Pest Management in Horticultural Ecosystems
Vol. 26, No.2 pp 179-183 (2020)

Efficacy of entomopathogen formulations against thrips, *Scirtothrips dorsalis* Hood on mango: A multilocation study

A. Y. MUNJ[1]*, P. V. RAMI REDDY[2], GUNDAPPA[3], and S. IRULANDI[4]

[1]Regional Fruit Research Station, Vengurle, Maharashtra, India,
[2]ICAR-Indian Institute of Horticultural Research, Bengaluru – 560089, India
[3]ICAR-Central Institute for Subtropical Horticulture, Lucknow, India
[4]Horticultural College and Research Institute, Periyakulam, Tamil Nadu, India

***E-mail:** aymunj@rediffmail.com

ABSTRACT: Thrips, *Scirtothrips dorsalis* Hood is emerging as a major pest of mango throughout India. Field studies were conducted at four major mango growing areas of India viz., Bengaluru (Karnataka), Lucknow (Uttar Pradesh), Periyakulam (Tamil Nadu) and Vengurle (Maharashtra) on the management of thrips on mango by using entomopathogens for three consecutive years from 2015-16 to 2017-18. Treatments were applied as foliar sprays at weekly interval starting from the flower initiation. The results revealed that spray of *Metarhizium anisopliae* (IIHR oil formulation @ 0.5 ml/l) was the most effective for management of thrips on mango.

Keywords: Entomofungi, mango, thrips, *Scirtothrips dorsalis*, *Metarhizium anisopliae*, biocontrol

INTRODUCTION

Thrips are an important group of sucking insects causing severe yield loss in several tropical fruit crops (Sithanantham *et al*., 2007; Reddy *et al.,* 2019). Thrips, *Scirtothrips dorsalis* Hood was considered a minor pest of mango. However, due to the excessive use of synthetic pyrethroides and neonicotinoides during first decade of 21st century, it has attained the status of a major pest in many mango growing states of India (Chavan *et al.,* 2009, Munj *et al.,* 2012 and Patel *et al.,* 2013; Bana *et al*., 2015). The nymphs and adults lacerate epidermis of tender leaves, flower buds, flowers, inflorescence ratches and fruits. As a result, the leaves become brownish, dusty and weak which results in leaf curl and leaf fall in severe stage. The flower buds and flowers become weak, turn brownish and fall down. Also fruit setting is badly affected (Pena *et al.,* 1998, Grove *et al*., 2000, Munj *et al.,* 2012 and Reddy *et al*., 2020). Thrips lacerate the epidermis of mango fruits which results in development of grey coloured patches on fruits resembling sapota fruits which becomes unmarketable (Chavan *et al.,* 2009, Munj *et al*., 2012 and Gawade *et al*., 2014). Several other species of thrips have been reported recently to cause damage to different plant parts of mango *viz., Thrips florum* Schmutz, (inflorescence and fruits), *Bathrips jasminae* Ananthakrishnan (leaves), *Haplothrips ganglbaueri* Ananthakrishnan (inflorescence) (Reddy *et al.,* 2020).

Many insecticides of different groups have been recommended for management of mango thrips by different workers (Kumar *et al.,* 1994; Munj *et al*., 2012; Patel *et al.,* 2013; Gawade *et al.,* 2014 and Bana *et al.*, 2015). However, large scale and indiscriminate use of inorganic insecticides leads to the problems like resistance, resurgence and residues**.** Non chemical means of pest management like biopesticides have a great potential in achieving residue free and environmentally safe plant protection. Therefore, present study was undertaken to evaluate different entomopathogenic fungi based formulations for their efficacy against mango thrips under different agro climatic zones of India.

MATERIALS AND METHODS

The field experiments were conducted at four locations *viz.,* Bengaluru (Karnataka); Lucknow (Uttar Pradesh), Periyakulam (Tamil Nadu) and Vengurle (Maharashtra) during 2015-16 to 2017-18 to evaluate the entomopathogens against thrips, *S. dorsalis* on mango under All India Co-ordinated Research Project on Fruits. The experiments were conducted in a randomized block design with seven treatments and 3 replications. The treatments included solid and liquid formulations of three entomopathogenic fungi viz., *Beauveria bassiana, Metarhizium anisopliae* and *Lecanicilium (Verticilium) lecanii* and a standard check along with an untreated control (Table 1).

Uniformly flowered mango trees were selected randomly. The treatments were applied on selected trees as per treatment details and spray schedule. First spray was given at paicle intiation stage followed by the second and third sprays at weekly interval. Fourth and fifth sprays were need based and given when fruits were at pea and lemon size. Ten panicles per tree were labelled randomly and the thrips population was counted a day before and seven days after every spray. For recording thrips population, the panicles were given gentle tap by placing against a white paper and thrips fallen on white paper were counted. The observations on fruit infestation (scrapping of fruit rind) due to thrips feeding were rated on 0 - 4 scale at marble stage of fruits where nil damage was rated as 0, 1-25% scrapping as 1, 26-50% as 2, 51-75% as 3 and 76-100% as 4 (Godase *et al*., 2002). Also, the infested fruits due to thrips were counted at the time of harvesting and the data were converted into per cent infested fruits. The fruit yield was recorded (kg/tree) and the benefit cost ratios for different treatments were calculated.

Table 1. Details of entomopathogen and other treatments used in the study

Treatment No.		Treatment details
T_1	:	Foliar application of *Lecanicillium lecanii* @ 5g/l (1x10^8 cfu/g) (commercial formulation)
T_2	:	Foliar application of *Metarhizium anisopliae* (IIHR liquid formulation @ 1ml/10 l)
T_3	:	Foliar application of consortia of *M. anisopliae* + *B. bassiana* (IIHR liquid formulation @ 1ml/10 l)
T_4	:	Foliar application of *Metarhizium anisopliae* (IIHR oil formulation @ 0.5 ml/l)
T_5	:	Foliar application of *Beavaria bassiana* (IIHR liquid formulation @ 1 ml/l)
T_6	:	Standard check – insecticides treatment 1st spray of 0.004 per cent spinosad 45 SC at panicle emergence stage followed by 0.008 per cent thiamethoxam 25 WG after 21 days and 3rd need based spray of azadirachtin 10000 ppm @ 3ml/l)
T_7	:	Control

RESULTS AND DISCUSSION

The pooled data of three years (2015-16 to 2017-18) indicated that all treatments were significantly effective in reducing thrips population compared to control (Table 2). The pre count observations recorded a day before insecticide application were statistically non significant which indicate uniform pest population throughout experimental area. The data revealed that the thrips population was lowest with standard check of insecticide treatment at all locations. The thrips populations counts due to T_6 were at 2.46 thrips/panicle at Bengaluru, 1.24 at Periyakulam, 1.65 at Vengurle and 1.19 at Lucknow. However these were at par with the treatment involving *M. anisopliae* oil formulation (T_4).

Among the different entomopathogen treatments, T_4 (Foliar application of IIHR formulation of *M. anisopliae* oil formulation @ 0.5 ml/l) was found to be the most effective treatment at Bengaluru (4.11 thrips/panicle), Lucknow (1.19 thrips/ panicle), Periyakulam (2.21 thrips/panicle) and Vengurle (2.35 thrips/panicle). At Bengaluru, Lucknow and Vengurla, the treatment T_4 was found significantly superior over rest of the treatments, whereas, at Periyakulam it was at par with rest of the treatments except untreated control. The oil formulation of *M. anisopliae* was found to be at par with standard check involving insecticide applications. The thrips population in untreated control 7 days after application of treatments was very high at different centres viz., Bengaluru (25.46), Lucknow (10.63), Periyakulam (12.69) and Vengurle (12.64).

The pooled data on per cent fruit damage due to thrips and damage rating is presented in Table 3. It is evident from the data that, among the different entomopathogen treatments, the per cent infested fruits due to thrips was minimum in treatment T_4 at all the four centers *viz.*, Bengaluru (4.92%), Lucknow (5.00%), Periyakulam (8.89 %) and Vengurla (11.64%) as against 19.39, 29.50, 33.99 and 25.07 per cent in untreated control, respectively. The treatment T_4 was significantly superior over rest of the treatments at all the four centres. The data recorded on thrips damage score (0-4 scale) on fruits in different treatments at different centres revealed that, among the different entomopathogens, the least thrips damage score on fruits was recorded in treatment T_4 at all the four centers (Bengaluru 0.99, Lucknow 0.74, Periyakulam 1.21 and Vengurle 1.29) which was significantly superior

Table 2. Efficacy of different treatments against mango thrips (pooled data of 2015-16, 2016-17 and 2017-18)

Treatment	Thrips count /panicle							
	Bengaluru		Lucknow		Periyakulam		Vengurle	
	Pre count	7 days after last spray	Pre count	7 days after last spray	Pre count	7 days after last spray	Pre count	7 days after last spray
T_1	19.5 (4.41)	8.53 (2.92)	26.57 (2.23)	2.23 (1.49)	8.85 (2.97)	5.24 (2.24)	11.89 (3.58)	3.25 (2.09)
T_2	17.47 (4.18)	8.43 (2.90)	28.20 (2.29)	3.40 (1.84)	8.93 (2.99)	4.12 (2.03)	10.74 (3.41)	3.35 (2.09)
T_3	17.30 (4.17)	6.80 (2.60)	26.62 (2.26)	7.79 (2.79)	8.63 (2.94)	3.91 (1.79)	9.51 (3.24)	3.66 (2.14)
T_4	19.30 (4.39)	4.11 (2.02)	27.29 (2.26)	1.19 (1.09)	8.73 (2.95)	2.21 (1.41)	9.45 (3.22)	2.35 (1.80)
T_5	19.70 (4.43)	9.13 (3.02)	24.70 (2.21)	2.77 (1.66)	8.98 (2.99)	4.19 (1.87)	9.84 (3.28)	3.34 (2.10)
T_6	18.96 (4.35)	2.46 (1.56)	23.63 (2.22)	2.17 (1.47)	8.74 (2.96)	1.24 (1.14)	9.92 (3.30)	1.66 (1.62)
T_7	18.80 (4.34)	25.46 (5.05)	22.77 (2.12)	10.63 (3.26)	8.43 (2.90)	12.69 (3.56)	9.23 (3.19)	12.64 (3.69)
CD ($p = 0.05$)	NS	0.58	NS	0.22	NS	0.89	N.S.	0.28

Figures in parantheses are square root n+1 transformed values

Table 3. Efficacy of different treatments to reduce thrips damage on fruits (pooled data of 2015-16, 2016-17 and 2017-18)

Treatment	Bengaluru		Lucknow		Periyakulam		Vengurle	
	Infested fruits (%)	Thrips damage score	Infested fruits (%)	Thrips damage score	Infested fruits (%)	Thrips damage score	Infested fruits (%)	Thrips damage score
T_1	11.01	1.64	14.03	0.83	19.93	1.61	15.10	1.57
T_2	9.34	1.44	15.90	1.07	15.87	1.46	14.51	1.52
T_3	7.30	1.77	12.24	0.97	11.00	1.59	15.70	1.57
T_4	4.92	0.99	5.00	0.74	8.89	1.21	11.64	1.29
T_5	11.96	1.87	19.00	1.10	21.91	1.67	15.00	1.58
T_6	3.07	0.93	3.17	0.57	5.41	1.14	6.30	0.96
T_7	19.39	2.76	29.50	1.60	33.99	2.51	25.07	2.16
CD ($p = 0.05$)	1.67	0.23	1.95	0.11	1.24	0.76	1.66	0.22

Table 4. Yield and B: C ratio recorded in different treatments (pooled data of 2015-16, 2016-17 and 2017-18)

Treatment	Yield (kg/tree) and B : C ratio							
	Bengaluru		Lucknow		Periyakulam		Vengurle	
	Yield	B:C ratio	Yield	B:C ratio	Yield	B:C ratio	Yield	B:C ratio
T_1	61.95	1.27	37.27	4.47	48.87	1.75	30.97	1.38
T_2	57.60	3.23	29.63	2.02	51.62	1.89	28.17	1.23
T_3	59.30	3.46	27.55	1.29	50.71	2.11	27.81	1.20
T_4	71.45	4.15	57.16	8.73	62.89	2.29	31.39	1.42
T_5	50.15	2.24	36.50	4.35	49.42	1.79	28.93	1.22
T_6	78.20	3.36	53.67	4.37	66.17	2.52	33.18	1.50
T_7	33.40	-	20.77	--	43.62	-	24.00	-
CD ($p = 0.05$)	8.43	-	2.70		1.23	-	2.96	

over rest of the treatments. In untreated control the thrips damage score was comparatively high at all the four centres *viz.*, Bengaluru (2.76), Lucknow (1.60), Periyakulam (2.51) and Vengurla (2.16).

The economics of different treatments was worked out based on yield and benefit cost ratios were calculated (Table 4). Yield harvested was significantly highest from trees treated with oil formulation of *M. anisopliae* (T_4). The yield recorded at different locations was: Bengaluru (71.45 kg/tree), Lucknow (57.16 kg/tree), Periyakulam (62.89 kg/tree) and Vengurla (31.39 kg/tree). The treatment T_4 was significantly superior over all other treatments at Bengaluru, Periyakulam and Lucknow, whereas, at Vengurla it was at par with T_1 (Foliar application of *Verticillium lecanii* 5 g/l commercial product). The B:C ratio presented in Table 3 revealed that, among the different entomopathogen treatments, the B:C ratio of treatment T_4 is maximum at all the centers *viz.,* Bengaluru (4.15), Lucknow (8.73), Periyakulam (2.29) and Vengurle (1.42).

More or less similar results have been recorded by Bana *et al.* (2015). They reported the efficacy of a module containing first spray of *B. bassiani* followed by a second spray of *V. lecanii* and third need based spray of 10000 ppm azadirachtin for management of mango thrips. Reddy *et al*. (2019) found that entomopathogen, *M. anisopliae* was effective in reducing thrips damage in grapes. From the overall results it can be concluded that the oil based formulation of *M. anisopliae* (0.5 ml/l.) developed by ICAR-IIHR, Bengaluru is significantly effective for management of thrips on mango at all the four locations tested. Considering its safety and cost effectiveness*, M. anisopliae* could be an ideal component of IPM of mango.

ACKNOWLEDGEMENT

This work was carried out with the financial support from the ICAR-All India Coordinated Research Project (AICRP) on Fruits, Bengaluru. Authors thank Dr Prakash Patil, Project Coordinator, ICAR-AICRP (Fruits) and authorities of their respective organizations for encouragement and support.

REFERENCES

Anonymous. 2016. Evaluation of different entomopathogens against mango hopper and thrips. Proceedings of 3rd Group Discussion meeting of AICRP (F) held at PAU, Ludhiana, 3-6 March, 2016, pp. 193-195.

Bana, J. K., Ghoghari, P. D., Kalaria, G. B., Saxena, S. P. and Shah, N. I. 2015. Efficacy of management modules against inflorescence thrips. *Pest Management in Horticultural Ecosystems*, **21**(2): 119-124.

Chavan, S. A., Dalvi, M. B., Munj, A.Y., Patil, P. D. and Salvi B. R. 2009. In: *Mango Plant Protection.* Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, M.S, pp. 1-2.

Gawade, B. K., Munj, A. Y. and Narangalkar, A. L. 2014. Management of mango thrip complex. *Pestology*, **38** (10): 57-59.

Godase, S. K. and Bhole, S. R. 2002. Evaluation of some synthetic pyrethroides against flower thrips of cashew. *Pestology*, **26** (3): 19-20.

Grove, T., Giliomee, J. H. and Pringle, K. L. 2000. Seasonal abundance of different stages of citrus thrips, *Scirtothrips aurantii*, on two mango cultivars in South Africa. *Phytopurasitica*, **28**: 1-11.

Kumar, S., Patel, C. B., Bhatt, R. J. and Rai, A. B. 1994. Population dynamics and insecticidal management of the mango thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) in South Gujarat. *Pest Management and Economic Zoology*, **2**:59-62.

Munj, A. Y., Jalgaonkar, V. N., Salvi, B. R. and Narangalkar, A. L. 2012. Seasonal incidence and control of mango thrips. *Pestology*, **36** (12): 35-37.

Panse R. K., Gupta A. and Jain P. K. 2012. Eco-friendly management of *Thrips tabaci* (Lindeman) in onion. *Pesticide Research Journal*, **24** (2): 155-158.

Patel, K. B., Saxena, S. P., Patel, K. M. and Gajre, N. K. 2013. Biorational pest management in mango. *Bioinfolet* , **10** (3B): 947-951.

Pena, J. E., Mohyuddin, A. I. and Wysoki, M. 1998. A review of the pest management situation in mango agro ecosystem. *Phytoparasitica* , **26**:1-20.

Reddy, P. V. R., Ganga Visalakshy, P. N. and Verghese, A. 2019. Entomopathogenic fungus, *Metarhizium anisopliae* (Metsch.) (Deuteromycotina: Hyphomycetes): A potential non - chemical option for the management of thrips, *Scirtothrips dorsalis* Hood on grapes. *Journal of Entomology and Zoology Studies*, **7**: 638-640.

Reddy, P. V. R., Rashmi, M. A., Sreedevi, K. and Singh, S.2020. Sucking pests of mango. In: Sucking Pests of Crops ed: Omkar. https://doi.org/10.1007/978-981-15-6149-8_13. Springer Nature, Singapore.

Sithanantham, S., Vartharajan, R., Ballal, C. R. and Gangavishalakshy, P.N. 2007. Research status and scope for biological control of sucking pests in India: Case study of thrips. *Journal of Biological Control*, **21**(special issue): 1-19.

Tripathy, P., Das, S. K., Priyadarsini, A., Sahoo, B. B., Dash, D. K. and Rath, L. K. 2013. Field efficacy of some botanicals against onion thrips under Odisha condition. *Indian Journal of Plant Protection*, **41** (2): 182-183.

MS Received: 24 October 2020
MS Accepted: 30 November 2020