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Integrated Pest Management of Mango Mealybug (*Drosicha mangiferae*) in Mango Orchards

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ABSTRACT

An experiment was conducted to destroy the eggs and management of nymphs through different IPM components. The mango orchards were visited and it was found that maximum number of females were exposed from the roots of host plants in the field (1.9 m^2) and minimum numbers of females were recorded from the cracks of trees, sides of kacha roads, soil under tree canopy (0.16 m^{-2}). The data revealed that the treatment with three measures (cultural, mechanical & chemical) were combined had maximum effect in reducing the population i.e., 98.46%. It was also concluded from the results that the measures in integrated form gave better results than the single treatment.

Key Words: Mango; *Drosicha mangiferae*; Hibernation places; IPM

INTRODUCTION

Mango (*Mangifera indica* L.) a member of family Anacardiaceae is known as king of fruits for its sweetness, excellent flavor, delicious taste and high nutritive value (Singh, 1968; Litz, 1997). This important tropical fruit is being grown in more than 100 countries (Sauco, 1997). It is also valuable ornamental and shade tree, which contributes to the protection of soil against erosion and different medicinal virtues (D Almeida, 1995). A number of insect pest are known to attack the mango trees, which have been studied in detail (Sen, 1955; Giani, 1968; Herren, 1981; Tandon & Verghese, 1985). 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. Severe infestation affects the fruit set and causes fruit drop. They secrete honey dew over, which sooty mould develops (Tandon & Lal, 1978). Due to the growth of sooty mould on the leaves, photosynthetic activity is affected (Pruthi & Batra, 1960). Karar *et al*. (2006) reported that mealybug (*Drosicha mangiferae* Green.) is the serious pest of mango crop in Pakistan and is growing threat to our mango orchards.

Farmer's adopted different ways to control this pest, for example in Benin (West Africa), some farmers destroyed infected trees with mango mealybug to control the infestation (Willink & Moore, 1988), which is un-affordable solution. In general, the insecticides are considered to be the quick method for the control of insect pests but dependence on the pesticides has its own complications as WTO pointed out, Phytosanitory standards, admissible limits of residues by World Health Organization and many management problems like development of pest resistance to pesticides, increased risk to humans, biodiversity and environment. This situation demanded some alternate measures to overcome these problems. The objective of our current project is collection and destruction of eggs so that minimum quantity of insecticides may be used. The female of *D. mangifera* lays eggs in the soil which remains there for the period of six to seven months. Different practices, like hoeing, ploughing, digging are applied by the farmers on the recommendation of previous researchers for destroying the eggs of the pest to minimize its effects, while such practices are discouraged by the horticulturists for injuries in root zone and destruction of fabricious root system of the plant. A research trial was planned to know its hibernation places and develop an effective and alternative way to destroy the eggs without disturbing the roots systems of the plants. The aim of our study was to replace the existing practices with some easy, effective, cheap and harmless ones.

In this paper, only screened practices were used, which were identified through a series of experiments in mango orchards.

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MATERIALS AND METHODS

Detection of hibernated females. During 2005 survey, most of the farmers reported that the females of mango mealybug laid egg in different places and are difficult to manage. To confirm the knowledge an experiment was conducted in September-October, 2005 to expose the eggs of mealybug from different places before their hatching. The places were confirmed in 10 mango orchards, which were heavily infested with mango mealybug in district Multan. The distance between orchards was 3–10 km. From each orchard 0.27 m^2 was taken each of different places:
(i) Under tree near trunk, (ii) Mud wall around the orchards, (iii) Cracks in tree, (iv) Soil under tree canopy, (v) Sides of kacha water channel, (vi) Sides of kacha roads, (vii) Under fallen leaves, (viii) Under the roots of host plants. The places were hoed with *Ramba* and the exposed females were counted from 0.27 m^2.

IPM trail. The treatments, as detailed below, which provided the best results during 2005 experiments, were included in IPM trail. An orchard, having commercial mango variety Chaunsa (Sammar bahist) heavily infested with mango mealybug was selected with a private farmer Mr. Mahmood Ahmad Bucha in village Buch Mubarak Tehsil and District Multan. The practices were applied during April, 2006 to June, 2007 after recording the data. After treatment, the data was recorded in coming season i.e., December 2007 to 3rd week of February 2008, when the pest appears after hatching of eggs. A completely randomized design (CRD) with 8 treatments including 1 control was adopted with 3 replications. The effect of these practices (detailed below) were observed through counting the population of the 1st instar nymphs weekly from the trunk of trees in unit area, marked on the trunk of trees with chalk 0.46 m above the ground. Marked portion was repaired weekly after data. Percent reduction was calculated as:

$$\% \text{ reduction} = [\text{Average population in control } (m^{-2}) - \text{Average population in treatments } (m^{-2})] \times 100 / [\text{Average population } m^{-2} \text{ in control}]$$

Mechanical practices. Only *Haider's* band was applied. *Haider's* band consists of a plastic sheet and 4 cm grease. The trunk of the tree is plastered with mixture of mud and wet farm yard manure (1:1 ratio). It is pasted all around the trunk 26 cm in width from 0.46 to 0.62 m above the ground so that it provides an even and smooth surface for wrapping the plastic sheet, which does not allow the nymphs to crawl from underneath the band. Then plastic sheet is wrapped around the trunk on the surface pasted with mud mixture. It is tightened from the joining ends with three 1.75 cm iron nails (at upper, middle, lower ends of joint) with a hammer. After fully wrapping the plastic sheet a 4 cm grease band is applied in the middle portion of plastic sheet. This band was applied on the trunk of 3 trees in December-2006 to 3rd week of February 2007 to stop the upward movement of nymphs.

Chemical practices. Infested trees were sprayed once, only with Acetamiprid @ 100 g 100 L^{-1} of water against 1st instar in the 2nd week of February. The selected three trees were thoroughly sprayed with hand knapsack sprayer using 10-12 L of water treatment (3-4 L $tree^{-1}$). The chemical practice was used to kill the 1st instar nymphs.

Cultural practices. Cultural practices were used to collect the egg carrying female in mounds before spreading to hibernation places. For this purpose, a plastic sheet of 1.54 m in width and length according to the size of trunk were spread around the trunk of three trees to stop the entry of females in roots of host plant. Mounds were made on the plastic sheet around the trunk with the materials present under the tree like dried leaves, weeds, clods of mud, grass, debris and small dried branches up to 0.46 m high in the 1st week of April-2007. For direct falling females as well as those females, which were searching their hibernation places four other mounds of 0.46 × 0.46 m were made under the tree with the same materials in four different directions East, West, North and South away from 1.85–2.75 m of tree without plastic sheet. So each tree has 5 mounds. These mounds were spread at the end of June 2007 after hibernation of egg carrying females.

Mechanical x chemical practice. *Haiders* bands were applied on the trunk of 3 trees in December-2006 to 3rd week of February 2007 to stop the up-ward movements of 1st instar nymphs. The gathered nymphs below the band were sprayed once with insecticide Acetamiprid @ 100 g 100 L^{-1} of water in the 2nd week of February.

Cultural x mechanical practice. A plastic sheet of 1.54 m in width and length according to the size of trunk were spread around the trunk of three trees to stop the entry of females in to roots of host plant. Mounds were made on the plastic sheet around the trunk of three trees with the materials present under the tree like dried and fallen leaves, weeds, clods of mud, grass, debris and small dried branches up to 1.5 foot high in the 1st week of April-2006. For direct falling females as well as those females, which were searching their hibernation places four other mounds of 0.46 × 0.46 feet were made under the tree with the same materials in four different directions East, West, North and South away from 6-9 feet of tree without plastic sheet. So each tree has 5 mounds. These mound were spread at the end of June 2006 after hibernation of egg carrying females. In December-2006 to 3rd week of February 2007 *Haider's* bands were applied on the trunk of these trees to stop the nymphs below the band.

Cultural × chemical practice. Cultural practices were applied on the selected three trees in the 1st week of April, 2006 and these mounds were spread at the end of June 2006. These trees were sprayed thoroughly once with Acetamiprid @ 100 g 100 L^{-1} of water against 1st instar in the 2nd week of February 2007.

Cultural x mechanical x chemical practices. Cultural practices were applied in month of April 2006 and the mounds were spread at the end of June 2006 on the selected

Table I. Average number of females exposed along with eggs per 2.5 cm^2 area

Location of mango orchards in Multan	Under tree near trunk	Under leaves	Under the roots of plants	Soil under tree canopy	Sides of kacha water channel	Sides of kacha road	Mud wall around orchards	Cracks in tree
Chah Fazil wala	0.02	0.01	0.17	0.02	0.06	0.01	0.04	0.00
Basti Arian	0.01	0.02	0.12	0.01	0.03	0.01	0.06	0.00
Bhatay wala	0.03	0.03	0.08	0.00	0.03	0.01	0.03	0.00
Mouza Langrial	0.01	0.04	0.24	0.01	0.04	0.00	0.05	0.01
Mouza Langrial	0.04	0.01	0.07	0.00	0.02	0.02	0.03	0.00
Nawab pur	0.06	0.03	0.06	0.00	0.05	0.01	0.03	0.01
Adda Bosan	0.04	0.02	0.20	0.02	0.03	0.00	0.05	0.00
Basti Gujran	0.02	0.05	0.10	0.04	0.03	0.01	0.04	0.00
Qasim Bela	0.03	0.01	0.08	0.03	0.01	0.00	0.06	0.02
Saidan wali khoi	0.02	0.03	0.11	0.01	0.04	0.01	0.05	0.01
Average	0.03	0.03	0.12	0.01	0.03	0.01	0.04	0.01

Table II. IPM of mango mealy bug during, 2006-08

Treatments/practices	Population reduction (%) over control after treatment
Mechanical	45.23 g
Chemical	48.68 f
Cultural	70.58 e
Mechanical × Chemical	78.03 d
Cultural × Mechanical	81.32 c
Cultural × Chemical	87.70 b
Cultural × Mechanical × Chemical	98.46 a
Control	0.00 h
LSD @ 5%	1.05

three trees. In the month of December 2006 *Haider's* were applied. The nymph gathered below the band were sprayed once with chemical Acetamiprid @ 100 g 100 L^{-1} of water in the 2nd week of February.

RESULTS AND DISCUSSION

Mango mealybug after completing their life cycle come down the tree for hibernation and to lay eggs. Maximum females m^{-2} were exposed from the roots of their host plant (1.92 m^{-2}), these results are reflective of the natural phenomenon, that every females gives rise to its offspring's where plenty of food is available to their young ones where the young ones can easily find the host plant and food (Table I). If it finds the loose places near the trunk it prefers to enter into the roots of host plants. If the places are so hard, unable to enter in roots areas it will spread in whole orchard, where it finds some safe places like boundaries (mud) walls where the females exposed were 0.64 m^{-2}; the sides of kacha water channel where 0.48 females m^{-2} were found; near the trunk of host plant where 0.48 m^{-2} females were found. Whereas, under leaves, soil under the tree canopy, sides of kacha road and in cracks of trees low population was found to be 0.48, 0.16, 0.16 and 0.16 females m^{-2}, respectively.

The data regarding the percent reduction of mango mealybug in different treatments are given in Table II. The maximum reduction of mango mealybug was observed in those trees, where cultural methods+ mechanical + chemical were applied together resulted in maximum reduction of mango mealybug i.e., 98.46% followed by cultural + chemical, cultural +mechanical and mechanical + chemical with 87.70, 81.32 and 78.03% reduction of mango mealybug, respectively and showed significant difference with one another. The minimum reduction of mango mealybug was recorded to be 45.23% in the treatment where mechanical method was applied alone and also differed significantly from those of observed in all other treatments. From these results it was concluded that combination of cultural, mechanical, chemical methods of control showed good control of mango mealybug.

These finding agree with the findings of Bajwa and Gul (2000) who reported similar results on *Paulownia* spp attacked by mango mealybug. They managed this pest through destruction of eggs, banding of trees and application of insecticides together. Jia *et al.* (2001) found significant reduction of mango mealybug through integration of dusting of 25% parathion in micro capsules form or 5% phoxim on the ground before the soil freezes in winter, 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 for the control of nymphs of mealybug.

Ishaq *et al.* (2004) worked on the integrated management of mango mealybug and reported that this pest is difficult to control by water based insecticides. So for its management by using sticky bands along with burning and burying treatments significantly reduced the incidence of infestation by mango mealybug (0.00-15.79%). Gul *et al*. (1997) 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. Tandon and Verghese (1985) for the control of *Drosicha* spp. and *Rastrococcus iceryoides* are, exposure of eggs during summer, removal of weeds, conservation of natural enemies, application of alkathane bands and spray of neem seed extract 4% or garlic oil on trunk below band. Atwal (1963) reported that the pest could be controlled by destroying eggs laid under the infested trees; nymphs could be prevented from crawling up the trees by applying 8 cm wide sticky bands with grease material or slippery bands with alkathene or plastic sheets around the

trunk. Repeated applications are necessary after scrapping off the crust on the band.

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