopericum*)" was aimed to investigate the impact of seed treatment against leaf miner.

Material and Methods

The present experiment was carried out at Kittur Rani Channamma College of Horticulture, Arabhavi, during the year 2023-2024. The laboratory experiment was laid out in completely randomized block design. While, the field experiment was laid out in randomized block design with three replications. The treatment detail included methyl jasmonate (MeJA), UHSB - POP, water and ethyl alcohol.

Procedure of seed treatment

To prepare one millimolar MeJA solution, 229 micro litres of MeJA (95%) was dissolved in 5 ml of ethyl alcohol and volume was adjusted to one litre by using distilled water. Here, ethyl alcohol was used as soluble solvent (Pushpalatha *et al.*, 2021). Seed treatment was done in the laboratory. A total of 200 seeds of tomato hybrid Arth-2075, was procured from Ankur seeds Pvt. Limited, Ranebennur and were placed inside sterile petri dishes (35 mm diameter). These seeds were soaked in 50 ml of previously prepared aqueous methyl jasmonate solution. The petri dishes were then covered with an aluminium foil and incubated for 24 hr in the dark at 4°C. Before sowing, seeds were washed twice for 10 minutes in distilled water and allowed to dry on a paper towel (Worrall *et al.*, 2012). Whereas, for control treatments tomato seeds were soaked without MeJA containing ethyl alcohol and water. Then treated seeds were sown in portrays containing autoclaved cocopeat mixed with vermicompost as the growing media. After twenty-five days of sowing, raised seedlings were further transplanted to the main field to investigate the impact of MeJA on incidence of leaf miner under field condition.

Table 1 : Seed treatment details for the management of insect pests of tomato

SL. No	Treatments	Concentration (mM)	Dosage (µl/50 ml)
T_1	MeJA	0.5	5.73
T_2	MeJA	0.75	8.59
T_3	MeJA	1.00	11.45
T_4	MeJA	2.00	22.9
T_5	MeJA	2.50	28.63
T_6	MeJA	3.00	34.35
T_7	Ethyl alcohol	-	50 ml
T_8	UHSB - POP	Seed treatment with thiram	3 g per litre
T_9	UTC (Water)	-	0.25 ml

Observations recorded

The observation on leaf miner incidence was recorded 15 and 25 days after sowing. After transplanting of seedlings to the main field, observations were recorded at 15, 30, 45, 60, 75 days after transplanting.

Per cent leaf damage was recorded by dividing number of damaged leaves out of twenty-five leaves from five seedlings and expressed in percentage. The number of live mines on the leaves were recorded by counting leaf miner live tunnels on all the twenty five leaves from five seedlings in each treatment.

To interpret the results, comparison between treatment means were made using Duncan's multiple range test (DMRT) and standard error mean (SE. m ±) and critical difference (CD) at one per cent and five per cent level of significance were computed.

Result and Discussion

The results pertaining to per cent leaf damage, number of live mines are presented in Table 2, 3, 4, respectively.

Leaf miner incidence

Among the treatments, significantly lowest (6.04%) per cent leaf damage was recorded in UHSB - POP followed by the treatment MeJA at 3 mM and it was statistically on par with MeJA at 2.5 mM and MeJA at 2 mM (10.89, 11.21 and 11.44%, respectively). However, significantly highest (18.34%) per cent leaf damage was recorded in untreated control which was statistically on par with ethyl alcohol (T_7) (17.58%) (Table 2).

Similarly, significantly lowest (0.12 mines/leaf) number of live mines were recorded in UHSB - POP. Next best treatment MeJA at 3 mM has recorded significantly lowest (0.33 mines/leaf) number of live mines which was statistically on par with MeJA at 2.5 mM and MeJA at 2 mM (0.34 and 0.35 mines/leaf, respectively). However, significantly highest (0.52 mines/leaf) number of live mines were recorded in untreated control and it was statistically on par with ethyl alcohol (0.50 mines/leaf) (Table 2).

Table 2 : Effect of MeJA on incidence of Leaf miner (*Liriomyza trifolii*)

Treatment	Dose/l	25 DAS			
		Leaf damage (%)	Per cent reduction over control	Number of live mines/leaf	Per cent reduction over control
T_1 - MeJA	0.5 mM	12.25 (20.48)^b	33.21	0.42 (0.96)^b	19.23
T_2 - MeJA	0.75 mM	12.24 (20.48)^b	33.26	0.40 (0.95)^b	23.07
T_3 - MeJA	1 mM	12.15 (20.40)^b	33.75	0.39 (0.94)^b	25.00
T_4 - MeJA	2 mM	11.44 (19.77)^c	37.62	0.35 (0.92)^c	32.69
T_5 - MeJA	2.5 mM	11.21 (19.56)^c	38.87	0.34 (0.92)^c	34.61
T_6 - MeJA	3 mM	10.89 (19.27)^c	40.62	0.33 (0.91)^c	36.54
T_7 - Ethyl alcohol	5 ml	17.58 (24.79)^a	4.14	0.50 (1.00)^a	3.85
T_8 - UHSB - POP	-	6.04 (14.23)^d	67.06	0.12 (0.79)^d	76.92
T_9 - UTC	-	18.34 (25.35)^a	-	0.52 (1.01)^a	-
S. Em±		0.28		0.008	
CD (1%)		1.12		0.034	
CV (%)		2.32		1.53	

Note: * Values in parenthesis are arcsine transformed; DAS- Days after sowing
* Values in parenthesis are square root (√x+0.5) transformed
* Figures in each column followed by same alphabet are not significantly different (P=0.05 by DMRT)
* At 15 DAS leaf miner incidence was not observed during experimental period.

Per cent reduction of leaf damage and live mines over control at nursery condition

The order of efficacy of treatments against leaf damage and number of live mines of by leaf miner based on per cent reduction over untreated control was UHSB - POP (T_8) (67.06 and 76.92%, respectively) > MeJA at 3 mM (40.62 and 36.54%, respectively) > MeJA at 2.5 mM (38.87 and 34.61%, respectively) > MeJA at 2 mM (37.62 and 32.69%, respectively) > MeJA at 1mM (33.75 and 25.00%, respectively) > MeJA at 0.75 mM (33.26 and 23.07%, respectively) > MeJA at 0.5 mM (33.21 and 19.23%, respectively) > Ethyl alcohol (4.14 and 3.85%, respectively) (Table 2).

Per cent leaf damage and number of live mines at field condition

The treatments differed significantly with respect to per cent leaf damage. Among the treatments, significantly lowest (9.34%) per cent leaf damage was recorded in UHSB - POP followed by the treatment MeJA at 3 mM which was statistically on par with MeJA at 2.5 mM and MeJA at 2 mM (21.01, 21.14 and 21.34%, respectively). Further, the next best treatments which recorded lowest per cent leaf damage (23.52%) was MeJA at 1 mM and it was statistically on par with MeJA at 0.75 mM and MeJA at 0.5 mM (23.78 and 24.00%, respectively). However, significantly highest (29.20%) per cent leaf damage was recorded in untreated control which was statistically on par with ethyl alcohol (28.36%) (Table 3).

In case of number of live mines, among all treatments, significantly lowest (0.48 mines/leaf) number of live mines were recorded UHSB - POP followed by the treatment MeJA at 3 mM (1.07 mines/leaf) which was statistically on par with MeJA at 2.5 mM and MeJA at 2 mM (1.08 and 1.09 mines/leaf, respectively). Similarly, the next best treatments which recorded less (1.19 mines/leaf) number of live mines was MeJA at 1 mM and it was statistically on par with MeJA at 0.75 mM and MeJA at 0.5 mM (1.20 and 1.21 mines/leaf, respectively). However, significantly highest (1.48 mines/leaf) number of live mines were recorded in untreated control which was statistically on par with ethyl alcohol (T_7) (1.42 mines/leaf) (Table 4).

Per cent reduction in leaf damage and live mines over control at field condition

The order of efficacy of treatments against Leaf miner leaf damage and number of live mines based on per cent reduction over untreated control was UHSB - POP (68.01 and 67.56% , respectively) > MeJA at 3 mM (28.04 and 27.70%, respectively) > MeJA at 2.5 mM (27.60 and 27.02%, respectively) > MeJA at 2 mM (26.91 and 26.35%, respectively) > MeJA at 1 mM (19.45 and 19.59%, respectively) > MeJA at 0.75 mM (18.56 and 18.91%, respectively) > MeJA at 0.5 mM (17.81 and 18.24%, respectively) > ethyl alcohol (2.87 and 4.05%, respectively) (Table 3 and 4).

The results from the present study suggested that among the methyl jasmonate treatments, seed treatment with MeJA at higher concentrations (3 mM, 2.5 mM and 2 mM) showed maximum reduction in leaf damage and number of live mines compared to lower concentrations (1 mM, 0.75 mM and 0.5 mM) at nursery as well as field conditions this is may be due to induction of natural defense mechanism by MeJA and it will stimulate the production of secondary metabolites like phenols, tannins and defensive enzymes like polyphenol oxidases and proteinase inhibitors, which reduces the performance of herbivores by interfering with feeding deterrence. Also, MeJA treatment initiates the systemic acquired resistance (SAR) where the whole plant becomes resistance to insect pests. Abe *et al.* (2013) who found application of JA at 0.1 mM concentration reduced the feeding scars of leaf miner in tomato. Black *et al.* (2003) who found application of JA significantly reduced the number of leaf miners in celery. Similar findings were observed by Doostkam *et al.* (2023) who found exogenous application of JA at 50 µM concentration showed decrease in leaf damage and number of live mines in cucumber. Escobar- Bravo *et al.* (2017) reported application of MeJA reduced the thrips damage in def-1 mutant due to increase in trichome density in tomato. Sun *et al.* (2017) who reported the high JA. induced resistance has reduced the whitefly infestation in tomato. Mouden et. al. (2020) who found JA induced resistance resulted in reduced thrips damage in tomato. Esmaeily *et al.* (2021) also reported the application of JA and combination with *Nesidiocoris tenuis* showed reduced growth, survival, longevity and fecundity of whitefly in tomato. Pushpalatha *et al.* (2021) found that after first and second foliar application of MeJA at 1 mM along with Azadirachtin at 2 ml/lit reduced the number of eggs and number of mites in grapes.

Conclusion

The present study on effect of seed treatment with methyl jasmonate (MeJA) at different concentrations significantly reduces the incidence of leaf miner and also it will act as one of the ecofriendly tool in pest management. Among methyl jasmonate treatments MeJA at 3 mM, 2.5 mM and 2 mM concentration recorded minimum leaf damage and number of live mines as compared to other treatments.

Table 3 : Impact of MeJA on leaf damage by leaf miner (*Liriomyza trifolii*) at transplanted field

Treatments	Dose/l	Leaf damage (%)					Average	Per cent reduction over control
		15 DAT	30 DAT	45 DAT	60DAT	75 DAT		
T_1 - MeJA	0.5 mM	12.98 $(21.06)^b$	18.71 $(25.58)^b$	26.19 $(30.73)^c$	29.52 $(32.91)^b$	32.59 $(34.81)^b$	24.00 $(29.02)^b$	17.81
T_2 - MeJA	0.75 mM	12.68 $(20.86)^b$	18.65 $(25.58)^b$	25.89 $(30.58)^c$	29.48 $(32.88)^b$	32.21 $(34.58)^b$	23.78 $(28.90)^b$	18.56
T_3 - MeJA	1 mM	12.60 $(20.79)^b$	17.63 $(24.82)^b$	25.78 $(30.51)^c$	29.39 $(32.83)^b$	32.19 $(34.57)^b$	23.52 $(28.70)^b$	19.45
T_4 - MeJA	2 mM	11.59 $(19.90)^c$	16.23 $(23.76)^c$	23.48 $(28.98)^d$	26.58 $(31.03)^c$	28.81 $(32.46)^c$	21.34 $(27.23)^c$	26.91
T_5 - MeJA	2.5 mM	11.54 $(19.85)^c$	15.65 $(23.30)^c$	23.37 $(28.91)^d$	26.37 $(30.90)^c$	28.78 $(32.44)^c$	21.14 $(27.08)^c$	27.60

T_6 - MeJA	**3 mM**	11.48 (19.80)^{c}	15.26 (22.99)^{c}	23.26 (28.83)^{d}	26.28 (30.84)^{c}	28.75 (32.42)^{c}	21.01 (26.98)^{c}	28.04
T_7 - Ethyl alcohol	**5 ml**	15.05 (22.82)^{a}	21.30 (27.48)^{a}	30.14 (33.30)^{b}	36.46 (37.14)^{a}	38.85 (38.56)^{a}	28.36 (31.86)^{a}	2.87
T_8 - UHSB - POP	-	5.38 (13.41)^{d}	7.36 (15.74)^{d}	10.07 (18.51)^{e}	10.90 (19.28)^{d}	12.98 (21.12)^{d}	9.34 (17.61)^{d}	68.01
T_9 - UTC	-	15.57 (23.12)^{a}	22.36 (28.14)^{a}	32.12 (34.45)^{a}	36.69 (37.18)^{a}	39.25 (38.71)^{a}	29.20 (32.32)^{a}	-
S. Em±		0.22	0.27	0.36	0.40	0.43	0.46	
CD (5%)		0.66	0.81	1.08	1.20	1.32	1.38	
CV (%)		6.56	5.28	5.70	5.98	5.83	3.86	

Note: * Values in parenthesis are arcsine transformed; DAT- Days after transplanting
* Figures in each column followed by same alphabet are not significantly different (P=0.05 by DMRT)

Table 4 : Effect of MeJA seed treatment on live mines of leaf miner (*Liriomyza trifolii*) at transplanted field

	Dose/l	**Number of live mines/leaf**					**Average**	**Per cent reduction over control**
		15 DAT	**30 DAT**	**45 DAT**	**60DAT**	**75 DAT**		
T_1 - MeJA	**0.5 mM**	0.86 (1.17)^{b}	0.88 (1.18)^{c}	0.96 (1.21)^{b}	1.54 (1.43)^{b}	1.81 (1.52)^{b}	1.21 (1.30)^{b}	18.24
T_2 - MeJA	**0.75 mM**	0.85 (1.16)^{b}	0.87 (1.17)^{c}	0.95 (1.20)^{b}	1.53 (1.42)^{b}	1.79 (1.51)^{b}	1.20 (1.29)^{bc}	18.91
T_3 - MeJA	**1 mM**	0.84 (1.16)^{b}	0.86 (1.17)^{c}	0.94 (1.20)^{bc}	1.51 (1.42)^{b}	1.78 (1.51)^{b}	1.19 (1.29)^{bc}	19.59
T_4 - MeJA	**2 mM**	0.78 (1.13)^{c}	0.81 (1.14)^{d}	0.87 (1.17)^{d}	1.36 (1.36)^{c}	1.64 (1.46)^{c}	1.09 (1.25)^{d}	26.35
T_5 - MeJA	**2.5 mM**	0.76 (1.12)^{c}	0.80 (1.14)^{d}	0.86 (1.17)^{d}	1.35 (1.36)^{c}	1.63 (1.46)^{c}	1.08 (1.25)^{d}	27.02
T_6 - MeJA	**3 mM**	0.74 (1.11)^{c}	0.79 (1.14)^{d}	0.85 (1.16)^{d}	1.34 (1.36)^{c}	1.62 (1.46)^{c}	1.07 (1.24)^{d}	27.70
T_7 - Ethyl alcohol	**5 ml**	1.01 (1.23)^{a}	1.02 (1.23)^{b}	1.13 (1.28)^{a}	1.80 (1.52)^{a}	2.15 (1.63)^{a}	1.42 (1.38)^{a}	4.05
T_8 - UHSB - POP	-	0.37 (0.93)^{d}	0.36 (0.92)^{e}	0.42 (0.96)^{e}	0.57 (1.04)^{d}	0.69 (1.09)^{d}	0.48 (0.99)^{e}	67.56
T_9 - UTC	-	1.06 (1.24)^{a}	1.08 (1.25)^{a}	1.18 (1.28)^{a}	1.86 (1.52)^{a}	2.21 (1.63)^{a}	1.48 (1.38)^{a}	-
S. Em±		0.007	0.007	0.01	0.011	0.013	0.013	
CD (5%)		0.021	0.021	0.03	0.033	0.039	0.039	
CV (%)		5.85	5.65	5.89	5.42	6.70	2.58	

Note: * Values in parenthesis are square root ($\sqrt{x+0.5}$) transformed; DAT- Days after transplanting.
* Figures in each column followed by same alphabet are not significantly different (P=0.05 by DMRT).

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