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Toxicity of Some Insecticides to Control Mango Mealy Bug, *Drosicha mangiferae*, a Serious Pest of Mango in Pakistan

Syed Ismat Hussain, Mushtaq A. Saleem* and Shoaib Freed
Department of Crop Protection, University College of Agriculture, Bahauddin Zakariya University, Multan, Pakistan

Abstract.- Mango mealy bug, *Drosicha mangiferae*, is one of the most serious insect pests of mango because it reduces the plant vigor by sucking the sap from inflorescence, tender leaves, shoots and fruit peduncles. To control this pest, insecticides of different groups were evaluated in both the laboratory and field conditions. In laboratory conditions profenofos showed maximum percent mortality of 93.3% and 86.67% of the 1st and 2nd instar mango mealy bug. While triazophos proved to be an effective insecticide for the control of the 4th instar by showing 64.0 and 100% mortality in leaf dip method and foliar application. Out of seven insecticidal band applications tested in the field conditions, the combination of cotton + buprofezin proved effective by manifesting 99.10% control of mango mealy bug. The present study has shown that the insecticides tested, especially profenofos, methomyl and triazophos, and cotton + buprofezin band application provided effective control of the mango mealy bug. The control of this insect pest throughout the orchards predominantly depends on judicious use of chemicals like profenofos, triazophos, methomyl, acetamiprid, buprofezin and deltamethrin, for the development of an integrated pest management strategy.

Key words: Insecticides, mango mealy bug, leaf dip method, new chemistry insecticides, carbamates.

INTRODUCTION

Mango, *Mangifera indica* L, a member of the family *Anacardiaceae*, is one of the most important nutritionally rich in carbohydrates and vitamins and foreign exchange earning fruit crop of Pakistan. Nature has endowed Pakistan with wide range of agro-climatic conditions, which permit quality production of both tropical and temperate fruits. The climate of Pakistan is favorable to all types of fruits. Mango is the second major fruit crop of Pakistan after citrus. Pakistan is standing at 5th place in world's total mango production **(**FAO, 2001; MINFAL, 2002). The output during the current year (2010) has substantially decreased to 9-10 tons per hectare. It is about 50% of the potential yield, which is 20 tones per hectare (Shahid, 2006), that shows a significant difference between average and potential yields. The main reason for the yield reduction is the pest pressure and diseases attacking the mango orchards.

A number of insect pests are known to attack the mango trees, which have been studied in detail (Sen, 1955; Giani, 1968; Herren, 1981; Tandon and Verghese, 1985). Some of these are certainly responsible for causing considerable damage and become a limiting factor in many mango-growing areas. To effectively monitor a mango orchard for insect pest outbreaks, growers must be first aware of the types of insect pests they are likely to encounter and should conduct the surveys on a regular basis. (Patriquin *et al.*, 1995).

Mango mealy bug, *Drosicha mangiferae* is one of the most serious insect pests of mango in Pakistan due to its polyphagous nature (Green, 1908). It lays egg in loose soil within radius of 2-3 meter around the infested trees. Hatching of the eggs starts with rise in temperature and the nymphs crawl to the succulent shoots and base of fruiting parts (Birat, 1964; Atwal, 1976). The nymphs and female bugs suck sap from inflorescence, tender leaves, shoots and fruit peduncles. As a result, the affected inflorescences are shriveled and get dried. Rigorous infestation affects the fruit set and causes fruit drop. They exude honey dew over the leaves, on which sooty mould is developed (Tandon and Lal, 1978). Mango mealy bug is difficult to control by insecticides and the use of chemicals has been inefficient (Yousuf and Ashraf, 1987; Khan and Ahsan, 2008). The sticky bands along with burning and burying treatments significantly reduced the

* Corresponding author: mushtaqasaleem@hotmail.com or shbfkh@gmail.com
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frequency of infestation of mango mealy bug by 0.00-15.79%. Burlap bands reduced population of mango mealy bug nymphs by 78.98%. Stem injection can achieve a very high level of mortality of sucking insects (98%). The mortality rates achieved with insecticide sprays were up to 55% (Ishaq *et al.*, 2004).

Keeping in view all the problems associated with management of *D. mangiferae*, a study was planned with the objective to develop a proper management technique against mango mealy bugs by using different insecticides and band applications.

MATERIALS AND METHODS

Insects

The mango mealy bugs were collected early in the morning in a jar with the help of an aspirator and then brought to the laboratory. Fresh mango leaves as food were provided in the jars for the crawlers.

Effect of different insecticides

Against 1st and 2nd instar

To examine the toxicity of insecticides *viz.*, thiodicarb, methomyl, profenofos, chlorpyrifos, bifenthrin, emamectin benzoate, methamidophos, chlorfenpyr, flufenoxuron, imidacloprid, acetamiprid, buprofezin, λ-cyhalothrin, deltamethrin and carbaryl against the 1st and 2nd instar of *D. mangiferae***,** leaf dip bioassay method was used. Insecticidal solution (30ml) of each insecticide was prepared at their field recommended doses (Table I). Fresh mango leaves equal to the size of Petri dish (5cm) were dipped into the insecticide solution for about 1 min and then air dried at room temperature. After drying, these treated leaves were placed in the Petri dishes containing moistened filter paper to avoid desiccation of the leaves. Thereafter ten active crawlers of the 1st and 2nd instar were placed in the Petri dishes containing treated leaves with the help of fine camel hair brush. Each Petri dish was then placed under controlled conditions (25 ± 2°C, 60 ± 5 % RH). Experiment was laid under Completely Randomized Design (CRD) with sixteen treatments including control while all the treatments were replicated thrice. Mortality data was taken up to seven days of post treatment.

Table I.- Insecticides used at their field recommended doses against 1st and 2nd instar mango mealy bug.

Common name	Trade name	Dose in 100 L water	Dose in 30 ml water
Thiodicarb	Larvin® 80 DF	375 g	0.12 g
Methomyl	Lannate® 40 SP	250 g	0.075 g
Profenofos	Curacron® 50 EC	800 ml	240 µl
Chlorpyrifos	Larsban® 40 EC	750 ml	225 µl
Bifenthrin	Talstar® 10 EC	200 ml	60 µl
Emamectin benzoate	Proclaim® 019 EC	200ml	60 µl
Methamidophos	Methamidophos® 60 SL	500 ml	150 µl
Chlorfenpyr	Pirate® 360 SC	330 ml	125 µl
Flufenoxuron	Cascade® 10 WDC	400 ml	100 µl
Imidacloprid	Confidor® 20SL	250 ml	100 µl
Acetamiprid	Acetamiprid® 20 SP	150 ml	0.125 µl
Buprofezin	Buprofezin®	600 g	0.25 g
Λ-cyhalothrin	Karate® 2.5 EC	330 ml	125 µl
Deltamethrin	Decis® 10 EC	250 ml	60 µl
Carbaryl	Sevin® 85 SP	1.5 kg	0.1 g

Table II.- Insecticides used at their field recommended doses against 4th instar mango mealy bug.

Common name	Trade name	Dose in 100 L water	Dose in 30 ml water
Triazophos	Hostathion® 40 EC	375µl	1500µl
Methomyl	Lannate® 40 SP	0.25µl	1.0µl
Emamectin benzoate	Proclaim® 019 EC	100µl	400µl
Spinosad	Tracer® 240 SC	25µl	100µl
Imidacloprid	Imidacloprid® 25 WP	0.03µl	0.12µl
Bifenthrin	Talsatr® 10 EC	20µl	80.0µl
Kerosene oil		500µl	2000µl

Against 4th instar

In order to determine toxicity of insecticides at their recommended field doses (Table II) *viz.*, triazophos, methomyl, emamectin benzoate, spinosad, imidacloprid, bifenthrin and kerosene oil, against the 4th instar mango mealy bug, two methods were applied *i.e.* leaf dip method and foliar method.

Bioassay

Leaf dip method

For the leaf dip bioassay, leaves were cut as the size of Petri dish. These leaves were dipped in insecticide solution containing 50 ml water + insecticide. There were five replications in each treatment and eighth treatment was labeled as control, in which leaf discs were dipped in tap water only. In each replication five, 4th instars mealy bug were placed. The data was recorded up to 7 days after insecticidal treatment.

Foliar method

Lady hand sprayer was used in this method. The insecticide solutions were prepared in the lady hand sprayer. Under spraying method, two different solutions were made i.e., one containing 200 ml water + insecticide and other containing 200 ml water + insecticide + 2000 µl vegetable oil. These solutions were then sprayed (one time) on dorsal side of mealy bug. Fresh mango leaves were provided to the treated mealy bugs. There were five replications in each treatment. One treatment was of control in which mealy bugs were sprayed with tap water only. In each replication five 4th instar mealy bugs were placed. The data was recorded up to seven days.

Effect of different insecticidal bands against mango mealy bug under field conditions

Insecticides with powder formulations viz., carbaryl, acetamiprid, methomyl, trichlorophos, thiodicarb, buprofezin and cotton + buprofezin were used for band trial against the 1st instar mango mealy bug for their susceptibility against insecticides at their recommended field doses. The insecticide bands (2 inch diameter) were applied 3 feet above ground level around the trunks. The band was made in the way that first, the trunk (two inches width) was covered with moist soil and then, insecticide was gently applied on the moist soil.

Data collection and statistics

Data was recorded after every three days by adopting the following procedure: A square of 6 x 6 inches dimension above and below the band was made with the help of a pointed needle to record the number of mealy bugs present in that marked square only.

Percentage control of first instar mango mealy bug was calculated by the following formula:

$$\text{Control (\%)} = \frac{\text{No. of } 1^{st} \text{ instar mealy bug BB}^{1} - \text{No. of } 1^{st} \text{ instar mealy bug AB}^{2}}{\text{No. of } 1^{st} \text{ instar mealy bug BB}^{1}} \times 100$$

[1]AB, above band; [2]BB, below band

All the data recorded was subjected to statistical analysis by using SAS (2002).

RESULTS

Toxicity of different insecticides against 1st instar under lab. conditions

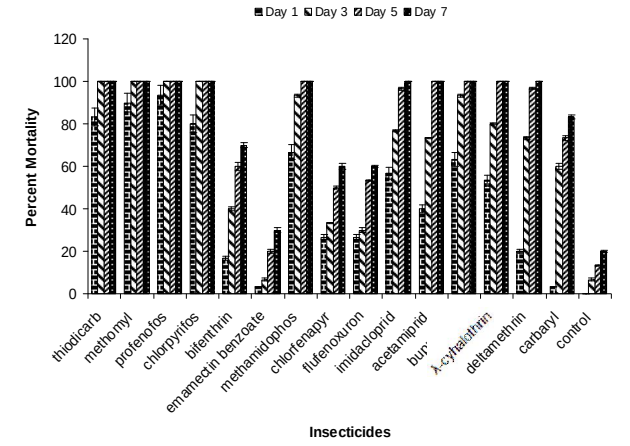
The results revealed that profenofos gave highest percentage mortality (93.3%) one day post treatment, followed by methomyl, thiodicarb and chlorpyrifos with 90.0, 83.3 and 80.0 % mortality of the 1st instar mango mealy bug, respectively (Fig.1A). The results exhibited that 100% mortality was achieved by using profenofos, methomyl, thiodicarb, methamidophos and chlorpyrifos after three days of treatment. In contrast to this, emamectin benzoate and bifenthrin proved to be least effective by showing 30.0 and 70.0% mortality after seven days of treatment.

Toxicity of different insecticides against 2nd instar under lab. conditions

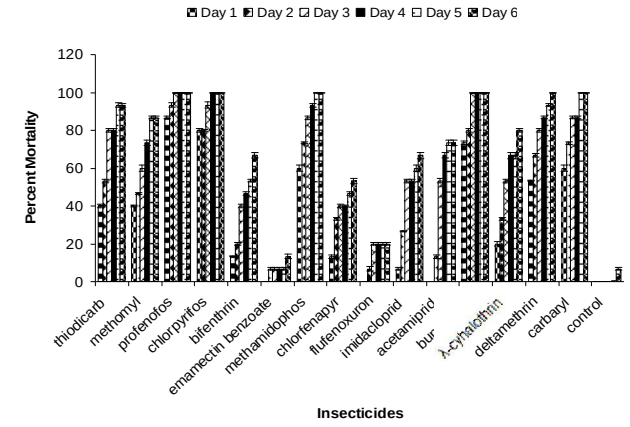
The data showed that profenofos was the best insecticide after one day of treatment, which gave 86.67% mortality of the 2nd instar, followed by chlorpyrifos (80%) and buprofezin (73.33%). Profenofos and buprofezin achieved 100% mortality after three days of the treatment, while chlorpyrifos produced 100% mortality four days post treatment. Methamidophos and carbaryl exhibited 100% mortality after five days of the treatment respectively. Conversely deltamethrin provided 100 % mortality after seven days of the treatment (Fig. 1B).

Toxicity of different insecticides against 4th instar under lab. conditions

Percent mortality of mealy bugs against different insecticides through leaf dip method is



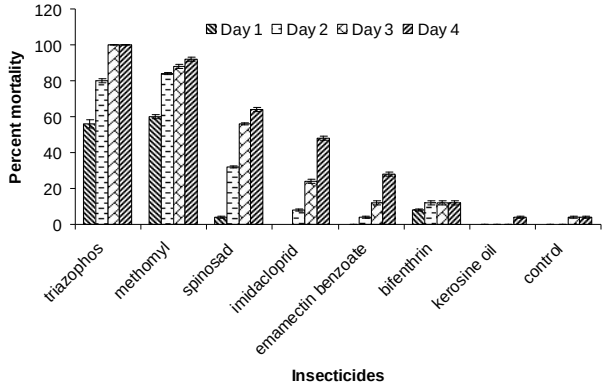
A



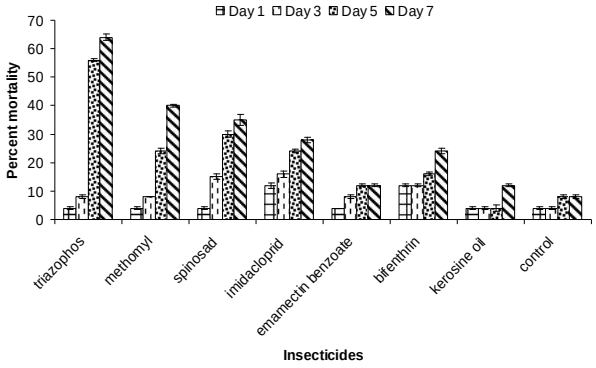
B

Fig. 1. Percent mortality of the 1st instar (A) and 2nd instar (B) mango mealy bug against different insecticides.

shown in Figure 2A. The results in turn revealed that triazophos gave the maximum mortality *i.e.* 64 % (after 7 days of treatment) followed by methomyl (40.0%), imidacloprid (28.0%), bifenthrin (24.0%), emamectin benzoate (12.0%) and kerosene oil (12.0%). Percent mortality of mealy bugs against different insecticides through foliar method is given in Figure 2B. The results revealed that triazophos provided the maximum mortality of 100%, followed by methomyl, spinosad, imidacloprid, emamectin benzoate, bifenthrin and kerosene oil which gave 96.0, 72.0, 52.0, 36.0, 16.0 and 4.0%, respectively. Percentage mortality of mealy bugs against different insecticides mixed with vegetable oil through foliar application method is displayed in Figures 3. The results manifested that triazophos and spinosad gave the maximum mortality (100 and 96.0%) of mealy bug followed by methomyl (92.0%), imidacloprid (48.0%), emamectin benzoate (40.0%), bifenthrin (28.0%) and kerosene oil (16.0%) respectively. Figure 3A shows the comparison of three treatments after one day post application of insecticide which exhibited that methomyl gave the highest percent mortality of the 4th instar mealy bug through foliar application with vegetable oil. Similar results have been showed in Figures 3B and 3C, but Figure 3D revealed the fact that triazophos had the maximum mortality after seven days of treatment by foliar application with and without vegetable oil.



A



B

Fig. 2. Percent mortality of the 4th instar mango mealy bug against different insecticides by application (A), and leaf dip method (B).

Effect of different insecticide bands against mango mealy bug under field conditions

Figure 3A shows that one day post application of insecticidal bands around the tree trunk *i.e.* the band of cotton + buprofezin and acetamiprid provided the best results by giving the 99.10 and 92.57% control against mango mealy

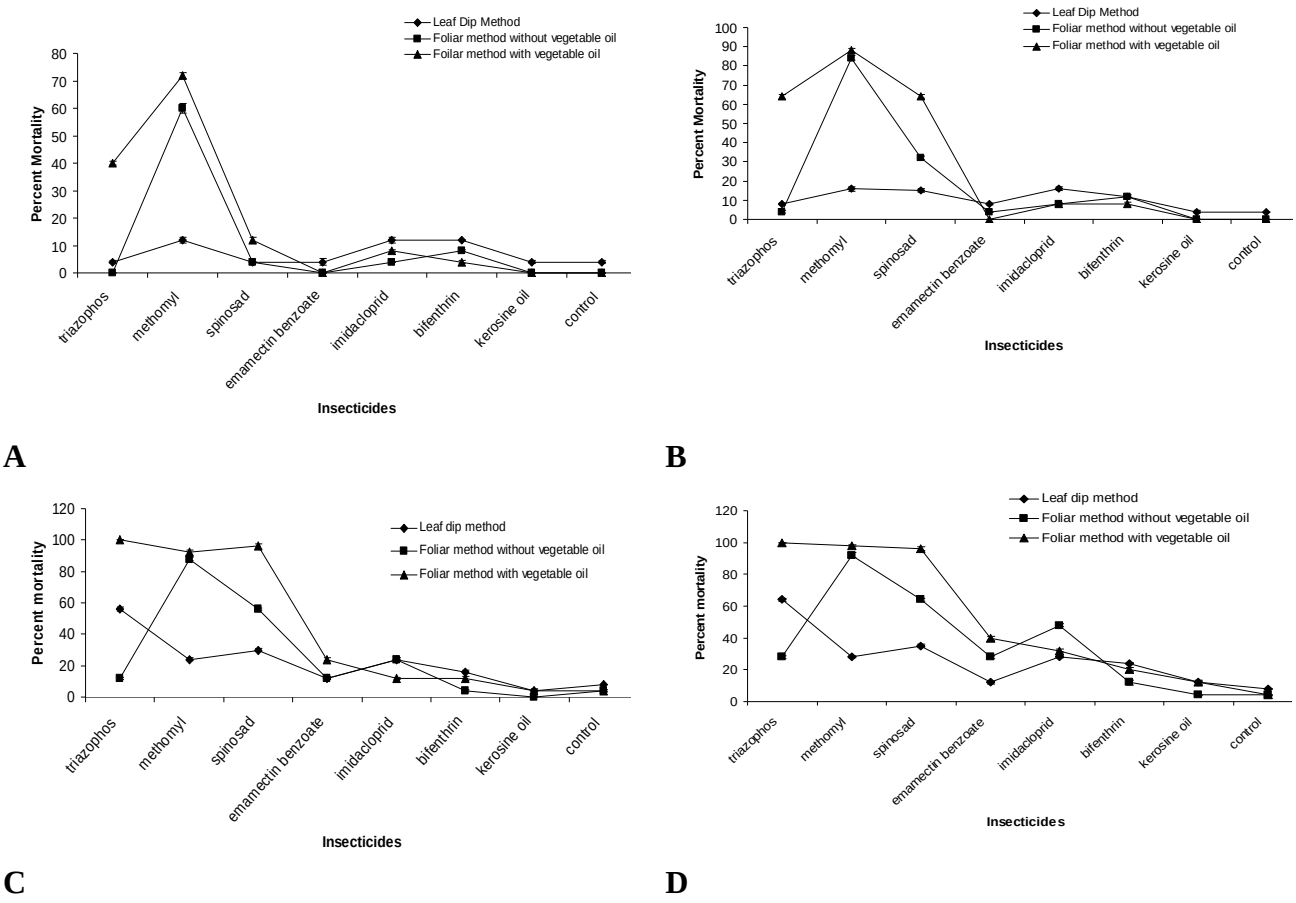


Fig. 3. Percent mortality of the 4th instar mango mealy bug one day (A), two day (B), three days (C) and five days (D) post treatment.

bugs, respectively. It was followed by carbaryl, buprofezin and methomyl giving 67.07, 62.25 and 50.58 % control, respectively while the remaining bands gave less than 50% control. After three days of insecticidal bands application (Fig. 4), the band consisting of cotton + buprofezin gave the best result (87.25% control), followed by acetamiprid, carbaryl and buprofezin with 75.29, 61.49, 54.12% control respectively, while other bands provided less control. After six days of application of insecticide bands (Fig. 4) the band of acetamiprid and band of cotton + buprofezin produced the best results by giving 60.74 and 60.54% control, respectively against mango mealy bugs, followed by carbaryl and buprofezin giving 54.44 and 46.70% control, respectively while the band of methomyl gave least control (8.89%). After nine days of insecticidal

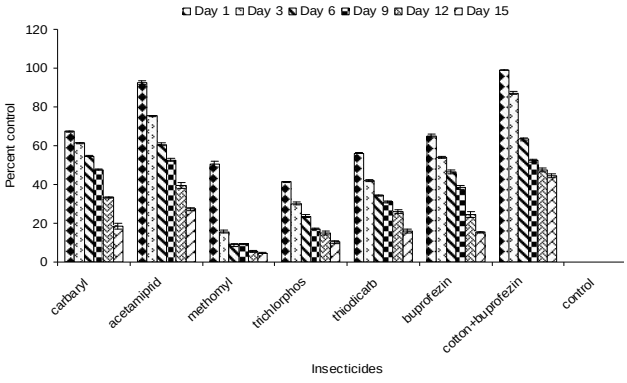


Fig. 4. Percent control of the 1st instar mango mealy bug after insecticidal bands application

bands application (Fig. 4) the efficacy of bands decreased and the percentage control by the bands

was in the order of cotton + buprofezin > acetamiprid > carbaryl > buprofezin > thiodicarb > trichlorophos > methomyl showing that cotton + buprofezin band was the most effective while methomyl band was the least effective against mango mealy bugs.

DISCUSSION

The study was conducted to check the efficacy of different insecticides at their field doses as recommended by different insecticidal companies against various instars of *D. mangiferae*. The results revealed that profenofos, methomyl and triazophos provided effective results for the control of *D. mangiferae* under lab. conditions. The results are in confirmation with that of Saeed *et al*. (2007). It indicated that profenofos, chlorpyrifos and methomyl manifested better control of mealy bugs in field experiments. According to Agrello *et al*. (1992), chlorpyrifos and methomyl manifested good control against the Comstock mealybug, *Pseudococcus comstocki* (Kuwana) in both the laboratory and field conditions. The results showed that profenofos was the best insecticide for the control of the 1st and 2nd instar *D. mangiferae* (Fig. 1). Jia *et al*. (2001) found significant reduction of mango mealy bug through integration of dusting of 25% parathion in micro capsules formulation. Effective control for the nymphs of mealy bug was reported by the application of 5% phoxim on the ground or painting mixture of 1 kg 40% omethoate + 5 kg mineral oil and spraying 300 times solution of Bt or 2000 times solution of 20% fenpropathrin. However the results of present experimentation revealed that maximum mortality percentage was obtained by using methomyl, imidacloprid, acetamiprid, buprofezin and deltamethrin (Fig. 1).

Different bioassay methods were used to check their efficacy, whether these can contribute in the efficiency of insecticides. The results revealed that triazophos was effective in both methods *i.e.* leaf dip bioassay and foliar application (Fig. 3). Our results are contrary to that of Ishaq *et al*. (2004) whose work on the integrated management of mango mealy bug reports that this pest is difficult to control by water based insecticides. So far its management by using sticky bands along with burning and burying treatments significantly reduces the incidence of infestation by mango mealy bug (0.00-15.79%).

In another trial, insecticidal bands were applied in the field conditions on the mango tree, to check the efficiency of different combination of insecticides. The results revealed that the insecticidal band *i.e.* cotton + buprofezin and acetamiprid showed effective control (92.57-99.10%) of mealy bug (Fig. 4). The results are in accordance with that of Gul *et al*. (1997) who worked on *D. stebbingi* and reported that integration of banding of tree trunks, destruction of eggs by soil working and application of insecticides was the most effective control strategy. Another study related to the application of bands showed that for the control of *Drosicha* spp. and *Rastrococcus iceryoides*, exposure of eggs during summer, removal of weeds, conservation of natural enemies, application of alkathane bands and spray of 4% neem seed extract or garlic oil on trunk below band reduced the population (Tandon and Verghese, 1985). Our findings agree with the findings of Bajwa and Gul (2000) who reported similar results on *Paulownia* spp. attacked by mango mealy bug. They managed this pest through destruction of eggs, banding of trees and application of insecticides together. The studies by Karar *et al*. (2009) suggested that maximum reduction *i.e.*, 98.46% of mango mealy bug was observed in the application where cultural methods were combined with mechanical and chemical methods. From these results it was concluded that combination of cultural, mechanical and chemical methods of control provided effective control of mango mealy bug. Moreover insecticidal profenofos, methomyl, triazophos and cotton + buprofezin band application are necessary for the effective control of mango mealy bug.

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