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INSECTICIDE AND PAPAYA LEAF EXTRACT TOXICITY TO MUSTARD APHID (*LIPAPHIS ERYSIMI* KAL.)

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ABSTRACT

Different insecticides and papaya leaf extract were studied for their toxicity and insecticidal activity to mustard aphid (*Lipaphis erysimi*). The insecticide Lambda-Cyhalothrin showed higher toxicity with LC_{50} value 0.57 ppm, followed by Abamectin, Imidalcoprid, Acetmiprid, Chlorpyrifos and Bifenthrin with 0.63, 0.67, 0.82 and 2.0 ppm, respectively. Insecticide resistance was not found in the aphid. Papaya extract showed a good insecticidal activity with LC_{50} value 87.0 ppm.

Keywords: *Liphis erysim, Mustard aphid, Carica papaya, Insecticides.*

INTRODUCTION

Mustard aphid, *Lipaphis erysimi* Kalt., (Homoptera: Aphididae), is one of the important insect pest of various mustard (Rapeseed) plants. It causes crop losses through phloem feeding and transmission of plant pathogens; Mustard oil crops are favorite hosts of mustard aphid. Infested plants limit their flowering, growth and even die (Singhvi, 1973). Insecticides are sudden remedy to economic losses in developing countries like Pakistan (Razaq, 2011; Liu, 2002). World without pesticides would loss 78% of fruits, 54% of vegetables and 32% of cereal crops (Cai, 2009). Pesticides are notorious for hazardous impact on human health and environment. Therefore, the health concerns demand food free from synthetic insecticide. Organic farming copes with alternative to insecticides by using pest and disease resistant varieties, bio-pesticides, cultural practices, and judicial use of insecticides or altogether (Aktar, 2010). Development of pest resistance to pesticides has forced the farmers to use extensive doses of insecticide, which is world-wide concern in term of pesticide residue, pest resistance (Pimental, 1992; Gopal, 2001). Since, plant extracts, oils and other derivatives (botanicals) are studied for insecticidal activity. Especially the papaya seed extract known to insecticidal properties. An insecticidal compound 'Papain' has also been reported from papaya (Konno, 2003). During present study the insecticides were assessed for their toxicity to mustard aphid (Table 1) and compared with earlier reports. Papaya acetic acid extract was also studied for the insecticidal activity.

MATERIALS AND METHODS

Mustard aphids were reared on potted mustard plant in a screen-house. Five aphids were transferred with a brush to each bioassay chamber containing thin, surface sterilized leaf with 0.01% sodium hypochlorite. The leaf midrib was covered with sterilized moistened cotton (Fig. 1). C. papaya leaves collected from the field located at the back yard to Department of Agriculture & Agribusiness Management, University of Karachi. The leaves were washed thoroughly with sterilized water and placed in a tray for 15 days for air-drying. The leaves were then ground in mortar and pestle to fine powder. Five gram leaf powder added to 100 ml acetic acid and left for 15 days to dissolve completely. The suspension then filtered through sterilized filter paper. The filtrate was kept in vent chamber at 25 °C till the solvent was dried. Known quantity of the dried extracted matter was dissolved in water to get solutions having 100, 200, 400 and 800 ppm concentrations by using dilution equation. Six chemical insecticides were assessed for toxicity to L. erysimi (Table 1). Insecticide concentration was made up from 0.1, 0.4, 0.7, 1.0, 1.3, 1.6, 1.9, 2.2, 2.5 to 2.8 ppm in water solution. One ml of each insecticide or leaf extract concentration was sprayed on mustard aphid population on leaf in the bioassay chambers. Extract or insecticide free water solution was sprayed on aphid population in bioassay chambers as control with 5 replicates.

Table 1. Description of insecticides used during the study

Insecticide	Trade name and concentration	Group
Abamectin	Cure 1.8 EC	FermentationProducts
Acetamiprid	Vimix 20EC	Neonicotinoid
Bifenthrin	Talstar 10EC	Pyrethroid
Chlorpyrifos	Lorsban 40EC	Organophosphate
Imidacloprid	Crown 200SL	Neonicotinoid
Lambda-Cyhalothrin	Karate 2.5EC	Pyrethroid

The bioassay chambers incubated at room temperature and number of living and dead insects was observed after 24 hours of application. Percents mortality was calculated by using Abbott's formula (Abbott, 1925). The Probit regression was analyzed by keeping time as constant and concentrations as variable (time dose mortality analysis) at IBM-SPSS 19 statistical software.

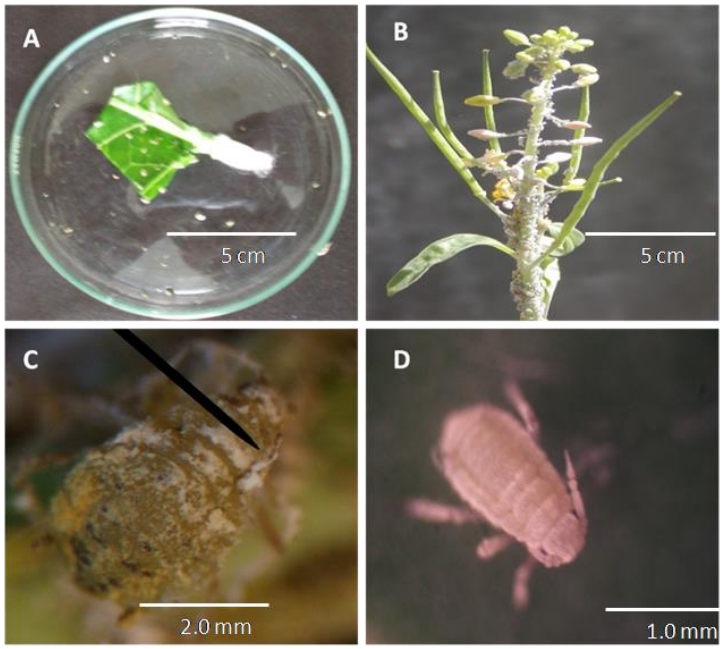

Figure 1. A: the bioassay chamber assembly. B: mustard plant infested with reared mustard aphid. C: Adult wingless female mustard aphid and D: a young nymph mustard aphid (L. erysimi)

RESULTS AND DISCUSSION

Insecticide Lambda Cyhalothrin was found highly toxic with the lowest LC_{50} value 0.57 ppm to aphid populations on mustard plant leaf inside bioassay chamber. Abamectin, Imidacloprid and Acetamiprid were found with LC_{50} value 0.63, 0.67 and 0.82 ppm. Chlorpyrifos and Bifenthrin found with lower toxicity and increased LC_{50} value 1.7 and 2.0 ppm (Fig. 2; Table 2). Probit analysis showed lowest fluctuation in mortality confidence limits, which suggests no insecticide resistance to all test insecticides in the mustard aphid (Fig. 2; Table 2).

Toxicity of Lambda Cyhalothrin to mustard aphid (LT_{50} 0.57) is consistent with earlier reported LT_{50} 0.57 (Devee, 2011). Sawaran and Loganathan, (2002) also reported that L. erysimi was highly susceptible to Lambda Cyhalothrin. Present study found that Abamectin was toxic to the aphid (LC_{50} 0.63 ppm), However, the toxicity record of Abamectin is not available. Devee and Baruah (2012) reported the efficacy of Imidacloprid and Bifenthrin with LC_{50} values 0.00017 and 0.00015 mg. The report supports toxicity of Imidacloprid and varies in Bifenthrin toxicity. Toxicity of Acetamiprid was reported with LC_{50} value 10.7 ppm to green peach aphid (M. persicae) (Nidhi, 2013), that shows higher LC_{50} values than present study. It might be due to different species of aphids have different susceptibility to an insecticide. A rare literature on insecticide toxicity of Acetamiprid and Chlorpyrifos to mustard aphid is available in terms of median lethal dose.

Papaya leaf extract showed insecticidal activity to aphid with LC_{50} value 87.0 ppm. The extract showed fluctuation in 95% confidence limit of LC_{50} values from 33.0 to 145.0 ppm (Table 2). The fluctuation of extract shows insect resistance to the extract. C. papaya leaf extract has been reported for insecticidal activity to A. gossypii, E. vittella, P. puncticollis, B. tabaci (Zobayer and Hasan, 2013), fall army worm (Perez-Gutierrez, et al., 2011) and Sitophilus zeamai (Muzemu, 2013). C. papaya seeds were also reported for cysteine proteases papain, which showed higher insect mortality (Konno, 2004). Present study also suggests the insecticidal activity of C. papya leaf extract against mustard aphid (L. erysimi).

Table 2. LC_{50} values of C. papaya extract observed after 24 hours after application on aphid inside bioassay chambers

Treatment	LC_{50} (ppm)	95% C.L.		Estimate-Intercept	Z-Intercept	Sig.	Chi^2(df=48)
		Min.	Max.				
Abamectin	0.63	0.51	0.74	3.1-0.60	39.2-25.3	0.00	878.1
Lambda-Cyhalothrin	0.57	0.50	0.66	2.8-0.67	38.7-28.1	0.00	514.0
Acetamiprid	0.82	0.60	1.20	3.2-0.28	39.7-11.9	0.00	2297.0
Imidacloprid	0.67	0.58	0.77	3.0-0.50	38.6-21.7	0.00	522.8
Chlorpyrifos	1.74	1.5	2.0	2.52-0.61	29.6-23.8	0.00	573.5
Bifenthrin	2.0	1.8	2.3	1.80-0.60	25.5-26.0	0.00	148.6
Papaya leaf extract	87.0	33.0	145.0	2.14-4.1	16.3-13.8	0.00	744.1 $_{(df=18)}$

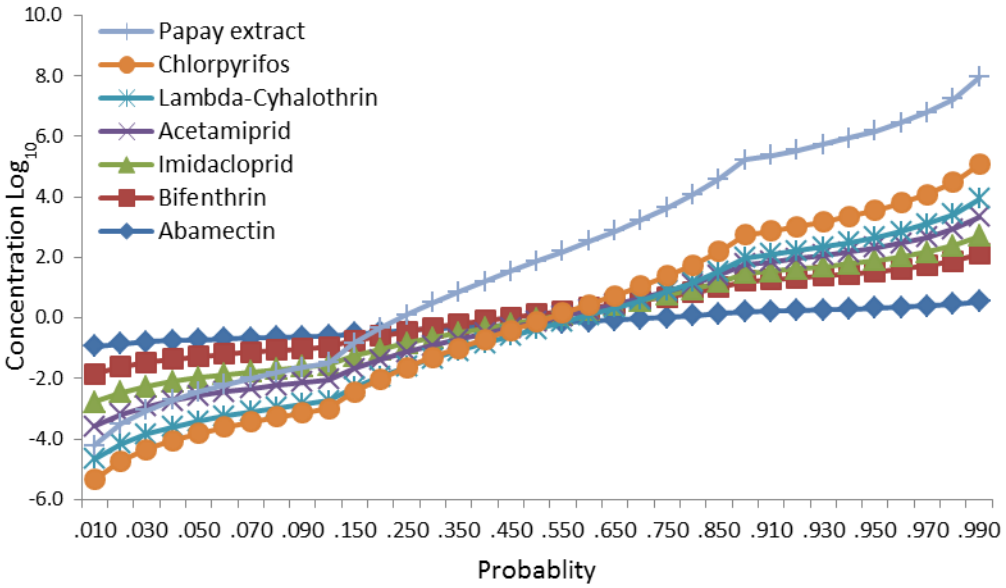

Figure 2. Probit regression estimate of $LC_{0\text{-}99}$ value Log_{10} of each insecticides to L. erysimi (mustard aphid) inside bioassay chmber.

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