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Evaluation of different insecticides against mango midges (Diptera: Cecidomyiidae)

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Abstract
The present study was conducted to evaluate insecticides for the control of mango midges under field conditions. Four insecticides: Bifenthrin (100 g/L EC), Nitenpyram (100 g/L SL), Emamectin Benzoate (14.2 g/L EC) and Imidacloprid (200 g/L SL) were evaluated for it efficacy to reduce the larval population and the development of new galls. The results showed that the maximum reduction in the larval population was recorded in Nitenpyram insecticide showed (87.97%) mortality and the minimum larval mortality was recorded in Emamectin benzoate with (71.31%). The infestation of midges continues after treatment but the Bifenthrin treated trees showed least development of galls from 0.27±0.81 to 1.16±0.27% and the maximum development of gall recorded in Imidacloprid and Nitenpyram treated trees which showed same development of galls in all seven weeks. These findings can be helpful in effective management of mango gall midges.

Keywords: Mango, gall midges, insecticides, larval population

1. Introduction

Mango (*Mangifera indica* L.) is an important fruit of tropical and subtropical regions of the world [1]. Mango is considered as the "king of fruits" due to its flavour and dietetic value. About 1595 varieties of mangoes are known in the entire world while only 25 to 30 cultivars are grown on commercial scale [2]. The principle commercial cultivars of Pakistan are: Chaunsa, Dashehari, Anwar Ratul, Gulab-e-Khas, Langra, Siroli, Zafran, Sindhri, Maldha, Fajri [3]. In Pakistan, mango is mainly grown in Punjab and Sindh province. It is also grown in India, Java, Philippines, West Indies, Hawaii and Florida (US). Pakistani mangoes are renowned for their flavour. During 2008-09, the area of Pakistan under mango cultivation was 15600 ha and the mango fruit production totaled 1,732,000 tonnes [4].

However, its production is decreasing due to various factors mainly insect pests and diseases [5-7]. Mango midges (Diptera: Cecidomyiidae) are the most important pest in several countries. It cause 78% of a 202 ha mango growing areas in Okinawa was infested by the gall midge [8]. Cecidomyiids are considered more important because they infest the crop during the flowering season and as well as new leaf flushes. This causes immature leaf and fruit senescence, and in severe cases lead to total crop loss [8]. Mature larvae of some species fall to the ground and pupate in the soil while some species pupate in the galls. At least 16 nominal species of gall midges are known to attack mango. Two genera, *Procontarinia* Kieffer and Cecconi & *Erosomya* Felt, have been found to be frequently associated with mango [9-10]. In Pakistan, several species of midges including *Procontarinia matteiana* [11], *Procontarinia mangicola* and *Dasineura amaramanjarae* [12] have been reported to attack mango.

Infestation of mango midges can be managed by applying different insecticides during the growing season. In the current study, the efficacy of various conventional and new insecticides was tested against mango midges. The main purpose of this trail was to find suitable chemical (s) that could significantly reduce the infestation of the mango midge complex.

2. Materials and Methods

The present study trail was conducted during March 2011 at the area of *(KG Farm Mouza Easan Wala Tehsil Kot Adu*) and four (4) mango trees per replication were selected for experiment and different selected insecticides Bifenthrin (100 g/L EC), Nitenpyram (100 g/L SL), Emamectin Benzoate (14.2 g/L EC) and Imidacloprid (200 g/L SL) were sprayed during mango season with foot sprayer. Similar numbers of trees were sprayed with water as control.

Trail layout was a Randomized Complete Block Design (RCBD) with four insecticides that were replicated four times. A day before application of insecticides, plastic sheets were spread under the trees the canopy. The numbers of larvae were counted next day which were dropped on the sheets as pre-treatment data. Then insecticides treatments were applied. After the treatments the data was taken after 1, 2, 3 and 7 days of application, respectively. Gall development rate was recorded on the trees sprayed with different insecticides. Treated trees were tagged and no of gall per leaf were counted with the interval of one week. These four readings were compared with pre-treatment data and four insecticides were compared with control plant's larval population.

2.1 Statistical Analysis

The data regarding different insecticides against mango midges was subjected to statistical analysis by LSD test (Statistix" version 8.1, Analytical Software, 2000).

3. Results

There was no statistically significant difference were evident in the percentage mortality of mango midge's larvae after treating trees with four insecticides ($P \geq 0.05$) and after four different hours. The data for the highest larval mortality was recorded by Nitenpyram insecticide after 24 hours (65.34±16.39), 48 hours (89.78±11.05), 72 hours (89.78±11.05) and week (97.56±4.22) respectively. While the lowest larval mortality was recorded by Emamectin benzoate insecticides after 24 hours (24.07±10.95), 48 hours (79.27±17.96), 72 hours (89.52±10.03) and week (92.38±10.82) respectively. All the insecticides treatments after 24, 48, 72 hours and week means also showed the significant difference between insecticides. The means result showed that the Nitenpyram insecticide showed (87.97%) mortality which is followed by Imidacloprid (83.47%), Bifenthrin (80.84%) and Emamectin benzoate with (71.31%) larval mortality. All the insecticides induced significantly high mortalities when compared to the control (Table 1).

It is concluded that the gall development was in progress in all plants treated with different insecticides. There was statistical difference noted in gall development rate after treatment among different insecticides but the rate of gall development was very rapid in control plants. Table 2 showed that infestation of midges continues after treatment but the Bifenthrin treated trees showed least development of galls from 0.27±0.81 to 1.16±0.27% followed by Imidacloprid 0.29±0.13 to 1.83±0.08% while the Imidacloprid and Nitenpyram treated trees showed same development of galls. The infestation of midges increases when the temperature increases and Relative Humidity decreases.

Table 1: Efficacy of different insecticides on larva of mango midges

Treatments	24 Hours	48 Hours	72 Hours	Week	Means
Bifenthrin	51.32±18.09 a	86.94±12.07 a	87.69±9.57 a	97.44±4.44 a	80.84 ab
Nitenpyram	65.34±16.39 a	89.78±11.05 a	97.56±4.22 a	99.19±1.41 a	87.97 a
Emamectin benzoate	24.07±10.95 a	79.27±17.96 a	89.52±10.03a	92.38±10.82a	71.31 b
Imidacloprid	57.62±7.87 b	86.11±11.31 a	93.33±7.19 a	96.83±3.64 a	83.47 a
Control	5.77±18.12 b	-1.03±5.59 b	21.95±8.81 b	19.61±7.59 b	11.57 c
Means	40.82 c	68.21 b	78.01 ab	81.09 a	
LSD	25.101	25.788	23.929	38.342	

Mean sharing similar letters are not significant different by LSD Test at p=0.05

Table 2: Leaf gall development rate on mango plants treated with different insecticides

Week	Bifenthrin	Emamectin benzoate	Imidacloprid	Nitenpyram	Control	Temperature C °	RH %
1	0.27±0.18 a	0.29±0.13 a	0.44±0.16 a	0.44±0.18 a	0.31±0.11 a	24.2	75
2	0.31±0.18 a	0.35±0.11 a	0.55±0.16 a	0.55±0.18 a	0.77±0.14 a	27.4	64.3
3	0.40±0.17 b	0.49±0.10 b	0.92±0.23 ab	0.92±0.29 ab	1.26±0.12 a	26.5	56.8
4	0.54±0.20 c	0.81±0.02 bc	1.21±0.17 ab	1.21±0.31 ab	1.51±0.14 a	27.8	39.8
5	0.71±0.17 c	1.11±0.07 bc	1.55±0.15 ab	1.55±0.38 ab	2.03±0.18 a	31.2	34.28
6	0.77±0.19 d	1.30±0.09 c	1.80±0.11 b	1.80±0.44 b	2.47±0.19 a	31.3	42.78
7	1.16±0.27 c	1.83±0.08 b	2.15±0.18 b	2.15±0.53 b	2.89±0.22 a	31.4	35.5

Mean sharing similar letters are not significant different by LSD Test at p=0.05

4. Discussion

In this study, imidacloprid and nitenpyram were found the most effective insecticides to reduce population of midge's larvae. Both of these insecticides belong to neonicotinoid group with novel mode of action. Our results of larval population reduction by imidacloprid are similar to (WU *et al*., 2006) [13] in which 100% reduction in the larval population of *Contarinia nasturtii* (Diptera: Cecidomyiidae), was recorded when sprayed with imidacloprid. In their study, imidacloprid spray provided protection against the midge attack for about seven weeks. They reported that neonicotinoid insecticides most effective insecticides for controlling *C. nasturtii* population either applied by spray, drench, or seed treatment.

The development of new galls in the current study was minimum on plants sprayed with bifentrhin as compared to other insecticides. The results are similar to (Mahmood Ur Rehman *et al*., 2014) [14] who reported that bifenthrin can provide effective control of the midge *D. amaramanjarae* (Diptera: Cecidomyiidae) during the inflorescence season. But, bifenthrin could be very dangerous to some hymenopterans parasitoids reported by (Prabhaker, 2007) [15] so it should be avoided.

5. Conclusion

It is concluded that the insecticides Nitenpyram showed comparatively effective against mango gall midges larval population but the Bifenthrin insecticides treated trees showed least development of galls. These insecticide management can be helpful for controlling mango gall midges.

6. Acknowledgement

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