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Management of thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) in mango using botanicals: a multilocation study

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ABSTRACT: Over the past decade, thrips *Scirtothrips dorsalis* Hood has emerged as a significant pest affecting mango cultivation across India. Multilocation field studies were carried out at six major mango belts in India, *viz.,* Bengaluru (Karnataka), Mohanpur (West Bengal), Paria (Gujarat), Rahuri (Maharashtra), Sangareddy (Telangana), and Vengurla (Maharashtra) to manage mango thrips using botanicals from 2019-20 to 2021-22. The findings indicated that in Karnataka, Gujarat, and Maharashtra, the application of neem soap spray at a concentration of 10g/l proved to be the most effective, while in West Bengal and Telangana, the treatment with azadirachtin at 10,000 ppm and a concentration of 3g/l was identified as the most effective.

Keywords: Botanicals, mango, *Scirtothrips dorsalis*, thrips.

INTRODUCTION

The mango crop is found to be infested by more than 100 insect and non-insect pests (Butani, 1962; Tondon and Verghese, 1985; Chavan *et al*., 2009; Narangalkar *et al*., 2018). Among these pests, thrips, a group of sucking insects, have emerged as a significant threat to fruit crops, causing substantial yield losses (Sithanantham *et al*., 2007; Kumar *et al*., 1994; Reddy *et al*., 2019; Munj *et al*., 2020). Although thrips were considered minor pests of mango until the last decade, their status has transitioned to major pests in recent years due to the excessive use of synthetic insecticides (Chavan *et al*., 2009; Munj *et al*., 2012; Patel *et al*., 2013; Bana *et al*., 2015; Munj *et al*., 2020). Notably, three new species of thrips, *Thrips florum* Schmutz (inflorescence and fruits), *Bathrips jasminae* Ananthakrishnan (leaves), and *Haplothrips ganglbaueri* Ananthakrishnan (inflorescence), have been reported infesting various parts of mango plants (Reddy *et al*., 2020). Utilizing their rasping and sucking mouthparts, thrips inflict damage on tender plant parts, such as leaves, flower buds, flowers, panicle raches, and fruits. This leads to blackening of leaf veins, a dusty appearance of affected leaves, weakness, leaf curl, and eventual leaf fall. Thrips also cause browning and shedding of flower buds and flowers, resulting in reduced fruit set (Pena *et al*., 1998; Grove *et al*., 2000; Munj *et al*., 2012; Salvi *et al*., 2018; Reddy *et al*., 2020; Munj *et al*., 2020; Patel *et al*., 2020). Mango fruit epidermis laceration by thrips leads to the development of grey-colored patches on fruits (Chavan *et al*., 2009; Munj *et al*., 2012; Gawade *et al*., 2014; Munj *et al*., 2020).

Various synthetic insecticides have been recommended for mango thrips management, along with bio-pesticides such as *Beauveria bassiana* and *Metarhizium anisopliae* (Kumar *et al*., 1994; Munj *et al*., 2012; Patel *et al*., 2013; Gawade *et al*., 2014; Bana *et al*., 2015; Reddy *et al*., 2019; Munj *et al*., 2020). Additionally, botanicals like neem seed kernel extract and neem oil have been suggested for effective thrips management (Aliakbarpour *et al*., 2011; Gundappa and Shukla, 2020). However, to assess their efficacy against mango thrips, it was imperative to evaluate different botanicals, leading to the initiation of the present multi-location study.

MATERIAL AND METHODS

The field experiments were conducted at six prominent research centers, namely the Indian Institute of Horticulture Research in Bengaluru (Karnataka), Bidhan Chandra Krishi Vishvavidyalaya in Mohanpur (West Bengal), Agriculture Experiment Station in Paria

(Gujarat), Mahatma Phule Krishi Vidyapeeth in Rahuri (Maharashtra), Fruit Research Station in Sangareddy (Telangana), and Regional Fruit Research Station in Vengurla (Maharashtra). These experiments were carried out as part of the All India Co-ordinated Research Project on Fruits from 2019-20 to 2021-22. The primary objective was to assess the effectiveness of various botanicals in managing thrips infestations on mango crops. The experiments were designed using a randomized block design, with three replications and seven treatments. Details of the treatments are provided in Table 1.

Spray schedule:

1st Spray: At panicle initiation stage

2nd spray:15 days after 1st spray

3rd spray:15 days after 2nd spray

4th spray:15 days after 3rd spray (need based)

5th spray:15 days after 4th spray (need based)

Observations

The pre-treatment pest population was counted a day before spray and the post treatment pest population was counted seven days after each spray. For counting thrips, the panicles were given single tap on a plain paper and the fallen thrips were counted with the help of hand lance. At the time of harvesting, the fruit yield per tree was recorded and the B:C ratio was worked out.

RESULTS AND DISCUSSION

The data collected on the management of mango thrips across the years 2019-20, 2020-21, and 2021-22 were pooled and subjected to analysis (Table 2). The results indicate the significant effectiveness of all treatments in thrips management. Pre-treatment observations made a day before insecticide application were statistically non-significant, suggesting a uniform pest population throughout the experimental area. Notably, the treatment with the standard check (T_6) consistently exhibited the lowest thrips population across all centers, with a population of 1.85 thrips/panicle in Bengaluru, 1.41 in Mohanpur, 2.32 in Paria, 0.33 in Rahuri, 1.50 in Sangareddy, and 0.03 in Vengurla. Among the various botanical treatments, the application of azadirachtin (T_1) emerged as the most effective in reducing thrips populations at Paria and Vengurla. In Paria, T_1 recorded 3.73 thrips/panicle seven days after the last spray, while in Vengurla, T_1 recorded 2.83 thrips/panicle. Treatment T_1 outperformed all botanical treatments significantly in Paria, while in Vengurla, it was comparable to T_3. At Mohanpur, Rahuri, and Sangareddy, T_5 (T_1 followed by T_3 followed by T_4 followed by T_2) demonstrated the highest efficacy in managing thrips, with population figures of 2.86, 1.13, and 2.25/panicle, respectively.

In Bengaluru, T_3 was found to be the most effective treatment for mango thrips management (2.45 thrips/panicle), standing on par with T_5, T_1, and T_4. Conversely, the untreated control exhibited a significantly high thrips population seven days after the last spray across all centers: Bengaluru (20.47), Mohanpur (6.19), Paria (11.90), Rahuri (11.43), Sangareddy (10.75), and Vengurla (10.73). Examining the mean percentage reduction in thrips population seven days after the last spray (Table 3), the standard check consistently recorded the highest reduction percentage at all centers. Among the botanical treatments, T_3 exhibited the highest percentage reduction in Bengaluru (88.04%). At Mohanpur, Paria, and Vengurla, T_1 demonstrated the highest reduction

Table 1.Treatment details

Treatment No.	Treatment details
T_1	Azadirachtin 10,000 ppm @3 ml/l of water
T_2	Botanical formulation "AAVYA" @ 4 g/l of water
T_3	Neem soap (IIHR product) @ 10g/l of water
T_4	Pongamia soap (IIHR product) @ 10g/l of water
T_5	T_1 followed by T_3 followed by T_4 followed by T_2
T_6	As per University/Institute recommendation for sucking pest (Standard check)
T_7	Control

Table 2. Efficacy of botanicals against mango thrips at different centres (2021-22)

Treatments	Number of thrips /tap/panicle											
	Bengaluru		Mohanpur		Paria		Rahuri		Sangareddy		Vengurla	
	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	Pre count	7 days after last spray	Pre count	7 days after last spray
T_1-Azadirachtin	13.28 (3.64)	2.98 (1.72)	7.14 (2.85)	2.89 (1.97)	7.09 (2.65)	3.73 (1.92)	8.63 (3.01)	3.13 (1.89)	8.25 (3.03)	2.75 (1.91)	9.13 (3.18)	2.83 (1.95)
T_2-"AAVYA"	15.48 (3.93)	5.25 (2.29)	6.68 (2.77)	5.20 (2.49)	6.55 (2.53)	7.38 (2.71)	9.05 (3.08)	2.40 (1.70)	8.37 (3.06)	2.50 (1.87)	8.90 (3.14)	4.17 (2.27)
T_3-Neem soap	14.26 (3.77)	2.45 (1.56)	6.59 (2.76)	2.97 (1.99)	5.36 (2.28)	6.04 (2.46)	8.80 (2.96)	1.23 (1.31)	8.25 (3.03)	3.12 (2.20)	9.93 (3.30)	3.00 (2.00)
T_4-Pongamia soap	15.67 (3.95)	3.02 (1.73)	6.87 (2.80)	3.43 (2.11)	6.90 (2.61)	6.35 (2.52)	7.90 (2.89)	2.05 (1.59)	8.62 (3.10)	3.00 (1.99)	10.67 (3.41)	4.47 (2.33)
T_5 -(T_1+T_3+T_4+T_2)	16.34 (4.04)	2.84 (1.68)	7.16 (2.86)	2.86 (1.97)	6.50 (2.54)	5.41 (2.32)	9.15 (3.10)	1.13 (1.27)	8.25 (3.03)	2.25 (1.79)	9.63 (3.26)	4.10 (2.26)
T_6-Standard check	14.27 (3.77)	1.85 (1.36)	6.93 (2.82)	1.41 (1.54)	7.26 (2.67)	2.32 (1.52)	8.40 (2.98)	0.33 (0.91)	8.12 (3.01)	1.50 (1.57)	8.83 (3.13)	0.03 (1.01)
T_7-Control	15.24 (3.90)	20.47 (4.52)	7.19 (2.86)	6.16 (2.68)	6.06 (2.43)	11.90 (3.45)	9.03 (3.08)	11.43 (3.45)	8.12 (3.01)	10.75 (3.42)	10.60 (3.40)	10.73 (3.44)
SEm±	-	0.11	-	0.07	-	0.05	-	0.05	-	**0.13**	-	0.07
CD at 5%	NS	0.33	NS	0.28	NS	0.15	NS	0.16	NS	**0.3**8	NS	0.20

*figures in parenthesis are square root transformed values

Table 3. Mean per cent reduction in thrips population (Pooled)

Treatments	Mean per cent reduction in thrips population					
	Bengaluru	Mohanpur	Paria	Rahuri	Sangareddy	Vengurla
T_1: Azadirachtin	85.44	69.43	68.68	70.86	71.63	84.40
T_2: AAVYA"	74.38	27.25	38.03	72.75	73.90	74.48
T_3: Neem soap	88.04	62.73	49.29	78.41	73.07	79.67
T_4: Pongamia soap	85.26	56.93	46.62	71.99	73.40	73.26
T_5: (T_1+T_3+T_4+T_2)	86.14	64.17	54.56	78.29	77.07	75.76
T_6 : Standard check	91.00	76.87	80.50	87.48	88.45	99.66
T_7: Control	-	-	-	-	-	-

Table 4. Yield recorded at different centers (Pooled)

Treatments	Yield (kg/tree)					
	Bengaluru	Mohanpur	Paria	Rahuri	Sangareddy	Vengurla
T_1: Azadirachtin	81.95	94.73	43.15	24.78	21.08	21.18
T_2: AAVYA"	67.84	71.53	24.17	22.79	22.39	17.21
T_3: Neem soap	80.54	79.96	34.01	31.53	18.11	19.43
T_4: Pongamia soap	78.32	73.54	28.28	26.16	17.29	16.45
T_5: (T_1+T_3+T_4+T_2)	78.54	88.00	27.84	32.78	23.85	17.05
T_6 : Standard check	84.21	97.63	51.53	42.28	25.23	26.96
T_7: Control	32.15	63.14	11.65	19.22	11.01	13.66
S.E	1.81	2.74	3.06	1.17	0.55	0.59
C.D	5.43	8.19	9.10	3.46	2.11	1.82

Table 5. Benefit- cost (B:C) ratio (Pooled)

Treatments	B.C. ratio					
	Bengaluru	Mohanpur	Paria	Rahuri	Sangareddy	Vengurla
T_1-Azadirachtin	2.55	2.68	1.71	1.57	2.40	1.38
T_2-"AAVYA"	1.14	1.88	1.58	1.52	2.15	1.35
T_3-Neem soap	3.46	2.19	1.80	2.04	1.19	1.42
T_4-Pongamia soap	2.87	2.04	1.61	1.69	1.27	1.23
T_5-(T_1+T_3+T_4+T_2)	2.50	2.52	1.62	1.90	1.99	1.29
T_6-Standard check	3.10	3.03	3.85	2.36	4.74	2.27
T_7-Control	-	-	-	-	-	-

percentages, recording 69.43%, 68.68%, and 84.40%, respectively. Rahuri and Sangareddy saw the maximum reduction with T_5 (78.29% and 77.07%, respectively).

The marketable fruit yield at harvest (Table 4) revealed that the standard check treatment (T6) consistently produced the highest fruit yield at all centers. Among the botanical treatments, T1 recorded the maximum fruit yield in Bengaluru (81.95 kg/tree), Mohanpur (94.73 kg/tree), Paria (43.15 kg/tree), and Vengurla (21.18 kg/tree). However, T_1 was comparable to other treatments in some centers, indicating its effectiveness. Economic analysis and the calculation of the Benefit-Cost (B: C) ratio (Table 5) showed that the standard check treatment (T_6) consistently yielded the highest B: C ratio at all centers except Bengaluru. Among the botanical treatments, T_3 exhibited a higher B:C ratio in Bengaluru (3.46), Paria (1.80), Rahuri (2.04), and Vengurla (1.42). In Mohanpur and Sangareddy, T_1 had a higher B: C ratio (2.68 and 2.40, respectively). These findings indicate that for effective mango thrips management with botanicals, the treatment involving neem soap (IIHR product) at 10g/l (five sprays at 15-day intervals, starting from panicle initiation) is most effective in Bengaluru, Paria, Rahuri, and Vengurla. Conversely, for Mohanpur and Sangareddy, the treatment of 10,000 ppm azadirachtin at 3ml/l proves most effective. Similar results have been reported by Aliakbarpour *et al*. (2011), Bana *et al*. (2015), and Gundappa and Shukla (2020).

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