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Research Article

Efficacy of different insecticides against cotton mealy bug *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae) in ecological zone of Rahim Yar Khan.

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Abstract

A field experiment was conducted during summer seasons 2012 and 2013 to determine the efficacy of different insecticides against cotton mealy bug (*Phenacoccus solenopsis*) at Adaptive Research Farm Rahim Yar Khan. Five different insecticides prophenophos 50EC @2000ml/ha, carbosulfan 20EC @1250ml/ha, Imidacloprid 20SL @625ml/ha, malathion 57EC @1250ml/ha and Dimethoate 40EC @625ml/ha were evaluated in a three replicated RCBD method including an unchecked. Before application of insecticides, the pre treatment observations were taken on mealy bug, while post- treatment observations on mealy bug were taken after 3rd, 5th and 7th days of application of insecticides. However, prophenophos 50EC (97.15%) showed its effectiveness up to 7th day of the spray. While, imidacloprid 20SL (91.9%) and dimethoate 40EC (85%) was next to prophenophos. This attained its effectiveness up to 7th day after application. Least controlled was observed when applied carbosulfan 20EC (75.5%) and malathion 57EC (58%).

Keywords: Cotton, *P. solenopsis*, insecticides, RCBD.

Introduction

Cotton (*Gossypium hirsutum* L.) is known as the "white gold" of Pakistan. It is the most important and economy dependent crop of Pakistan (Hakim et al. 2011). Cotton (Family Malvaceae), is important fiber crop in the world. It is a perennial semi-shrub grown as an annual crop in both tropical and warm temperate regions. In textile manufacturing, it produces seeds with a potential multi product base such as hulls, oil, lint and food for animals (Ozyigit et al 2007). It contributes a huge share in the foreign exchange earnings of the country (Ahmad et al. 2011). In cotton, the insect pests' infestation caused deterioration in lint quality and 10–40% losses in crop production (Gahukar, 2006). Among 1326 species of insects that attack cotton (Hargreaves, 1948) throughout the world. Mealy bug has never been reported from cotton in Pakistan until 2005 when for the first time *Phenacoccus solenopsis* Tinsley was recorded from Vehari Punjab. This insect alone was held responsible for the loss of 0.2 million bales (bale weighs 375 lbs or 170 kg) in 2007 in Pakistan as reported by (Muhammad, 2007). Mahmood et al (2011) reviewed its world distribution. According to them it is a new world species and has recently entered a number of countries in Asia and Australia. They reported that this insect is widespread on the plains of Pakistan.

The estimated yield losses in cotton due to mealybug were around 12% in 2006 and almost 40% in 2007 in the Punjab province (Kakakhel, 2007). The mealy bug on different plants has been reported by Arif, et al. (2009) who reported the indene of mealy bug *P. solenopsis* on about 154 plants but was most abundant on cotton. Mealy bug, besides cotton is devastating to many other economic crops such as; vegetables, ornamental plants and has been reported infesting 149 plant species (Afzal et al., 2009). Mealy bugs feed on phloem tissues, suck plant sap and cause leaves to distort. The leaves become yellow and dropped off and severely affected plants may die. This insect also produces honey dew resulting in sooty mold growth which hinders photosynthesis process (Saeed et al, 2007). Ants and wasps feeding on honey dew may deter biological control agents (Cudjoe et al, 1993). Biological control of mealy bugs has been practiced in different parts of the world, particularly on fruits like citrus and avocado. Certain native and introduced parasitoids have provided good control (Bartlett and Clancy, 1972). If population is low, thumb and fore finger trick works well along with dabbing each mealy bug with alcohol (Anonymous, 2006). However, mealy bug outbreaks require the use of insecticides due to its rapid growth as compared to predators and parasitoids (Bartlett and Clancy, 1972). Buprofezin reduced nymphal and adult population of bunch infestation (Muthukrishnan et al 2005). Insect growth regulators and nicotine based insecticides proved as good alternatives in some vineyards (Danne et al, 2006). Chemical control measures include petroleum spray, oils and soap sprays (JainHua, 2003). So use of chemicals is an essential part of integrated pest management in crop protection measures (Mohyuddin et al 1997).

Neonicotinoids are among the most effective insecticides for the control of sucking insect pests. The insecticide, imidacloprid was the first insecticide of this class released in 1991 (Elbert et al., 2008) and is effective against a number of insect pests. Imidacloprid has been found efficient against *Planococcus sp*. and other mealy bug species in grapevines (Elbert and Nauen, 2004). Profenophos has been reported one of the effective insecticides against *P. solenopsis* (Dhawan et al. 2009; Bhosle et al. 2009; Aheer et al., 2009). Saeed et al, 2007 reported that Curacron 50 EC (profenofos) @ 1976 ml, Supracide 40 EC (methidathion) @ 1235 ml, and Lorsban 40 EC (chlorpyrifos) @ 2470 ml per hectare under field conditions provided effective control of *P. solenopsis* in cotton upto 7 days after application. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012). Chemical control, being rapid method of pest control, is an important practice of integrated pest management (IPM) program to overcome losses caused by insect pest to crop (Mohyuddin *et al.,* 1997 and Gogi et al. 2006). Due to reduced use of insecticides the incidence of mealy bug and dusky cotton bugs is higher these days, however as reported by Rajanikantha (2004) no variation between Bt and non-Bt cotton hybrids. Keeping in view the economic importance and pest status of mealy bug and environmental hazards imposed by nonselective synthetic insecticides, these studies were conducted to evaluate and screen out the most effective selective synthetic insecticide for management of mealy bug on cotton crop.

Materials and Methods

The experiment was conducted at Adaptive Research Farm Rahim Yar khan during 2012 and 2013 against cotton mealy bug *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae) to test the efficacy of five insecticides viz. prophenophos 50EC @2000ml/ha, carbosulfan 20EC @1250ml/ha, Imidacloprid 20SL @625ml/ha, malathion 57EC @1250ml/ha and Dimethoate 40EC @625ml/ha on cotton variety, MNH-886. The experiment was laid out in Randomized Complete Block Design (RCBD). The insecticides used in the present experiment were obtained from the local market and were sprayed at field recommended doses when the population of pest reached the Economic Threshold Level (ETL). The ETL for the dusky cotton bug was considered as on appearance/attack. There were 6 treatments including control, having 3 repeats. The plot size was kept as 20 ft x 34 ft. The plant inspection method was used for sampling the pest population. The field recommended doses of the insecticides as presented in Table 1 were sprayed with hand operated knapsack sprayer having 20 liters capacity fitted with hollow cone nozzle. The control plot remained un sprayed. The sprayer was calibrated using simple water by calculating the amount of water required for spraying on a unit area prior to experiment. All agronomic practices like irrigation, fertilizer applications etc. were kept uniform throughout the experiment on all plots. Ten plants were selected, at random, per treatment/plot for recording pest population early in the morning. Ten top and middle stem portions (15 cm for each)

including leaves were examined for the presence of mealy bug from each plot. To study the efficacy of different insecticides as mentioned in (Table 1), population of cotton mealy bug was recorded by the same method a day before spray and 3rd, 5th and 7th days after treatment. Crop was kept free from weeds. Mortality of pest was calculated with following formula:

$$\text{Percent mortality} = \frac{A-B}{A} \times 100$$

Where A = population of cotton mealy bug in control plot

B = post treatment population of cotton mealy bug in each treatment

Data were analyzed statistically with M-stat package and means were compared by DMR test at 5 percent probability level.

Table 1. Different insecticides used against cotton mealy bug *Phenacoccus solenopsis* with respective doses per hectare.

S. #	Insecticides with formulation	Dose (ml or gm/ha)
1	Prophenophos 50EC	2000
2	Carbosulfan 20EC	1250
3	Imadicloprid 20 SL	625
4	malathion 57EC	1250
5	Dimethoate 40EC	625
6	Control	

Results and Discussion

Insecticides (Table 1) were sprayed in recommended doses when the population of cotton mealy bug reached economic threshold level (ETL). Insecticides were dissolved in water to prepare insecticide solutions on vol. / vol. and Wt. / Vol. basis. The crop was sprayed in the morning before 10 a. m. The population of insect pests was recorded 3rd, 5th and 7th days after application of insecticides. The data on pest population were analyzed by using Fisher's analysis of variance technique and LSD test at 0.05 probability level was employed to compare the differences among the treatments mean (Steel *at al*., 1997). The effectiveness of various insecticides was considered to be an indirect reflection of pest population in various treatments i.e. lower population of insect pests would represent higher toxicity and vice versa.

The population of cotton mealy bug was significantly lower ($P<0.05$) in insecticides treated plots as showed in (Table 2). All tested insecticides (Table 1) caused significant mortality in population of cotton mealy bug even 7 days after spray. Prophenophos was statistically highly effective with mortality in cotton mealy bug population as 92 and 97% even 5th and 7th days of treatment during 2012 followed by Imadicloprid and Dimethoate that caused a mortality in population of (85.3 and 90.8) and (77 and 82) after 5th and 7th days of treatment. Imidacloprid has been found efficient against *Planococcus sp*. and other mealy bug species in grapevines (Elbert and Nauen, 2004). In case of carbosulfan the mortality in population as 69 and 77% after 5th and 7th days of treatment. Then in case of malathion the population mortality was 53 and 63% after 5th and 7th days of treatment as described in table 2. Similar results were reported by (Aheer, et al. 2009) who also mentioned that all tested insecticides proved significantly effective against mealy bug up to 7 days after treatment.

Prophenophos and Imadicloprid proved to be the best products 5th and 7th days after application of insecticides. Profenophos has been reported one of the effective insecticides against *P. solenopsis* as reported by (Dhawan et al. 2009; Bhosle et al. 2009; Aheer et al., 2009).

Table 2. Mean percent population mortality of cotton mealy bug after application of different insecticides on cotton during 2012.

Treatments	Dose/ha (g,ml)	Post treatment average population/plant			Mortality (%)		
		3rd day	5th day	7th day	3rd day	5th day	7th day
Prophenophos 50EC	2000	16	9.6	4.2	84.6	92	97
Carbosulfan 20EC	1250	42	37	33	60	69	77
Imadicloprid 20 SL	625	25	17.8	13.2	76	85.3	90.8
malathion 57EC	1250	62	57	53	41	53	63
Dimethoate 40EC	625	30	27	25	71	77	82
Control		105.2	121.6	143.5	-	-	-

Each value is a mean of three replications. Means sharing similar letters in columns are not significantly different by DMR test (P=0.05)

It is evident from the (Table 3) that insecticides were found to be effective in controlling population of cotton mealy bug during 2013 under field conditions. All tested insecticides (Table 1) caused significant mortality in population of cotton mealy bug even 7 days after spray. Prophenophos was statistically highly effective with mortality in cotton mealy bug population as 93.7 and 97.3% even 5th and 7th days of treatment during 2013 followed by Imadicloprid and Dimethoate that caused a mortality in population of (90 and 93) and (81.3 and 88) after 5th and 7th days of treatment. In case of carbosulfan the mortality in population as 63 and 74% after 5th and 7th days of treatment. Then in case of malathion the population mortality was 45 and 53% after 5th and 7th days of treatment as described in table 3. Prophenophos proved to be the best products 5th and 7th days after application of insecticides. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012). Saeed et al, 2007 reported that Curacron 50 EC (profenofos) @ 1976 ml, Supracide 40 EC (methidathion) @ 1235 ml, and Lorsban 40 EC (chlorpyrifos) @ 2470 ml per hectare under field conditions provided effective control of *P. solenopsis* in cotton up to 7 days after application.

Table 3. Mean percent population mortality of cotton mealy bug after application of different insecticides on cotton during 2013.

Treatments	Dose/ha (g,ml)	Post treatment average population/plant			Mortality (%)		
		3rd day	5th day	7th day	3rd day	5th day	7th day
Prophenophos 50EC	2000	14.5	7.0	3.2	85.5	93.7	97.3
Carbosulfan 20EC	1250	46	41.2	31.5	54	63	74
Imadicloprid 20 SL	625	23	11	7.5	77	90	93
malathion 57EC	1250	72	61	56	28	45	53
Dimethoate 40EC	625	35	21	14.2	65	81.3	88
Control		100.2	112.5	121.3	-	-	-

Each value is a mean of three replications. Means sharing similar letters in columns are not significantly different by DMR test (P=0.05)

Mealy bug snaps during experiment:






Conclusion

It is concluded from the research trial that all the insecticides proved to be effective for controlling cotton mealy bug but prophenophos 50EC @2000ml/ha proved to be more effective against cotton mealy bug followed by Imadicloprid and Dimethoate.

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