

Bio-efficacy of some insecticides against cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae)

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Abstract— Laboratory bioassay of eight insecticides namely Chlorpyrifos 20 EC, Ethiprole+ imidacloprid 80 WG, Pymetrozine 50 WP, Lamda cyhalothrin 4.9 CS, Imidacloprid 30.5 SC, Acephate 95 SG, Thiacloprid 240 SC and Fipronil 5 SC was done against cotton mealybug, *Phenacoccus solenopsis* Tinsley. Among insecticides, Lamda cyhalothrin 4.9 CS was the most toxic with the lowest LD₅₀ 16.03 ppm followed by Chlorpyrifos 20 EC (LD₅₀ 27.56 ppm), Ethiprole+ imidacloprid 80 WG (LD₅₀ 44.82 ppm), Imidacloprid 30.5 SC (LD₅₀ 80.68 ppm), Thiacloprid 240 SC (LD₅₀ 87.13 ppm), Pymetrozine 50 WP (LD₅₀ 181.45 ppm), Acephate 95 SG (LD₅₀ 359.61 ppm), Fipronil 5 SC (LD₅₀ 705.59 ppm).

Keywords— Bioassay, Lamda cyhalothrin 4.9 CS, insecticides, cotton mealybug, LD₅₀.

I. INTRODUCTION

Phenacoccus solenopsis was initially described by Tinsley [12] from specimens infesting the roots and stems of *Boerhavia spicata* and *Kallstroemia californica* within the nests of ants, *Solenopsis geminata*, in New Mexico, USA. It is a bisexual species and completed many generation in a year. Adult females are about 2 to 5 mm long and 2 to 4 mm wide. They are covered with a powdery, waxy secretion with six pairs of transverse, dark bands that are located across the pro- to meta-thoracic segments. A series of waxy filaments extend from around the margin of the body with the pair of terminal filaments longest. The ovisac is composed of fluffy, loose-textured wax strands [4]. They are polyphagous in nature and infest more than 154 plant species of 53 families comprising 20 field and horticultural crops, 45 ornamentals, 64 weeds and 25 bushes and trees [1, 2]. The insect weakens the plants by sucking the sap from leaves, twigs, stems, and sometimes from the roots and also from fruiting bodies. Later, the entire plants become stunted and shoot tips develop a bushy appearance and ultimately

causing havoc loss of the farmers. Due to their short life cycle they are capable to increase their numbers and spread rapidly within very short span of time in favourable environmental condition. For this, other control measures except chemical control is time consuming. So, chemical control is the last resort to check the mealybug population within short period of time. Keeping in view, the present study aims to evaluate the efficacy of certain new and conventional insecticides against this pest in order to monitoring insecticide resistance and to identify the potential molecules for developing proper management strategy against this pest.

II. MATERIALS AND METHODS

The present experiment was conducted in the Regional Research and Technology Transfer Station (OUAT), Chiplitima, Sambalpur, Odisha during February-March, 2016.

Source of the insecticides

Commercial formulations of Chlorpyrifos 20 EC (Sumitomo Chemical India Pvt. Ltd.), Ethiprole+ imidacloprid 80 WG (Bayer Crop Science Ltd), Pymetrozine 50 WP (Syngenta Korea Ltd.), Lamda cyhalothrin 4.9 CS (Safex Chemicals [India] Ltd.), Imidacloprid 30.5 SC (Coromandel Agrico Pvt. Ltd.), Acephate 95 SG (Rallis India Ltd.), Thiacloprid 240 SC (Bayer India Ltd.) and Fipronil 5 SC (Makhteshim- Agan India Pvt. Ltd.) were obtained from respective principal manufactures. The proprietary products were used to prepare stock solution in distilled water from which further concentrations were prepared subsequently by serial dilution (six to eight different concentrations were used for bioassay). Each treatment including untreated control was replicated thrice.

Bioassay test

Leaf dip method

Laboratory bioassay was done by leaf dip method [6, 9], unsprayed chrysanthemum leaves were taken and after washed in fresh water those leaf discs were dipped in the test solutions for 5 minutes with gentle agitation. Then they were placed on tissue papers for drying. On drying, these were placed in petri dish and petioles of the leaves were wrapped by water-soaked cotton. On each leaf disc, 20 mealybugs (3rd instar) taken from unsprayed chrysanthemum plants were placed with a fine camel hair brush and the test containers were covered with lid.

Data analysis

The responses (mortality) of mealybugs were recorded after 24 hours post-exposure period. The mortality data were subjected to log-dose probit analysis to generate estimates of a lethal concentration. Probit analysis and lethal concentrations were calculated according to Finney's method by using Polo plus software. This type of bioassay provides an exposure that is more similar that the insects would experience under field conditions.

III. RESULTS AND DISCUSSION

The LD₅₀ values obtained from probit analysis for mortality values after 24 hours of each insecticide applied are given in the table 1. According to the results of probit analysis of different tested insecticides, it is found that Lamda cyhalothrin 4.9 CS was the most toxic with the lowest LD₅₀ 16.03 ppm to mealybug, *P. solenopsis* followed by Chlorpyrifos 20 EC (LD₅₀ 27.56 ppm), Ethiprole+ imidacloprid 80 WG (LD₅₀ 44.82 ppm), Imidacloprid 30.5 SC (LD₅₀ 80.68 ppm), Thiacloprid 240 SC (LD₅₀ 87.13 ppm), Pymetrozine 50 WP (LD₅₀ 181.45 ppm), Acephate 95 SG (LD₅₀ 359.61 ppm), Fipronil 5 SC (LD₅₀ 705.59 ppm). As Fipronil 5 SC has the highest LD₅₀ value that refers it is the least effective among all tested insecticides against *P. solenopsis*. Qiao-li *et al.*, [8] studied the relative toxicity of some insecticides against 3rd instar nymphs of cotton mealybug with leaf dipping method and found that after 24 hours of treatment, relative toxicity of some insecticides from high to low was lambda-cyhalothrin, profenofos, chlorpyrifos, avermectins, phoxim, carbosulfan, spinosad, chlorfenapyr, beta cypermethrin, methomyl, emamectin benzoate, triazophos, petroleum oil, and rotenone respectively. Seni and Sahoo, [10] studied the bio-efficacy of some insecticides against papaya mealybug, *Paracoccus marginatus* and observed that after 24 hours, Chlorpyrifos 20 EC (LC₅₀ 21 µl/l) and Thiamethoxam 25 WG (LD₅₀ 44 mg/l) were the most toxic and Buprofezin 25 SC (LC₅₀ 1000 µl/l) was the least toxic among the insecticides tested in bioassay test (Potato dip method) and in case of field

trials, Thiamethoxam 25 WG, Spirotetramat 240 EC, Imidacloprid 17.8 SL, Dimethoate 30 EC, Lamda-cyhalothrin 5 EC and Buprofezin 25 SC were found effective for management of the papaya mealybug. Tanwar *et al.*, [11] reported that chlorpyrifos was effective against mealybug both in laboratory bioassay and in the field. Nagrare *et al.*, [7] tested some insecticides against *P. solenopsis* under the laboratory conditions and observed the better efficacy of chlorpyrifos followed by triazophos, diclorvos, endosulfan and spinosad. Banu *et al.*, [3] also found effectiveness of chlorpyrifos against *P. solenopsis* and *Paracoccus marginatus* in laboratory condition. Mandal *et al.*, [5] conducted laboratory bioassay to determine the relative toxicity of some insecticides against 3rd instar nymphs of cotton mealybug, *P. solenopsis* and found that after 24 hours of exposure, chlorpyrifos 20 EC was most effective followed by followed by dichlorvos 75 EC, triazophos 40 EC and spinosad 45 SC. Seni and Naik, [9] studied the Laboratory bioassay of eight insecticides at Chiplima, Odisha against mustard aphid, *Lipaphis erysimi* (Kalt.) using leaf dip method in 2016 and found that among insecticides, chlorpyrifos 20 EC was the most toxic (LD₅₀ 5.38 ppm) followed by imidacloprid 30.5 SC (LD₅₀ 22.14 ppm), ethiprole+ imidacloprid 80 WG (LD₅₀ 22.94 ppm), thiacloprid 240 SC (LD₅₀ 27.17 ppm), pymetrozine 50 WP (LD₅₀ 25.59 ppm), lamda cyhalothrin 4.9 CS (LD₅₀ 31.34 ppm), acephate 95 SG (LD₅₀ 111.22 ppm), fipronil 5 SC (LD₅₀ 234.15 ppm). The value obtain from this experiment can be used in future for monitoring surveys or for the immediate purpose of comparing the current results to that of a previously determined LD₅₀ to determine the susceptibility of the target insects has shifted or not. The LD₅₀s can also be used to examine seasonal changes in insecticide susceptibility or compare responses among species or insecticide [6].

IV. CONCLUSION

Thus, the present study revealed that among all the tested chemicals Lamda cyhalothrin 4.9 CS, Chlorpyrifos 20 EC, Ethiprole+ imidacloprid 80 WG, Imidacloprid 30.5 SC, Thiacloprid 240 SC may be recommended for effective management of cotton mealybug, *P. solenopsis* and the value of LD₅₀ of different insecticide against cotton mealybug be used in future for monitoring of any resistance development in cotton mealybug.

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Table.1: Dosage mortality response and LD₅₀ values of different insecticides for *Phenacoccus solenopsis* after 24 hours of exposure

Insecticide	Heterogeneity	Slope	LD ₅₀ (ppm)	Fiducial limits	Relative toxicity
Chlorpyrifos 20 EC	0.68	3.621± 0.579	27.56	22.025- 34.793	25.60
Ethiprole+ imidacloprid 80 WG	1.03	3.466± 0.548	44.82	31.742- 64.481	15.74
Pymetrozine 50 WP	0.78	3.131± 0.494	181.45	142.584- 234.989	3.89
Lamda cyhalothrin 4.9 CS	0.64	3.076± 0.564	16.03	11.969- 20.566	44.02
Imidacloprid 30.5 SC	0.15	3.887± 0.634	80.68	64.731-100.367	8.74
Acephate 95 SG	1.46	2.917± 0.472	359.61	227.687-645.910	1.96
Thiacloprid 240 SC	0.85	3.582± 0.606	87.13	68.415- 109.113	8.10
Fipronil 5 SC	0.16	4.491± 0.791	705.59	572.615- 866.168	1

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