

**DOSE RESPONSE BIOASSAY OF ACETAMIPRID AGAINST ADULTS OF PINK
HIBISCUS MEALYBUGS (*MACONELICOCCLUS HIRSUTUS*) UNDER
LABORATORY CONDITION**

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Abstract

The current study was investigated at the Department of Plant Protection, The University of Agriculture Peshawar during the year 2020 in a Randomized Complete Block Design (RCBD) with three replication. Aim of the study was to find out dose response bioassay of acetamiprid towards pink hibiscus mealybugs, (*Maconellicoccus hirsutus*) under laboratory condition. Three different concentrations 0.1%, 0.2% and 0.3% of acetamiprid was used in this experiment against the *M. hirsutus* using dip and spray method. In leaf dip method experiment, the results showed that maximum mortality (86.67%) was recorded at 0.3%, this was followed by 2 % with where 70% mortality was recorded after 72 hours. While at 0.1 % (50%) mortality was recorded. Similarly, while in case of spray maximum mortality of pink hibiscus mealybugs (78.57%) was recorded at dose rate 0.3% of acetamiprid followed by dose rate of 0.2 with (71.43%) while minimum mortality (50%) was observed at dose rate of 0.5%. The study revealed that 0.3% concentration of Acetamiprid was found effective against in both the dip and spray methods and can be used against in *M. Hirsutus* IPM program.

Keywords: Acetamiprid, *M. Hirsutus*, mealy bugs, IPM

Introduction

The mealybug, which was first reported in Pakistan in the early 1990s, has become a significant and serious pest affecting uncultivated, cultivated crops, and ornamental plants (Abbas *et al.*, 2010). With its wide range of biological attributes and environmental adaptability, the mealybug poses a serious threat to various types of vegetation and plants. Among the mealybug species, the pink hibiscus mealybug is particularly noteworthy, as it exhibits polyphagous feeding habits, with a preference for hibiscus plants (Williams, 1996). Like other scale insects, mealybugs display sexual dimorphism, with the wing-less neotenic females being the larger gender capable of continuous feeding and growth until mating. Unmated and overwintering mated females can survive for several months, and they lay their eggs either in a waxy covering (oviparity) or retain them in their reproductive tract until hatching (ovoviviparity). In contrast, adult males, if present, are delicate, short-lived insects that are easily overlooked in the field. Some species of mealybugs, such as *Saccharicoccus sacchari* (Cockerell), exhibit wing polymorphism, including wingless forms. The adult male undergoes sexual maturation and elongation of the "wax tail" within 1-2 days to be able to fly, respond to the sex pheromone emitted by virgin females, and mate (Mendel *et al.*, 2008; Silva *et al.*, 2009). The economic impact of pink hibiscus mealybugs (*M. hirsutus*) and its control measures are substantial, with estimated damages reaching around 700 million US dollars in the US and an overall estimation of 5 billion US dollars (Ranjan, 2006). Different researchers have used chemical insecticides and achieved promising results in reducing mealybug populations by testing them at various concentrations (Hussain *et al.*, 2012; Jhala *et al.*, 2010). The effectiveness of a wide range of chemicals, including carbonates, organophosphates, pyrethroids, insect growth regulators (IGRs), and neonicotinoids, has been assessed on pink hibiscus mealybugs in both field and laboratory bioassays (Jacobsen, 2002; Aida *et al.*, 2010; Castle *et al.*, 2011; Fatima *et al.*, 2016). Acetamiprid, when applied directly to pink hibiscus leaves or when the insects were exposed to it through direct contact, showed high toxicity against pink hibiscus mealybugs, particularly at higher concentrations. The effects of acetamiprid on insect development were found to be lethal and prolonged, although the impact may vary depending on the density and type of test insects (Nathan *et al.*, 2005; Khan *et al.*, 2013) investigated the effects of plant products and commercial

insecticides on sucking pests in cotton crops, observing that both acetamiprid and Datura Alba were highly effective, causing significant mortalities in populations of jassids, thrips, and whiteflies at different time intervals. The present studies were conducted to assess the activities of the different concentration of acetamiprid against adults of pink hibiscus mealybugs' using leaf dip method leaf spray method under laboratory condition.

Materials and Methods

Study Site

The study was conducted in Department of Plant Protection, October 2020 at the University of Agriculture Peshawar, Pakistan with the trend of higher mealybugs infestations during recent years on ornamental plantations.

Collection of Experimental Specimens

The samples of adult females of hibiscus mealybugs were collected from pink hibiscus at university of Peshawar.

To prepare various concentrations of insecticides, the desired volume of each insecticide formulation was measured and placed in a beaker. Water was added to the beaker to achieve a total volume of 100 ml. This process was repeated for all the insecticides, resulting in concentrations of 0.1%, 0.2%, and 0.3%. The method described by (Pal *et al.*, 1994) was followed to ensure the accurate preparation of different concentrations of insecticides.

Volume of insecticide (mL)=

$$\frac{\text{Total volume (L)} \times \text{Percentage of insecticide required}}{\text{Formulation of insecticide}} \times 100$$

Laboratory Procedure

Fresh, uninfested leaves from pink hibiscus plants were carefully collected and transported to the plant protection laboratory at the University of Agriculture Peshawar. Prior to treatment application, the leaves were thoroughly washed with distilled water and allowed to air-dry completely. For the experiment, twenty-four large Petri dishes were used as the experimental units. Each Petri dish contained leaves and 5 adult female mealybugs. The treatments were administered using both dipping and spraying methods, and the experimental units were maintained at a room temperature of 26-30°C. To prevent wilting of the leaf material during the bioassay periods, a slightly moistened cotton was placed in each Petri

dish. These procedures were followed in accordance with standard protocols in the field of plant protection research.

Exposure of Insecticide

Prior to their release into Petri dishes, the mealybugs were provided with fresh, uncontaminated leaves from the host plant for feeding. To assess the impact of insecticides on adult female mealybugs, a topical exposure procedure was employed by the researchers (Pal. *et al.*, 1994) was followed. This experience technique assisted controlling individual dosa (Tan. *et al.*, 2012) and prevented potential antifeedant effect of insecticides (Denseux *et al.*, 2006; Nauen *et al.*, 2003; Ramirez *et al.*, 2003).

Dip method

Three host plant leaves were plucked from tested plant species. Leaves were washed through tap water and then fully dried and were dip in the prepared solution of acetamiprid after dipping it was placed outside the petri dish for 20 mints to get dry. Petri dishes with 14 cm die were cleaned and put a white Whatman filter paper and proper moisture content applied. These shoots were placed in petri dish at equidistance manner. A circle was in the middle of the petri dish. When these plants fully settled then 30 number of mealybugs were put on the point/circle in middle of the petri dish gently.

Data Collection and Statistical Analysis

The mortality data, which was determined by observing the lack of movement in adult mealybugs when touched with a fine brush, was recorded at 24, 48, and 72 hours following the application of treatments. Probit analysis was employed to analyze the obtained data, allowing for a statistical evaluation of the mortality response.

Results and Discussion

Toxic effect of acetamiprid against *Pink Hibiscus* using leaf dip method

The results regarding efficacy of acetamiprid toxicity at various concentration levels against pink hibiscus mealybugs under laboratory condition using dip method has been showed in Table 1. Results revealed that maximum mortality of pink hibiscus mealy bugs (85.19%) was recorded at dose rate 0.3% of acetamiprid followed by dose rate of 0.2% with (66.67%) while minimum mortality (44.44%) were observed at dose rate of 0.5%.

Toxic effect of acetamiprid against Pink Hibiscus using leaf spray method

The results regarding efficacy of acetamiprid toxicity at various concentration levels against pink hibiscus mealybugs under laboratory condition using dip method has been showed in table 4.2. Results revealed that maximum mortality of pink hibiscus mealybugs (78.57%) was recorded at dose rate 0.3% of acetamiprid followed by dose rate of 0.2 with (71.43%) while minimum mortality (50%) were observed at dose rate of 0.5%. Similar results were obtained by (Rashid *et al.*, 2012) who reported that the impact of these chemicals on insect pests is detrimental, causing toxicity and impeding their growth. The extent of these effects is influenced by the concentration of the product and the specific species of insect. Similarly, while the results regarding efficacy of acetamiprid toxicity at various concentration levels against pink hibiscus mealybugs by using spray method. Results revealed that maximum mortality of pink hibiscus mealybugs (78.57%) was recorded at dose rate 0.3% of acetamiprid followed by dose rate of 0.2% with (71.43%) while minimum mortality (50%) were observed at dose rate of 0.5%. These results are in line with (Fatima *et al.*, 2016) who reported that Out of all the treatments tested with varying concentrations and durations of exposure, acetamiprid proved to be the most efficient insecticide for effectively managing mealybugs.

Table 1: Toxicity effect of different doses of acetamiprid against adult Pink Hibiscus mealybugs under laboratory conditions using leaf dip method.

Dose (%) of acetamiprid	Sample size	Mortality	Corrected Mortality	Probit
0.1	30	50	44.44	4.861
0.2	30	70	66.67	5.43
0.3	30	86.67	85.19	6.044

Table 2: Toxicity effect of different doses of acetamiprid against adult Pink Hibiscus mealybugs under laboratory conditions using leaf spray method.

Dose (%) of acetamiprid	Sample size	Mortality	Corrected Mortality	Probit
0.1	30	53.33	50	5
0.2	30	73.33	71.43	5.566
0.3	30	80	78.57	5.791

Dose response bioassay of acetamiprid against *M. hirsutus* using leaf dip method.

Figure 1 shows that the mortality of mealybugs on different doses of acetamiprid at different time intervals. In figure the x-axis showed the level of doses and y-axis represent the mortality rate of mealybug. The results showed that when the dose rate of acetamiprid increases, the mortality of *M. Hirsutus*. also increases. The highest mortality 6.044 was recorded at dose rate of (0.3%) while the lowest mortality (4.861%) was recorded at 0.1% dose rate. The study reaffirmed and validated the findings reported by (Nikam *et al.*, 2010), which highlighted the impact of Advantage on the mortality of mealybugs under varying concentrations in laboratory condition.

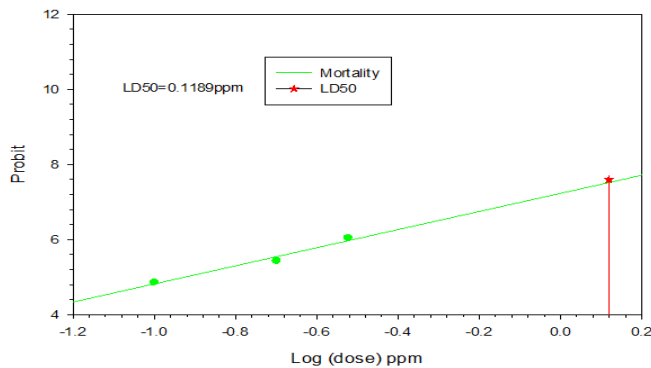


Figure: 1 Dose response bioassay of acetamiprid against *M. hirsutus* under laboratory condition using leaf dip method

Dose response bioassay of acetamiprid against *M. hirsutus* using leaf spray method

Figure 2 shows that the mortality of mealybugs on different doses of acetamiprid at different time intervals. In figure the x-axis showed the level of doses and y-axis represent the mortality rate of mealy bug. The results showed that when the dose rate of acetamiprid increases, the mortality of *M. Hirsutus* also increases. The highest mortality 5.791 was recorded at dose rate of (0.3%) while the lowest mortality (5%) was recorded at 0.1% dose rate. Our results are according to Raymond and Dickinson (2006), the insecticides acetamiprid, dinotefuran, and clothianidin exhibited significant effectiveness by causing over 80% mortality in adult *Leptomastix dactylopii* (Hymenoptera: Encyrtidae), a parasitoid that preys on the pseudococcidae species *Planococcus citri*.

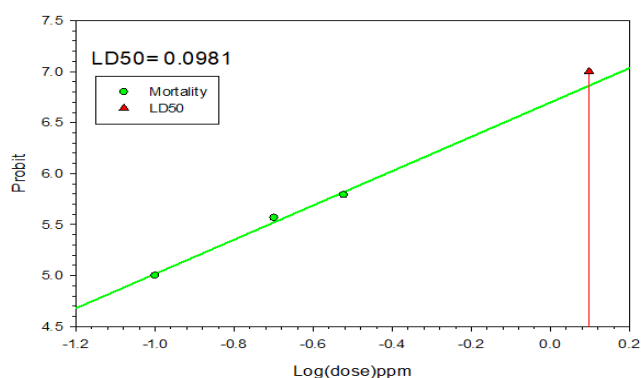


Figure 2: Dose response bioassay of acetamiprid against *M. hirsutus* under laboratory condition using leaf spray method.

Conclusion

This study concluded the dose-response efficacy of acetamiprid against pink hibiscus mealybugs (*Maconellicoccus hirsutus*) under laboratory conditions using a dip and spray application method. Results concluded that acetamiprid was most effective at a concentration of 0.3%, with mortality rates of 86.67% and 78.57% for the dip and spray methods, respectively. Mortality rates decreased with lower concentrations of acetamiprid, with only 50% mortality observed at 0.1% concentration. These findings suggest that acetamiprid can be an effective tool for controlling pink hibiscus mealybugs in both the dip and spray methods. Further research is needed to evaluate the efficacy of acetamiprid under field conditions, as well as its potential impact on non-target organisms.

Conflict of Interest

All authors have declared that there is no conflict of interests regarding the publication of this article.

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