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Genetic Resistance of Mango Mealy Bug against Sprayed Pesticides

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Abstract
Mango mealy bug being destructive pest of mango in Pakistan. This research was conducted to observe the resistance gained by this pest in recent era against commonly sprayed pesticides. The chemicals included, were bifenthrin, cypermethrin, triazophos; each pesticide with three different concentrations of low, medium and high as compared to control. Results showed that none of the concentration was found effective against mango mealy bug under laboratory conditions. When three pesticides along with their recommended dose, medium and higher were sprayed, insect's mortality was less in sprayed treatments as compared to control. These experiments explicitly revealed a threatening pest outbreak in mango eco-system. Further research should be carried out to understand its ongoing molecular process in insects to check its developed resistance.
Keywords: Mango mealy bug, insecticides, resistance, genetic resistance, mango.

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INTRODUCTION

Mango (*Mangifera indica* L.) belongs to family Anacardiaceae, is a fruit of great importance throughout the World, due to its aroma, flavor and nutritive value as it is a source of vitamin A and C. Generally referred as "Peach of Tropics", it was originated in South Asia and has been cultivated for 4000 years (Salunkhe and Desai, 1984). It has many benefits like protecting from soil erosion, medicinal uses, and act as an ornamental plant (d'Almeida, 1995). Globally, Mango has a large market like the USA stands at the top in the list of importers of Mango and other fruits. Besides the USA, Netherlands, China, Saudi Arabia, United Arab Emirates, also import mangoes.

Nature has gifted Pakistan with favorable conditions to produce various kinds of fruits, vegetables, and crops. Mango is known as the king of all fruits. Mango is the second-largest fruit crop in Pakistan following citrus. Pakistan is the fourth-largest producer of mangoes in the world (The Daily Records, 2017). In 2016 it supplied about 3.5% of the world's total mango production (FAO, 2018). Punjab and Sindh together produce about 98% of Pakistan's total mango with a share of 62% and 32% respectively are the major production provinces (Government of Pakistan. 2017).

Mango is attacked by more than 300 species of insect pests (Henderson and Tilton, 1955). But severe damage is caused by sucking pest which includes Mango Mealy Bug (*Drosicha mangiferae) and Mango Hopper (Idioscops nitidulus*). Both pest suck the cell sap from a tender portion, inflorescence and leaves, females lay eggs both nymph and adult causes damage which results in shriveling of inflorescence, they also secrete honeydew on which sooty mold grows which hindered the photosynthesis. Some ants protect mango mealybug from predators and parasitoids by feeding on honeydew secreted by them (Hussain *et al.,* 2012). Chemicals are considered an easy and effective way of controlling pests. Pakistan is spending 10 billion rupees on pesticides for this purpose (Aslam *et al.,* 2004).

Mango is attacked by more or less 260 species of Insects and Mites, which then further divided into fruit feeder 87, foliage feeder 127, inflorescence feeder 36, Bud inhibitor are 33 and 25 feed on trunk and branches, similarly, Mites (*Oligonychus* spp) and Scale insects are most destructive pest (Mohyuddin and Mahmood, 1993). Common insect pest of mango includes Mango aphid (*Toxoptera odinae),* Scale insect (*Coccus hesperidum*), Mango Fruit Fly (*Bactrocera dorsalis),* Mango nut weevil (*Sternochaetus mangiferae*), Mango Hopper (*Idioscopus nitidulus) and Mango Mealybug* (*Droschia mangiferae*) which suck the cell sap from a tender portion of the plant, resulting in shriveled leaves followed by dropping of fruits and so minimizing the yield. This pest also secretes Honeydew over which sooty mold grows which then inhibits the process of photosynthesis.

Different kinds of contact and systemic insecticides are sprayed over Mango from panicle emergence to fruit Harvest. For the effective control of Mango hopper, Imidacloprid is used (Samanta *et al.,* 2009) and is effective even at its low dose of 0.2ml/L (Verghese, 1999). Similarly, Insecticide from the carbamate group is used against sucking insects of Mango (Sucheta and Khokhar, 1996). Mango mealybug and fruit fly are difficult to control by using chemicals; their chemical control is nearly inefficient (Tandon and Lal., 1978). Polyethylene bands are effective against Mango mealybug (Yousuf, 1993).

Due to unnecessary and frequent use of pesticides, the insect pest gets immune to them, so these chemicals further cannot impose any stress on the population of the pest. Phenomena of pest resurgence and environmental pollution are also a resultant factor (Fishwick, 1988). Besides these two-mentioned factors, an elevation of minor pests to major pests is also a serious problem (Cunningham, 1984). Chlorpyrifos can control mealybug more efficiently than imidacloprid and Bifenthrin (Lanjar *et al.,* 2014). Host plant resistance can play a vital role in controlling resistance development in pest by suppressing the usage of lethal and sub-lethal doses of insecticide. This study was conducted to determine the resistance of mango mealybug against sprayed pesticides.

MATERIALS AND METHODS

Laboratory studies

This study was carried out in the Entomology Department of the University of Agriculture Faisalabad. Leaves were collected from the different portions of the same Mango plant, present in the Horticulture area of the University of Agriculture Faisalabad. The leaves chopped in equal size on a chopper board and kept in the Petri dishes; 100 in number, 30 for each treatment, and 10 for control at 25±2 ºC and 60±5% relative humidity. All the necessary measures were taken during the experiment.

Insecticides and their concentrations

We have used 3 insecticide treatments in this experiment; these were Arrivo (Cypermethrin), Trizone (Triazophos), and Bifenthrin. We have prepared 3 dilutions of 10µl, 20µl, and 30µl for each insecticide. Once leaves were chopped, these were treated by using the dipping method (Immaraju *et al.,* 1990).

Pesticides application for bioassay

Leaves were dipped in dilution of 10µl, 20µl, and 30µl for each insecticide respectively, and then after air-drying placed in Petri dishes containing a moistened filter paper. After that, we released mealy bug 1/petri dish and

cover it with lid. Then the data was noted at regular interval of 2.5 hours for 3 days.

Plot location and dimension

The experiment was laid under Completely Randomized Design (CRD) at a controlled condition.

Statistical analysis

The results from the experiment were entered in Microsoft Excel spreadsheet (Microsoft Corp., USA) and appropriate statistical analysis was performed using SPSS software.

RESULTS

Results of comparison of control with three levels of concentration of Arrivo (Cypermethrin) at the rate of 0.1, 0.2, and 0.3 at different nine stages of time are given in (Figure 1). It was observed that there were no significant differences (F= 4.90, df= 3, P= 0.0084).

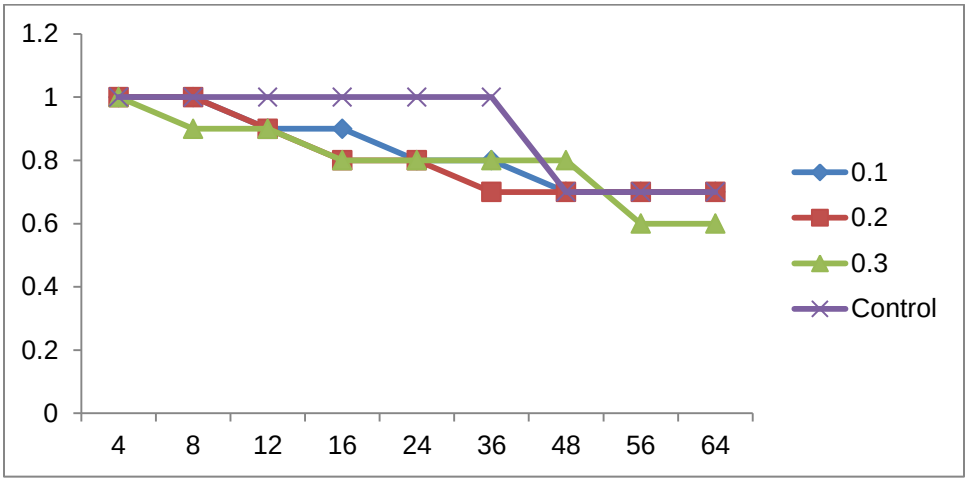

Fig. 1. Comparison of control with three levels of concentration of Arrivo.

Results of comparison of control with three levels of concentration of Trizone (Triazophos) at the rate of 0.1, 0.2, and 0.3 at different time intervals are given in (Figure 2). Significant differences were observed in our findings (F= 6, df= 3, P= 0.0033).

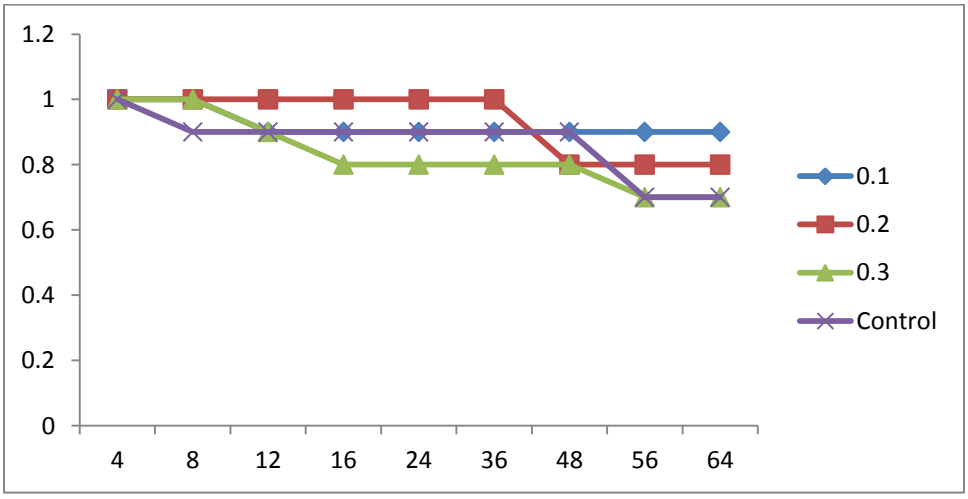

Fig. 2. Comparison of control with three levels of concentration of Trizone.

Results of comparison of control with three levels of concentration of Bifenthrin at the rate of 0.1, 0.2, and 0.3 at different time intervals are given in (Figure 3). Significant differences were observed in our findings (F= 7.29, df= 3, P= 0.0012).

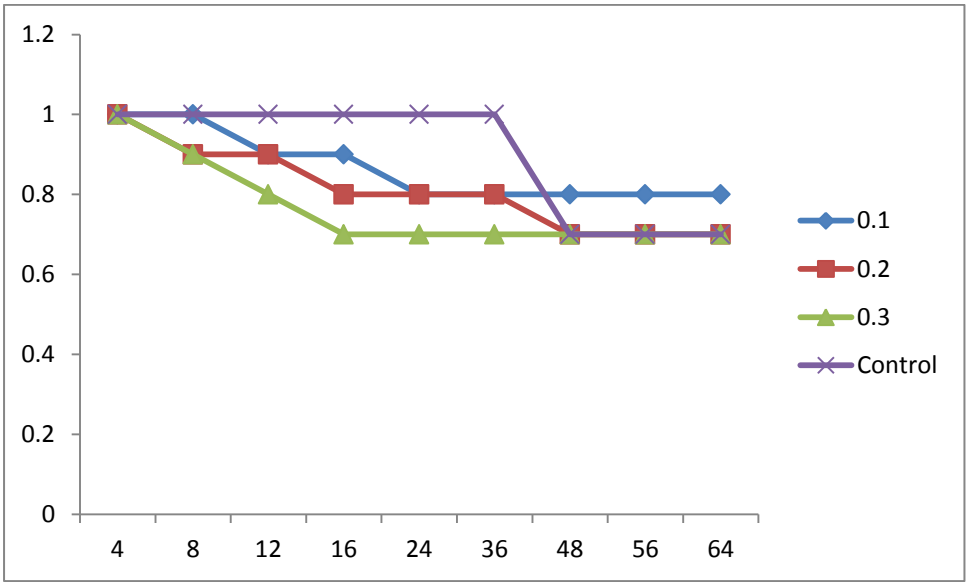

Fig. 3. Comparison of control with three levels of concentration of Bifenthrin.

DISCUSSION

It is worth discussing these interesting facts revealed by the results of the current experiment that Mango mealybug has developed resistance against the three above mentioned pesticides. Mostly treated Mealybugs were remained alive during three days of experiment against all the dilutions. Due to misuse or excessive use of the said insecticides in orchards by farmers or by non-professionals, insecticides were now useless in the case of mealybug. Results of our work agree to Ishaq et al. (2004) on integrated management of mango mealybug, according to him this pest is difficult to control by water-based insecticides. So, its management is effective if burning and burying or using Sticky bands which reduces the infestation of this pest up to 15%. Our findings were contrary to Saeed et al. (2007) who were successful to effectively control the *Drosicha mangiferae* with insecticides under Laboratory conditions. Our findings partly support the findings of Bokonon-Ganta et al. (2004) who said that all the producers used chemical method, Trimmed trees, used ash, burned tires under trees, fertilizer, and kerosene application did not control the pest at all in the field. Another study by Karar et al. (2010) reported that Chloropyrifos was not so effective against the adult female mealybug. It was revealed that using insecticides against this pest is not a good strategy to rely on, IPM techniques cause a considerable reduction in the population of mealybug as Karar et al. (2009) suggested that 98.46% control may be possible if chemical method along with the mechanical and cultural method is used.

Mango has its worth in all fruits due to its delicious taste. People from all over the world demand good quality mango that's why Pakistan is contributing a lot to full fill the demand but still, our exporters are not successful in achieving what they desire. According to an estimate, mango production would reach to 1431010 metric tons by 2024. This means that enough quantity will be available to export and for domestic use (Mustafa, 2003). But we are facing challenges of insect attacks and diseases, which deteriorate the quality of our produced and in severe cases leads to the whipped off orchards. Our results support a previous study that says, control of mango fruits pest alone with chemical is complicated due to resistance, pest resurgence, and elevation of minor pest to major pest (Cunningham, 1984).

The current study found the resistance in mealybug up to a notable level against Cypermethrin, Triazophos, and Bifenthrin in laboratory conditions. A previous study

documented that the control of mango pests was carried out by using chemicals like prophenophos, and combination of cotton+ buprofezin (Hussain *et al.,* 2012) along with other IPM strategies.

CONCLUSION

In conclusion, it was found that mango mealybug show mortality by the application of pesticides but less than expected at recommended doses. It means that there should be some precautionary measures taken to impair the further resistance development in these destructive bugs attacking mangoes.

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CONFLICT OF INTEREST

The authors declare that no there is no conflict of interest for this study.

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