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EFFICACY OF DIFFERENT INSECTICIDAL TREATMENT SCHEDULES AGAINST MANGO LEAF GALL MIDGE *Procontarinia matteiana*, (KIEFFER & CECCONI)

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ABSTRACT

India is the largest producer of mango in the world but in terms of productivity, it is the lowest among the top five countries. One of the major problems facing the mango industry is pest complexes that damage fruits, flowers, stems, and leaves. Mango is attacked by more than 400 pests in the world. Mango leaves are attacked by many species of Cecidomyiidae especially of the genera *Procontarinia*. The most common and widespread species is *Procontarinia matteiana* (Kieffer & Cecconi), a well-known pest of mango in Asia and Africa. The adult midge is a minute fly and dies within 24 hours of emergence after copulation and oviposition. On hatching maggots bore inside the leaf tissues, and feed within, resulting in the formation of small wart-like galls on leaves. Heavily galled leaves curled up and drop prematurely. As a result, it hampers the photo-synthetic efficiency and upset normal physiological activity of the tree resulting in reduced yields of mango fruits. Therefore a study was conducted at a private orchard in Chhotajagulia, North 24 Parganas, West Bengal, India on selected uniform plants (cv. Himsagar) to evaluate the bioefficacy of new insecticides mixtures along with conventional insecticides against mango leaf gall midge in two consecutive seasons (2017-18). The experiment was laid in a randomized block design with three replications of each treatment and an untreated check of water spray. The experiment comprised of eight treatments including the control. Five hundred leaves were randomly selected from a branch to observe and calculate the percentage of newly formed as well as mature galls on fresh leaves. The damage was assessed at weekly interval by counting total leaves versus the infested one. From the study it is revealed that the combination of beta-cyfluthrin 9% +imidacloprid 21% 300 OD@ 75 g a.i/ha was most effective to reduce leaf gall infestation followed by thiamethoxam 12.6% + lambda cyhalothrin 9.5% 247 ZC @ 22 g a.i/ha.

Keywords: Gall; midge; cecidomyiidae; himsagar; efficacy; insecticide.

1. INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most important fruit crops of the Indian subcontinent and occupies an important place in the horticultural wealth of our country. India is the largest producer of mango contributing 40.48% of the total world production but productivity is the lowest among the top five countries. The low productivity is mainly due to the associated disease problem. One of the major problems facing the mango industry is pest complexes that damage fruits, flowers, stems and leaves. Mango is attacked by more than 400 pests in the world [1]. Out of 260 species of insects and mites that have been

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recorded as minor and major pests of mango, 87 are fruit feeders, 127 are foliage feeders, 36 dwell within the inflorescence, 33 inhabit buds and 25 attack on branches and the trunk [2]. Midge is a serious pest of mango in mango growing countries of the world. It was first described by Felt in 1911 from material collected in St. Vincent, West Indies [3]. A midge is a dipteran fly of family Cecidomyiidae. Mango leaves are attacked by many species of Cecidomyiidae especially of the genera *Procontarinia*. The most common and widespread of these species is *P. matteiana*, a well-known pest of mango in Asia and Africa [4]. The life cycle of leaf gall midge comprises of two generations in a year. The first generation completes its life cycle in an average of three months maturing in February and March, while the second generation is completed in six to seven months. The second-generation coincides with the beginning of the rain, which is normally accompanied by a new flush of mango leaves. The gall fly oviposits on young leaf buds and when they hatch out the larvae burrow into the leaves inducing gall formation [5]. The adult midge is minute fly and dies within 24 hours of emergence. On hatching maggots bore inside the leaf tissues, and feed within, resulting in the formation of small wart-like galls on leaves where the insects develop into mature gall flies. Tumour-like growths develop on the host plants as a result of chemical stimuli from the galling insects (Fig. 2). These stimuli can be maternal secretions injected during oviposition or stimuli produced by larvae developing within the plant tissue [6]. These galls are predominantly formed on mango leaves although a few are found on stems and fruits [7]. Each gall inducing insect can manipulate the growth and development of plant tissue [8]. The female lays eggs into the tissue of young leaves leaving a small reddish spot. The leaf tissue under the red spot becomes swollen and soft. Gall formation begins within seven days and attains a maximum diameter of 3-4 mm. The galled leaves curled up and drop prematurely. As a result, it hampers the photo-synthetic efficiency and upset normal physiological activity of the tree resulting in reduced yields of mango fruits [9]. Galled leaves remaining on trees are known to provide reservoirs of anthracnose inoculums [10]. Though the information on the management of these two pests are available from elsewhere in the country, yet application of conventional insecticides recommended for controlling midges have not always been prove effective due to various reasons. Thus it is felt necessary to study the damage potentiality and control with conventional as well as newer molecules of pesticides with the least residual toxicity. Therefore a study was conducted to evaluate the bio efficacy of new insecticide mixtures along with conventional insecticides against the mango leaf gall midge.

2. MATERIALS AND METHODS

Efficacy of different insecticide treatments (Tables 1-3) against mango leaf gall midge was carried out at a private orchard in Chhotajagulia, North 24 Parganas, West Bengal, India on selected uniform plants (cv. Himsagar) in two consecutive seasons i.e. 2017 and 2018.The experiment was laid in a randomized block design with three replications of each treatment and an untreated check of water spray. One tree served as one replication. The experiment comprised of eight treatments including the control. The experimental site is situated at 23°N latitude and 89°E longitude with an average altitude of 9.75 m above sea level. Thiamethoxam is a neonicotinoid compound that acts on postsynaptic nicotinic acetylcholine receptors in the central nervous system of insect. Lambda cyhalothrin is a fluorinated pyrethrin analog that disrupts the nervous system in insects, causing paralysis and death. Beta cyfluthrin is a pyrethroid that acts as neurotoxin leading to convulsions and death. Imidacloprid is designed to be effective by contact or ingestion.Buprofezin inhibits larval moulting, suppresses oviposition, and reduces egg viability. The total quantity of each insecticide or combination for the particular treatment dose required for spraying the replicated plots in the experiment for mango was calculated on the basis of the active ingredient of their commercial product. The calculated amount of pesticides for each replicated plots was dilute with water and these were sprayed separately with the help of foot and hand sprayer. For thorough coverage of the trees, a spray fluid of 6 litres per tree was used and applied taking the necessary care to avoid drift. During the first season the first spray was given on 11th March, 2017 and the second spray on 2nd April, 2017. On the other hand, during the second season the first spray was given on 4th March 2018 and the second spray on 26th March, 2018. The observation was taken from 8 am to 10.30 am. Midge is a very small tiny fly with a short life span so it is difficult to count the population of the midge. Thus in the present study foliage with gall was counted to determine the efficacy of different insecticidal treatments. Five hundred leaves were randomly selected from a branch to observe and calculate the percentage of newly formed as well as mature galls on fresh leaves. The damage was assessed at weekly interval after each spray by counting total number of leaves versus the infested one. The data on the pest incidence was expressed as percentage of infestation after the spray and subjecting data to necessary transformation whenever needed. Analysis of variance (ANOVA) was used to compare effect of insectides on the infestations by leaf gall midge in two seasons. Arcsine transformation was used to validate assumptions of ANOVA.

3. RESULTS AND DISCUSSION

The effect of insecticidal treatments during first season (2017) on leaf gall midge were observed and presented (Table 1). It was obvious from the table that all the chemical treatments were significantly superior over control. Observation recorded at 7 days after first spray showed that the lowest average infestation is recorded in thiamethoxam 12.6% + lambda cyhalothrin 9.5% 247 ZC @ 22 g a.i/ha (27.46%) followed by imidacloprid 200 Sl @ 65 g a.i/ha (34.32%). Beta-cyfluthrin 9% +imidacloprid 21% 300 OD@ 75 g a.i/ha, beta-cyfluthrin 2.5% SC @ 31 g a.i/ha, lambda cyhalothrin 4.9 CS @ 15 g a.i/ha and thiamethoxam 25 WG @ 25 g a.i/ha recorded above 40% infestation. It was observed that buprofezin 25 SC @ 125 g a.i/ha is less effective of all insecticides used after 7 days of first spray. Observation recorded at 7 days after second spray showed that the lowest average infestation is recorded in thiamethoxam 12.6% + lambda cyhalothrin 9.5% (20.53%) followed by beta-Cyfluthrin 9% +imidacloprid 21% (26.38%). Imidacloprid 200 Sl, beta-cyfluthrin 2.5% SC, lambda cyhalothrin 4.9 CS and thiamethoxam 25 WG recorded in between 30- 40% infestation. It was observed that buprofezin 25 SC is continuously less effective of all insecticides used after 7 days of second spray. Mean of first and second spray showed that thiamethoxam + lambda cyhalothrin (23.99%) achieving the best performance followed by imidacloprid (31.04%) and lowest infestation reduction was recorded in buprofezin (48.45%). Therefore the efficacy of different insecticidal treatments in reducing the gall midge infestation after first and second spray during first season were in the order of thiamethoxam + lambda cyhalothrin > Imidacloprid >Beta-Cyfluthrin +Imidacloprid> thiamethoxam > lambda cyhalothrin > beta-cyfluthrin > buprofezin. In untreated control the mean infestation was recorded as 58.99% after both the sprays. The effect of insecticidal treatments during second season (2018) on leaf gall midge were observed and presented (Table 2). It was obvious from the table that all the chemical treatments were

Table 1. Mean effect of two sprays of insecticides against leaf gall midge during the first season (2017)

Treatments	Dose/g.a.i/ha	Percentage of infected leaves after I and II spray		
		7 days after 1st spray	7 days after 2nd spray	Mean of I and II sprays
T1	22	46.34(42.09)	32.66(34.85)	39.5(38.93)
T2	26.5	40.16(39.32)	26.38(30.90)	33.27(35.22)
T3	32	34.32(35.86)	27.76(31.79)	31.04(33.85)
T4	70	44.78(42.0)	35.78(36.73)	40.28(39.39)
T5	100	27.46(31.60)	20.53(26.94)	23.99(29.32)
T6	110	44.28(41.71)	37.29(37.63)	40.78(39.68)
T7	25	50.25(45.14)	46.66(43.08)	48.45(44.11)
CD at 5%	NS	0.69	1.79	1.24
SEm (±)	NS	0.24	0.62	3.01
Untreated Control (water spray)		50.66	67.32	58.99

NS- Non-significant; (Figure in parentheses are angular transformed values);
Means are not significantly different at p=0.05

Table 2. Mean effect of two sprays of insecticides against leaf gall midge during the second season (2018)

Treatments	Dose/g.a.i/ha	Percentage of infected leaves after I and II spray		
		7 days after 1st spray	7 days after 2nd spray	Mean of I and II sprays
T1	22	34.46(35.94)	26.86(31.21)	30.66(33.62)
T2	26.5	24.34(29.56)	18.8(25.69)	21.57(27.67)
T3	32	38.77(38.51)	29.86(33.12)	34.31(35.85)
T4	70	41.36(40.02)	35(36.27)	38.18(38.16)
T5	100	28.72(32.40)	22.24(28.13)	25.48(30.31)
T6	110	31.54(34.16)	24.78(29.85)	28.16(32.05)
T7	25	36.0(36.86)	33.92(35.62)	34.96(36.24)
CD at 5%	NS	1.98	1.88	1.93
SEm (±)	NS	0.69	0.65	1.98
Untreated Control (water spray)		49.82	54.64	52.23

NS- Non-significant; (Figure in parentheses are angular transformed values);
Means are not significantly different at p=0.05

significantly superior in all respect over control. Observation recorded at 7 days after first spray showed that the lowest average infestation is recorded in beta-cyfluthrin 9% +imidacloprid 21% 300 OD (24.34%) followed by thiamethoxam 12.6%+ lambda cyhalothrin 9.5% 247 ZC (28.72%). Thiamethoxam 25 WG, imidacloprid 200 Sl, beta-cyfluthrin 2.5% SC and buprofezin 25 SC continuously limited the infestation below 40%. It was observed that lambda cyhalothrin 4.9 CS (41.36%) was less effective of all insecticides used after 7 days of first spray. Observation recorded at 7 days after second spray showed that the lowest average infestation is recorded in beta-cyfluthrin 9% +imidacloprid 21% (18.8%) followed by thiamethoxam 12.6% + lambda cyhalothrin 9.5% 247 ZC (22.24%). Thiamethoxam 25 WG, imidacloprid 200 Sl, beta-cyfluthrin 2.5% SC and buprofezin 25 SC recorded no such improvement to restrict infestation. It was observed that lambda cyhalothrin 4.9 CS (35.0%) was less effective of all insecticides used after 7 days of second spray. Mean of second spray showed that beta-cyfluthrin + imidacloprid (21.57%) achieving the best performance followed by thiamethoxam+lambda cyhalothrin (25.48%) and lowest infestation reduction was recorded in lambda cyhalothrin (35.16%). Therefore the efficacy of different insecticidal treatments in reducing the gall midge infestation after first and second spray during second season were in the order of beta-cyfluthrin +imidacloprid > thiamethoxam 1 + lambda cyhalothrin > beta-cyfluthrin > thiamethoxam > imidacloprid > buprofezin > lambda cyhalothrin. In untreated control the mean infestation was recorded as 52.23% after both the sprays. It is clearly showed that (Table 3) the overall effect of different insecticidal treatments in reducing the gall midge infestation after two season were in order of thiamethoxam + lambda cyhalothrin >beta-cyfluthrin + imidacloprid > imidacloprid > beta-cyfluthrin> thiamethoxam > lambda cyhalothrin > buprofezin.

Table 3. Effect of two sprays of insecticides against leaf gall midge during the first & second season

Treatment	Insecticides (dose @ gram a.i./ha)	Overall infested leaves (Mean %)	Overall mean % reduction over control
T1	Thiamethoxam 25 WG @ 25 g	35.08	20.53
T2	Beta-Cyfluthrin 9% +Imidacloprid 21%300 OD @ 75 g	27.42	28.19
T3	Imidacloprid 200 Sl @ 65 g	32.67	22.94
T4	Lambda cyhalothrin 4.9 CS @ 15 g	39.23	16.38
T5	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% @ 22 g	24.73	30.88
T6	Beta-Cyfluthrin 2.5% SC @ 31 g	34.47	21.14
T7	Buprofezin 25 SC @ 125 g	41.7	13.91
	Untreated control	55.61	--

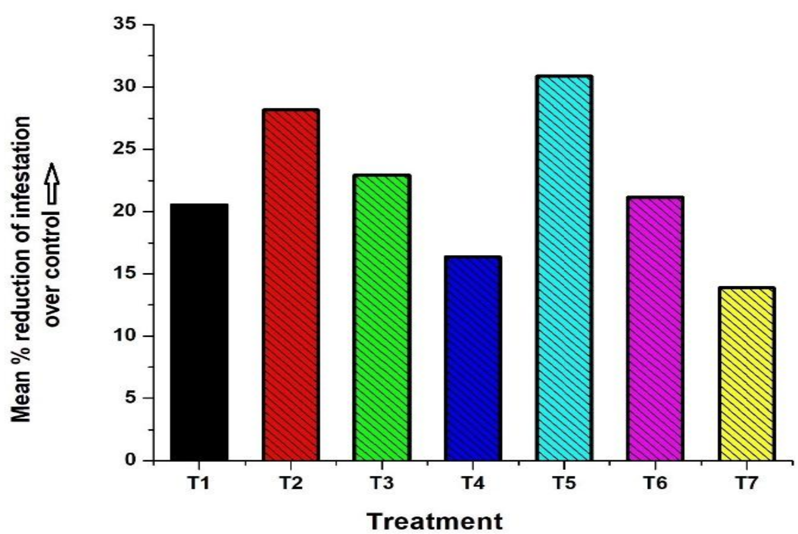

Fig. 1. Mean % reduction of infestation by different treatment schedules over control

Fig. 2. Galls on mango leaf

4. CONCLUSION

The results shows that the effectiveness of different insecticides used during two seasons are slightly different. In the first season the combined effect of thiamethoxam and lambda cyhalothrin was the most effective to reduce infestation. While in second season the combined effect of beta-cyfluthrin and imidacloprid was superior over other modules to reduce pest activity followed by beta-cyfluthrin +imidacloprid. Buprofezin is the less effective of all the insecticides used. It is evident that (Fig. 1) thiamethoxam +lambda cyhalothrin and beta-cyfluthrin +imidacloprid reduced the overall mean percentage reduction of infestation over control by 30.88% and 28.19% respectively. In conclusion, the result from mean effect of two sprays in both the seasons clearly revealed that thiamethoxam 12.6% + lambda cyhalothrin 9.5% gave the best performance followed by beta-cyfluthrin 9% +imidacloprid 21% and buprofezin 25 SC is the less effective of all the insecticides used. The present findings are in not close conformity with the reports of earlier workers as different insectides were used by them. According to Muhammad et al. [11] the nitenpyram insecticide showed (87.97%) larval mortality which is followed by imidacloprid (83.47%), bifenthrin (80.84%) and emamectin benzoate (71.31%). According to Rehman et al. [12] the best two treatments were bifenthrin and neem seed kernel extract (NSKE).

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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