Pest Management in Horticultural Ecosystems
Vol. 27, No.2 pp 220-224 (2021)

Impact of methyl jasmonate on *Tetranychus urticae* Koch in grapes Cv. Thompson Seedless

PUSHPALATHA*[1], A. M. NADAF[1], VENKATESHALU[1], D. A. PEERAJADE[2], RAGHAVENDRA[3], S. and G. MANJUNATH[4]

[1]Department of Entomology, [2]Department of Crop Improvement and Biotechnology, [3]Department of Biochemistry,
[4]Department of Plant Pathology
University of Horticultural Sciences, Bagalkot - 587104, Karnataka, India

***E-mail:** pushpap76@gmail.com

ABSTRACT: Field experiment was conducted at Horticulture Research and Extension Centre, Vijayapura (Tidagundi), Karnataka, India to evaluate the bio-efficacy of Methyl jasmonate (MeJA) against spider mite, *Tetranychus urticae* Koch in grapes cv. Thompson Seedless during the year 2020-21 (forward pruning). The results revealed that two sprays of abamectin 1.9 EC at 0.3ml/l found to be superior in suppressing the eggs and mites population after first and second spray by recording 2.81 eggs and 1.98 mites per square inch of leaf respectively which was at par with MeJA + Azadirachtin 10000 ppm at 1mM + 2ml/l with 3.08 eggs and 2.22 mites per square inch of the leaf respectively indicating the superiority of both the treatments against *T.urticae*. The next best treatments were MeJA + Azadirachtin 10000 ppm at 0.75mM + 2ml/l and MeJA + Azadirachtin 10000 ppm at 0.5mM + 2ml/l with 4.05, 4.14 eggs and 3.19, 3.29 mites per square inch of leaf respectively.

Keywords: Red spider mite, methyl jasmonate, grapes, *Tetranychus urticae*

INTRODUCTION

Jasmonic acid is an important signalling molecule for plant defensive responses upon mechanical wounding or herbivory damage. There is an increased interest in the use of exogenous chemical elicitors such as jasmonic acid to induce natural host defence mechanisms as an alternative to synthetic chemical pesticides (Chares and Erwin, 2010). Alternatives to pesticides are needed for economically viable and environmentally safe crop protection. One such possible alternative to pesticides is use of natural/ plant elicitors such as jasmonic acid. Grapes (*Vitis vinifera* Linn) belongs to the family Vitiaceae, is one of the most remunerative and economically important horticultural crops in India. Over, 85 species of insects are known to occur on grapes in India (Sunitha, 2017). In grapes, the major and economically important pest are mites. In grapes, about six species of mites *viz., Tetranychus urticae* Koch, *T. cinnabarinus* Boisdual, *T. neocaledonicus* Andre, *Oligonychus mangiferus* Rahmen and Sapra, *O. Punicae* Baker and *Eutetranychus orientalis* Klein are causing damage to the grapevine in India. Out of these six species of mites, the infestation of *T. urticae* is emerging sucking pest of grapes and inflicting considerable damage to the grapevine in recent times (Anon., 2008).

Keeping in view all these points the present study was carried out to know the bio-efficacy of natural elicitor *i.e.,* jasmonic acid (methyl jasmonate) on red spider mite in grape ecosystem.

MATERIALS AD METHODS

The experiment was conducted under field conditions at Horticulture Research and Extension Centre, Vijayapura (Tidagundi) to evaluate the bio-efficacy of methyl jasmonate (MeJA) against *T. urticae* in grapes. The cultivar 'Thompson Seedless' was selected for this experiment during the year 2020-21 (forward pruning). The experiment was laid out in randomized complete block (RCBD) design with ten treatments comprising of methyl jasmonate, azadirachtin, abamectin along with untreated control and each treatment was replicated thrice. Six plants from each treatment with three replications are selectedand tagged. For preparation of one millimolar MeJA solution, 229µl of MeJA has taken and dissolved in 5ml of Ethyl alcohol and volume was adjusted to one litre. Prepared spray solutions were mixed with two liters of water just prior to spray and sprayed twice at ten days intervals on the randomly selected grape plants (at morning 9am) by using knapsack sprayer (High volume sprayer) and total of two sprays were given at ten days interval. Pre-treatment count was made prior to the each spray. The post treatment counts were made at three, seven and ten days after each spray. Number of eggs and mites per one square inch of leaf was recorded by using the hand lens (10x) on abaxialsurface of the leaf at top, middle and bottom leaves from randomly selected plants in each treatment. The treatment means were separated by using DMRT.

Table 1. Bio efficacy of MeJA against eggs of *T. urticae* in grapes

Treatment	Dose/l	Number of eggs/square inch of the leaf*				
		DBS	3DAS	7 DAS	10 DAS	Average
T_1- MeJA	0.5 mM	11.27 (3.35)^d	7.22 (2.68)^d	6.27 (2.50)^d	6.24 (2.49)^d	6.67 (2.58)^d
T_2- MeJA	0.75 mM	11.11 (3.33)^d	7.17 (2.67)^d	6.12 (2.47)^d	6.10 (2.46)^d	6.51 (2.55)^d
T_3- MeJA	1.0 mM	11.06 (3.32)^d	7.07 (2.65)^d	6.03 (2.45)^d	5.95 (2.43)^d	6.34 (2.51)^d
T_4- Azadirachtin 10000 ppm	2.0 ml	7.76 (2.78)^c	6.01 (2.45)^c	5.02 (2.24)^c	4.45 (2.10)^c	4.88 (2.20)^c
T_5- MeJA + Azadirachtin 10000 ppm	0.5 mM +2.0ml	5.26 (2.29)^b	4.98 (2.23)^b	4.27 (2.06)^b	3.39 (1.84)^b	4.14 (2.03)^b
T_6- MeJA + Azadirachtin 10000 ppm	0.75 mM +2.0ml	5.22 (2.28)^b	4.79 (2.18)^b	4.21 (2.05)^b	3.27 (1.80)^b	4.05 (2.01)^b
T_7- MeJA + Azadirachtin 10000 ppm	1 mM + 2.0ml	5.11 (2.26)^b	4.71 (2.17)^b	2.34 (1.52)^a	2.21 (1.48)^a	3.08 (1.75)^a
T_8- Abamectin 1.9 EC (RPP)	0.3ml	4.03 (2.00)^a	3.56 (1.88)^a	2.33 (1.52)^a	2.20 (1.48)^a	2.81 (1.67)^a
T_9- UTC	-	17.24 (4.15)^f	19.31 (4.50)^f	19.60 (4.53)^f	19.21 (4.38)^f	19.04 (4.47)^f
T_{10}- UTC (Methyl jasmonatesoluble solvent- Ethanol)	5ml	13.64 (3.69)^e	18.68 (4.32)^e	18.42 (4.29)^e	18.28 (4.27)^e	18.45 (2.29)^e
SEm ±		0.18	0.24	0.20	0.17	0.16
CD @ 5%		0.56	0.74	0.62	0.55	0.49

Note: *Each value is the mean of three replications (Top leaves, Middle leaves and Bottom leaves of the Plants).

*Values in parenthesis are $\sqrt{(x + 0.5)}$ transformed; DBS – Days Before Spray; DAS – Days After Spray.

*Figures in each column followed by same alphabet (s) are not significantly different (P=0.05) by DMRT.

RESULTS AND DISCUSSION

The experiment was conducted to evaluate the bio-efficacy of methyl jasmonate against grape red spider mite, *T.urticae* and the results pertaining to eggs and mites population are presented in Table 1 and Table 2 respectively. The results revealed that all the treatments were significantly found superior over control.

Bio-efficacy of MeJA on eggs of *T.urticae*

Treatment MeJA + Azadirachtin 10000 ppm at 1 mM + 2 ml/l has significantly recorded lowest number of eggs (2.21 eggs per square inch of leaf)which was on par with the treatment abamectin 1.9 EC at 0.3ml/l (2.81 eggs per square inch of leaf). The treatments; MeJA + Azadirachtin 10000 ppm at 0.75 mM + 2 ml/l and MeJA + Azadirachtin 10000 ppm at 0.5 mM + 2 ml/l recorded 4.05 and 3.19 eggsper square inch of leaf respectively were also significantly recorded lowest number of eggs per square inch of leaf and they were statistically on par with each other. However, significantly highest number of eggs was recorded in untreated control (19.21 eggs per square inch of leaf) followed by untreated control (MeJA soluble solvent – Ethanol at 5 ml/l) (18.28 eggs per square inch of leaf) (Table 1). The present study is agreement with Markiewicz *et al*. (2020) who also reported that, the foliar application of jasmonic acid at 5 mM and 2.5 mM has significantly decreased the population of eggs and adult two-spotted spider mite (*T. urticae*) in apple trees. Similarly, Warabeida and Olszak (2015) reported that,exogenous application of methyl jasmonate at 1 mM/l was found effective against numerical growth of eggs of two spotted spider mite (*T. urticae*). The application of jasmonic acid induces the octadecanoic pathway in the plants. The efficacy of jasmonic acid may be attributed due to its direct defence mechanism, production of secondary metabolites like phenols and tannins upon herbivorous feeding and expression of resistance genes in the plant and non-development of resistance by mites.

Bio-efficacy of MeJA on mites of *T.urticae*

Treatment MeJA + Azadirachtin 10000 ppm at 1 mM + 2 ml/l has significantly recorded lowest number of mites (2.22 mitesper square inch of leaf) which was on par with the treatment abamectin 1.9 EC at 0.3ml/l (1.98

Table 2. Bio efficacy of MeJA against mites, *T. urticae* in grapes

Treatment	Dose/l	Number of mites/square inch of the leaf *				
		DBS	3DAS	7 DAS	10 DAS	Average
T_1- MeJA	0.5 mM	10.26 (3.20)^d	6.14 (2.47)^d	5.41 (2.32)^d	5.12 (2.26)^d	5.49 (2.34)^d
T_2- MeJA	0.75 mM	10.18 (3.19)^d	6.12 (2.47)^d	5.32 (2.30)^d	5.09 (2.25)^d	5.44 (2.33)^d
T_3- MeJA	1.0 mM	10.10 (3.17)^d	6.00 (2.44)^d	5.27 (2.29)^d	5.02 (2.24)^d	5.36 (2.31)^d
T_4- Azadirachtin 10000 ppm	2.0 ml	7.76 (2.78)^c	4.49 (2.11)^c	4.23 (2.05)^c	4.19 (2.04)^c	4.21 (2.05)^c
T_5- MeJA + Azadirachtin 10000 ppm	0.5 mM + 2.0ml	4.26 (2.06)^b	3.48 (1.86)^b	3.28 (1.81)^b	3.12 (1.76)^b	3.29 (1.81)^b
T_6- MeJA + Azadirachtin 10000 ppm	0.75 mM + 2.0ml	4.14 (2.03)^b	3.39 (1.84)^b	3.19 (1.78)^b	3.01 (1.73)^b	3.19 (1.78)^b
T_7- MeJA + Azadirachtin 10000 ppm	1 mM + 2.0ml	4.07 (2.01)^b	3.02 (1.42)^b	2.13 (1.45)^a	2.05 (1.43)^a	2.22 (1.48)^a
T_8- Abamectin 1.9 EC (RPP)	0.3ml	2.50 (2.00)^a	2.03 (2.42)^a	2.00 (1.41)^a	1.93 (1.38)^a	1.98 (1.40)^a
T_9- UTC	-	16.81 (4.10)^f	19.31 (4.39)^f	18.21 (4.26)^f	17.60 (4.19)^f	18.37 (4.28)^e
T_{10}- UTC (MeJA soluble solvent-Ethanol)	5ml	14.08 (3.75)^e	18.68 (4.32)^e	17.42 (4.17)^e	16.28 (4.03)^e	17.46 (4.17)^d
SEm ±		0.34	0.16	0.21	0.11	0.12
CD @ 5%		1.03	0.48	0.63	0.34	0.30

Note: *Each value is the mean of three replications (Top leaves, Middle leaves and Bottom leaves of the Plants). *Values in parenthesis are √ (x + 0.5) transformed; DBS – Days Before Spray; DAS – Days After Spray. *Figures in each column followed by same alphabet (s) are not significantly different (P=0.05) by DMRT.

mites per square inch of leaf). The treatments; MeJA + Azadirachtin 10000 ppm at 0.75 mM + 2 ml/l and MeJA + Azadirachtin 10000 ppm at 0.5 mM + 2 ml/l recorded 3.19 and 3.29 mitesper square inch of leaf respectively were also significantly recorded lowest number of mites per square inch of leaf and they were statistically on par with each other. However, significantly highest number of mites was recorded in untreated control (18.37 mites per square inch of leaf) followed by untreated control (MeJA soluble solvent – Ethanol at 5 ml/l) (17.46 mites per square inch of leaf) (Table 2). This study is also conformity with Charles and Erwin (2010) who reported the foliar application of methyl jasmonate at 1.00 mM/l against *T. urticae*found 60 per cent reduction in mite proliferation rate. Similarly Smart *et al*. (2013) studied the application of jasmonic acid at 3 mM had significantly reduced the oviposition levels of herbivorous mites, *T. urticae.* Application of jasmonic acid is also increases the trichome density on leaves which provides resistance against mites and also the MeJAapplication could be potentially be involved in initiation of resistance genes which are induced by JA application and can in some cases reduce pest performance.

Per cent reduction of eggs over control

The order of efficacy of treatments against number of eggs per square inch of leaf based on per cent reduction over control was abamectin 1.9 EC at 0.3ml /l (85.97%) >MeJA + Azadirachtin 10000 ppm at 1 mM + 2ml/ l (84.63%) >MeJA + Azadirachtin 10000 ppm at 0.75 mM + 2ml/ l (79.79%) >MeJA + Azadirachtin 10000 ppm at 0.5 mM + 2ml/ l (79.34%) > Azadirachtin 10000 at 2ml /l (75.62%) >MeJA at 1 mM/l (68.46%) >MeJA at 0.75 mM/ l (67.52 %) >MeJA at 0.5 mM/l (66.69 %) (Fig 1). This study is conformity with Yasuyuki*et al* (2004) who found that Jasmonic acid at 0.1 mM/l treated plants recorded significant reduction in number of eggs laid by *T. urticae* followed by JA at 0.01 mM and 1 mM/l recorded fewer eggs laid by *T.urticae*, the reason for this was jasmonate application had increased the amount of Jasmonic acid present in plants system and may be leaded to decrease the motile stages of the mites.

Per cent reduction of mites over control

The order of efficacy of treatments against mites numberper square inch of leaf based on per cent

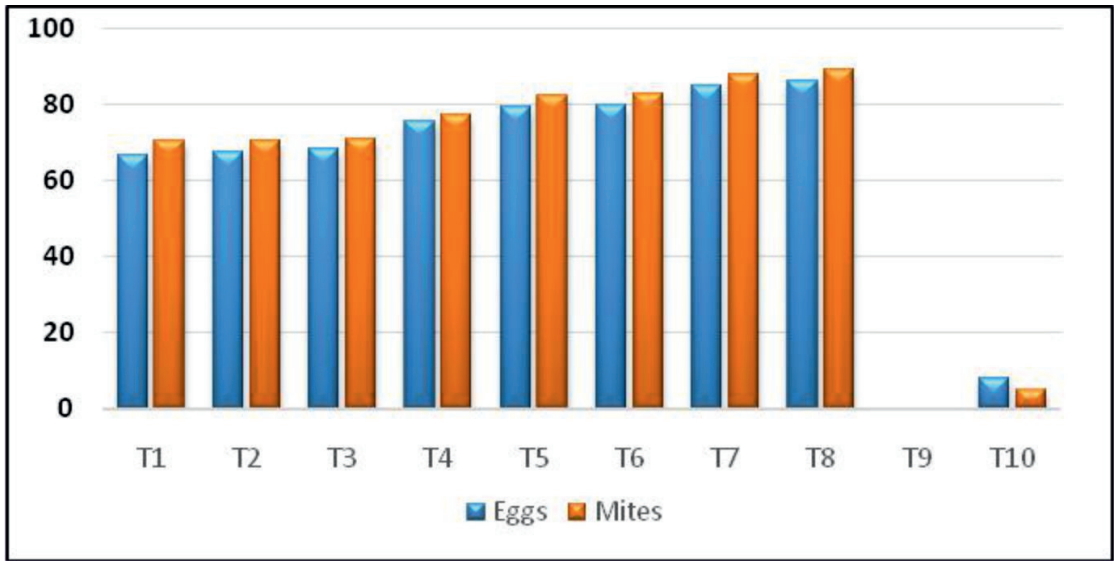

Fig. 1. Per cent reduction of eggs and mites over control

T1: Methyl Jasmonate (MeJA) @ 0.5mM/l, T2: Methyl Jasmonate (MeJA) @ 0.75mM/l, T3: Methyl Jasmonate (MeJA) @ 1mM/l, T4: Azadirachtin 10000 ppm @ 2ml/l, T5: Methyl Jasmonate (MeJA)+ Azadirachtin 10000 ppm @ 0.5mM + 2ml/l, T6: Methyl Jasmonate (MeJA)+ Azadirachtin 10000 ppm @ 0.75mM + 2ml/l, T7: Methyl Jasmonate (MeJA)+ Azadirachtin 10000 ppm @ 1mM + 2ml/l, T8: Abamectin 1.9 EC, T9: Untreated Control, T10: Untreated Control (Methyl Jasmonate soluble solvent- Ethanol @ 5ml/l).

reduction over control was abamectin 1.9 EC at 0.3ml /l (T_8) (89.22%) >MeJA + Azadirachtin 10000 ppm at 1 mM + 2ml/ l (T_7) (87.91%) >MeJA + Azadirachtin 10000 ppm at 0.75 mM + 2ml/ l (T_6) (82.63%) >MeJA + Azadirachtin 10000 ppm at 0.5 mM + 2ml/ l (82.09%) >Azadirachtin 10000 at 2ml /l (77.08%) >MeJA at 1 mM/l (70.82%) >MeJA at 0.75 mM/ l (70.38%) >MeJA at 0.5 mM/ l (70.27%) (Fig 1). This study is conformity with Warabeida and Olszak (2010) reported that exogenous application of methyl jasmonatewas found effective against numerical growth of two spotted spider mite (*T. urticae*), the antixenosis resistance mechanism of plants may be the reason of to reduce the mite population.

CONCLUSION

Among the MeJA treatments studied, the MeJA + Azadirachtin 10000 ppm at 1 mM/l + 2 ml/l (T_7) was found to be superior with significantly lesser eggs and mites population, followed by MeJA + Azadirachtin 10000 ppm at 0.75 mM/l + 2 ml/l (T_6) and MeJA + Azadirachtin 10000 ppm at 0.5 mM/l + 2 ml/l (T_5). Whereas, untreated control (MeJA soluble solvent - Ethanol @ 5 ml/l) and untreated control (T_9) were found least effective treatments by recording significantly the highest eggs population. Similar response was also observed by the ten treatments against mites population. Hence, methyl jasmonate is one of the key idea to avoid huge usage of chemical pesticidesin control of grape red spider mite and also it is eco-friendly management of insect pest in present agricultural and horticultural systems.

ACKNOWLEDGEMENT

The authors are thankful to Professor and Head, Department of Entomology, College of Horticulture, Bagalkot, Dean, College of Horticulture, Bagalkot as well as the Director of Research and Dean Post Graduate Studies, University of Horticultural Sciences, Bagalkot for providing all the necessary facilities during the course of the study.

REFERENCES

Anonymous. 2008. Management of mites on grapes, *Extension Folder No.15,* National Research Centre for Grapes, Pune, India.

Charles, L. R. and Erwin E. 2010. Spider mites (*Tetranychus urticae*) perform poorly on and disperse from plants exposed to methyl jasmonate. *Environmental Entomology,* **137**: 143–152.

Markiewicz, M., Warabieda, W. and Wojcik, D. 2020. Mutual relations between jasmonic acid and acibenzolar-*S*-methyl in the induction of resistance to the two-spotted spider mite (*Tetranychus urticae*) in apple trees. *Experimental and Applied Acarology,* **82**: 59–79.

Smart, L. E., Martin, J. L., Limpalaer, M., Toby, J. A., John, B. and Pickett, A. 2013. Responses of Herbivore and Predatory Mites to Tomato Plants Exposed to Jasmonic Acid Seed Treatment. *Journal of Chemical Ecology,* **39** (10): 1297-300.

Sunitha, M. D. 2017. Pest scenario and their abundance in grape ecosystem. *Journal of Entomology Zoology Studies,* **5** (6): 1766-1770.

Warabieda, W. 2015. The effect of methyl jasmonate and acibenzolar-S-methyl on the populations of the European red mite (*Panonychus ulmi* Koch) and *Typhlodromus pyri* Scheut in apple orchards, as well as on the yield and growth of apple trees. *International Journal of Acarology*, **41** (2): 100–107.

Warabeida, W. and Olszak, R.W. 2015. Effect of exogenous Methyl jasmonate on numerical growth of the number of the two-spotted spider mite (*Tetranychus urticae* Koch.) on strawberry plants and young apple trees. *Journal of Plant Protection Research,* **50** (4).

Yasuyuki, C., Ozawa, R. and Takabayashi, J. 2004. Effects of exogenous Jasmonic acid and benzo (1,2,3) thiadiazole-7-carbothioic acid S-methyl ester (BTH), a functional analogue of salicylic acid, on the egg production of a herbivorous mite *Tetranychus urticae* (Acari: Tetranychidae). *Applied Entomology and Zoology,* **39** (2): 311–314.

MS Received 26 September 2021
MS Accepted 25 November 2021