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# TOXICITY OF A SYNTHETIC PYRETHROID LAMBDA CYHALOTHRIN IN COMPARESION TO A BIOPESTICIDE (BIOCIDE) ABAMECTIN AGAINST 2ND AND 3RD INSTAR OF COTTON MEALYBUG *PHENACOCCUS SOLENOPSIS* (TINSLEY) (HEMIPTERA: PSEUDOCOCCICAE), A SUCKING PEST OF COTTON AND VEGETABLES

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## ABSTRACT

The toxicity of a widely used synthetic pyrethroid lambda cyhalothrin was determined and compared with a biological pesticide (biocide) of bacterial origin abamectin by topical method against 2nd and 3rd instar larvae of *Phenacoccus solenopsis* (Tinsley) (Hemiptera : Pseudococcidae). The result was observed after 24 hours of treatment, the range of mean % mortality and P-values were determined statistically at 95% C.I (through Minitab computer package). The $LC_{50}$ value was determined by log-probit graph paper. Both the pesticides have been proved toxic in laboratory assay against the pests. The calculated $LC_{50}$ was 0.65µg/cm$^2$ and 0.68 µg/cm$^2$ by lambda cyhalothrin and abamectin respectively against the 2nd & 3rd Instars of *P. solenopsis* (Tinsley).The efficacy of biocide abamectin was found to be less but quite comparable with the efficacy of synthetic pyrethroid lambda cyhalothrin.

**Key word:** Toxicity, $LC_{50}$, Bacterial product, Pyrethroid, *Phenacoccus*, Pseudococcidae

## INTRODUCTION

Cotton is among the major fiber crop of Pakistan and among the main source of foreign exchange. It Cotton along with its related products contributes around 10% to gross domestic product (GDP) of the country. A substantial number of factories processing oil and other byproducts depends upon cotton crop thus supporting millions of skilled and non-skilled peoples. It is largely cultivated in Punjab followed by Sindh provinces of Pakistan. The crop is found be vulnerable from seed to fruit due to viruses, fungi and insect pest of cotton. Insect pests capable to bring about 30 – 40% damage alone as estimated by Ahmed (1980). Cotton mealybug *P. solenopsis* is a polyphagous (Fand and Suroshe 2015) and can brought about compete destruction of crop as had happened in 2005 in Pakistan. It infest a wide verities of plants including cotton, vegetables and ornaments (Aheer *et al.*, 2009). The adult and immature causes same type of injury and capable to suck the sap except the adult male. It is found to be a voracious feeder, infest soft shoots and buds and usually protected in tight protected spaces. It is capable to spread viral diseases, secretion of honey dew may induce fungal infection and destroy quality of raw cotton. The pest show high reproduction rate the eggs or crawler are well protected within waxy cuticle of the female that found to be inert and serve as a barrier and even reduce pesticide penetration. The warm and humid climate strengthen the population that can soon cross the economic threshold.

The use conventional or synthetic pesticides are found to be an effective insect pest control strategies as happen in most of the cases. The indiscriminate use of synthetic chemicals destroy the environment through their persistency, pesticide residue, bioaccumulation, resistance and non-target mortality destroying natural habitat and human health as described by many researchers (Akobundu, 1987; Singh and Sarivastava, 1999; Tilman *et al.*, 2002; Carvalho, 2006 and Soomro *et al.*, 2008). For the safe guard of natural habitats the researchers have been extensively worked and evaluated the toxic potential of chemicals derived from the living sources with little residual effects, instant half- life and their human friendly approaches (Gupta and Dikshit, 2010; Rajput *et al.*,.2020). Abmectin is derived from a soil bacterium *Streptomyces avermitilis* and contains active ingredient avermectin (B1) along with other derivatives (Pitterna *et al.*, 2009). It shows toxic effects against helminthes, mites and insect pests. It is classified as Class IV toxicity or practically nontoxic and found to be more ecofriendly by the U.S. Environmental Protection Agency (EPA). It is largely used in veterinary treatment (Crump and Omura, 2011 and

Kose *et al.,* 2016), the residues are insoluble in water and become immobile in soil and unlikely to contaminate ground water, showing low mammalian toxicity (Bai and Ogbourne, 2016).

In view of the aforementioned biological and economic importance of cotton mealybug and limitations in its control, the object of the present study is to find out a more ecofriendly alternative and its possible inclusion to formulate a more sustainable integrated pests' management (IPM) system for the cotton mealybug *P. solenopsis* (Tinsley) in Pakistan.

## MATERIAL AND METHODS

Counted number of experimental insects were exposed for 24 hours in the seven petri dishes (each of 9-cm diameter) for topical bioassay (Durmuşoğlu *et. al.,* 2015). The dilutions of experimental chemicals were made in distilled water and were spread on each petri dish by means of micro pipette. One petri dish kept remain untreated and was marked as control to observe the effects of environment.

After preliminary experiments the selected concentrations of lambda cyhalothrin for the treatment of 1st and 2nd instar of cotton mealybug were 0.1964 µg /$cm^2$, 0.3928 µg /$cm^2$, 0.588 µg/ $cm^2$, 0.785 µg/ $cm^2$ and 0.98 µg/ $cm^2$ and for bacterial product abamectin was 0.1964 µg/$cm^2$, 0.3928 µg/$cm^2$, 0.785 µg/$cm^2$, 1.178 µg/$cm^2$ and 1.57µg/$cm^2$.

## RESULT

After 24 hours the observed percentage mortality was corrected following Tattersfield and Morris (1924) and Abbot (1925). The $LC_{50}$ was determined by plotting corrected percentage mortality against each doze µg / $cm^2$ on a log-probit graph paper. Further the standard error and range of mortalities at 95% C.I., and P- value was calculated statistically by using computer package, Minitab11.

The mortality by lambda cyhalothrin against the 2nd & 3rd instars of *P. solenopsis* is presented in Table 1, and was found to be 6.0% ± 2.45, 24.0% ± 2.40 , 32.0% ± 3.16 , 58% ± 2.5, and 78.0% ± 2.0 at the dozes of 0.1964, 0.3928 , 0.588 , 0.785 and 0.98 µg/cm2 respectively with the calculated $LC_{50}$ was 0.65µg/$cm^2$ as presented in Fig.1.

The percent mortality by abamectin is described in Table: 2 and was found to be 8.0% ± 2.0 , 27.0% ± 2.45, 54.0% ± 2.0, 72.0% ± 2.0 and 82.0% ± 2.45 at 0.196 µg/$cm^2$, 0.392 , 0.785 , 1.178 and 1.57 µg/$cm^2$ with the calculated $LC_{50}$ was 0.68 µg/$cm^2$ as presented in Fig. 2.

Table 1. Toxicity of Lambda Cyhalothrin against 2nd and 3rd Instar of *P. solenopsis* (Tinsley) after 24 hours of treatment at 95% C.I.

| **Dosage µg /$cm^2$** | **% Mortality** | **S.D.** (±) | **S.E.** (±) | **Range at 95% C. I.** | **P Value** |
|---|---|---|---|---|---|
| Control | Nil | | | | |
| 0.196 | 6.00 | 5.48 | 2.45 | (0.8, 12.8) | 0.00 |
| 0.392 | 24.00 | 5.48 | 2.45 | (7.20, 20.80) | 0.00 |
| 0.589 | 32.00 | 7.07 | 3.16 | (26.22, 48.78) | 0.00 |
| 0.785 | 58.00 | 5.48 | 2.45 | (53.2, 68.80) | 0.004 |
| 0.982 | 78.00 | 4.47 | 2.0 | (72.45, 89.55) | 0.704 |

P- Value lower than 0.05 is said to be significant.

Table. 2. Toxicity of Abamectin against 2nd and 3rd Instar of *P. solenopsis* (Tinsley) after 24 hours of treatment at 95% C.I.

| **Dosage µg /$cm^2$** | **% Mortality** | **S.D.** (±) | **S.E.** (±) | **Range at 95% C. I.** | **P Value** |
|---|---|---|---|---|---|
| Control | Nil | | | | |
| 0.196 | 8.00 | 4.47 | 2.00 | (2.45, 13.55) | 0.00 |
| 0.392 | 27.00 | 5.48 | 2.45 | (12.20, 29.80) | 0.00 |
| 0.785 | 54.00 | 4.47 | 2.00 | (40.45, 55.55) | 0.00 |
| 1.178 | 72.00 | 4.47 | 2.00 | (66.45, 77.55) | 0.000 |
| 1.57 | 82.00 | 5.48 | 2.45 | (76.20, 87.8) | 0.704 |

P- Value lower than 0.05 is said to be significant.

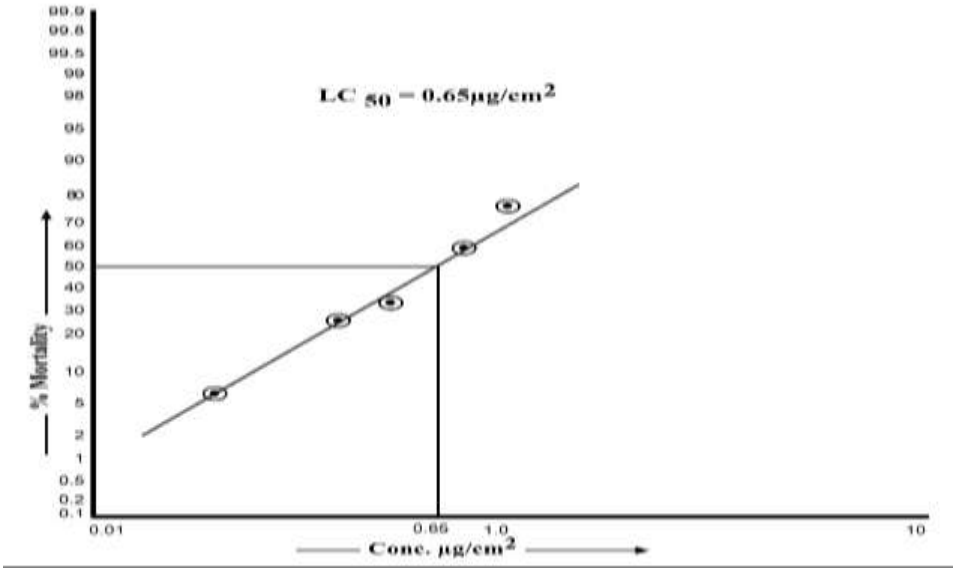


Fig.1. $LC_{50}$ curve of synthetic Lambda Cyhalothrin against the 2nd instar of *Phenacoccus solenopsis* (Tinsley) by topical method.

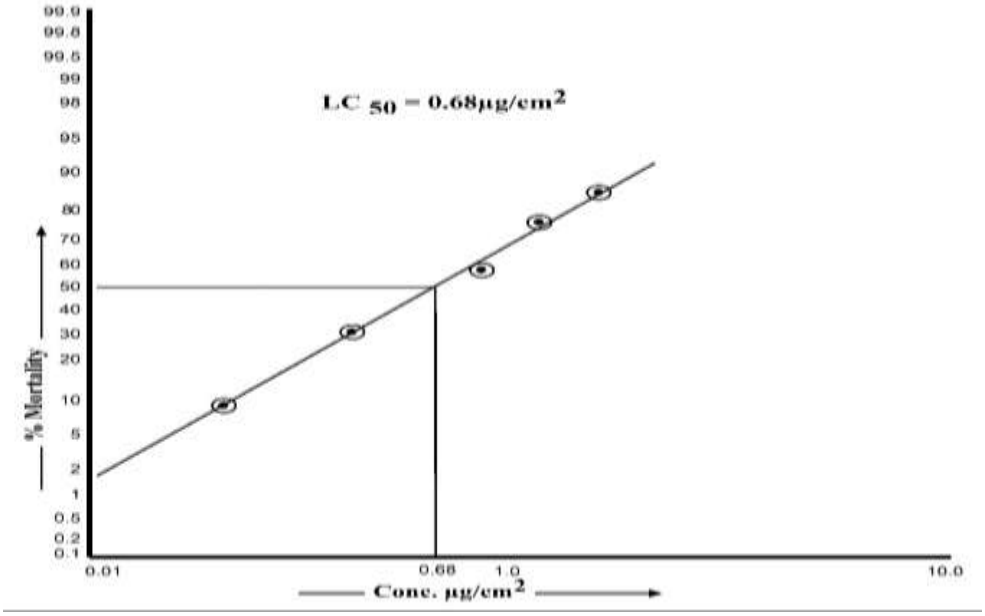


Fig.2. $LC_{50}$ curve of synthetic Abamectin against the 2nd instar of *Phenacoccus solenopsis* (Tinsley) by topical method.

**DISCUSSION**

Nizam *et al*. (1986) investigated the $LD_{50}$ of neem extract i.e 5.0 µg /insect against the nymph and adults of *B. germenica*. In the present investigation biocide abamectin showed toxicity against 2nd and 3rd instar of cotton mealybug $LC_{50}$ value was 0.68 µg/cm$^2$, the difference in findings might be due to differences in treatment technique and also due to difference in different insect pests.

Kidd and James (1991) described in detail the synthetic insecticide lambda cyhalothrin which was used to control a wide range of pests which included aphids, Colorado beetles and butterfly larvae on crops including cotton,

cereals, hops, ornamentals, potatoes, vegetables or others and is compatible with most other insecticides and fungicides. In the present investigation the lambda cyhalothrin proved to be more effective against cotton leafhoppers and it was somewhat equally toxic against the mealy bug of cotton.

Tabassum *et al*. (1996) compared toxicity of two neem extracts (N-6a and N-6b) on 3rd instar larvae of *Musca domestica* L. (PCSIR strain) and reported $LC_{50}$ of N-6a as 18.0mg/ g and for N-6b it was 3.6mg/g. in present finding a biocide abamectin is found to be toxic against immature of cotton mealybug.

Ahmad *et.al.* (1999) studied and evaluated $LC_{50}$ of cyhalothrin 0.01 µg/cm$^2$ and found to be more effective than sevin dust and neem extract against pule beetle. In present findings $LC_{50}$ of cyhalothrin found to be 0.65µg/cm$^2$ and found to be more toxic than biocide abamectin against cotton mealybug. The differences in result might be due to difference in experimental insect. Finding of many researchers found to be supportive and comparable with present investigations.

Saito and Miyata (1988) determined the comparative toxicities of some synthetic pyrethroids and reported cypermethrin as the most toxic to housefly *Musca domestica* by topical method. In present findings the synthetic pyrethroid cyhalothrin proved to be more toxic again as compare to bacterial product abamectin.

Kidd and James (1991) described the use of synthetic insecticide lambda cyhalothrin to control a wide range of pests including butterfly larvae. In the present investigation the lambda cyhalothrin proved to be more effective against immature of cotton mealybug.

Ahmad *et al*. (1999) in his laboratory assay against pulse beetle, Verghese (2000) in his field study and Ahmad *et al*. (2001) also reported the higher toxicity of lambda cyhalothrin in comparison to other synthetic and biocides In the present finding the lambda cyhalothrin found to be more toxic against immature of cotton mealybug under laboratory conditions when compared with bacterial product.

Akbar *et al.* (2007) evaluated the effectiveness of Biosal (neem formulation) in comparison with endosulfan and profenofos against jassid on brinjal at different time intervals and found moderate effect of Biosal against jassid with 47% mortality. In present finding 0.68 µg/cm$^2$ of bacterial product abamectin brought about 50% of mortality in laboratory condition and t are quite comparable with the toxicity caused by lambda cyhalothrin.

The field work of Dhingra *et al.* (2008) also support present findings, as they reported synthetic chemical are more effective as compared to fractions of azadirachtin. Ahsan *et al.* (2014) reported higher toxicity of abamectin as compared to lambda cyhalothrin and biosal against 2nd and 3rd instar of cotton leafhopper in laboratory trail. In present findings the lambda cyhalothin are found to be more toxic and the difference in $LC_{50}$ might be due to differences of in experimental insect.

Javed *et al.* (2018) reported toxicity of emamectin benzoate and indoxacarb followed by abamectin and lambda-cyhalothrin in comparison botanical *Azadirachta indica, Citrullus colocynthis* and *Nicotiana tabacum* against okra borers. The average reduction in infestation was found to be 20 to 56% and 18 to 10% by the synthetic insecticides and botanicals respectively. They recommended their integration in biorational IPM programs against lepidopterous borers of okra and other vegetables. The present findings found to be in agreement showing toxicities of synthetic lambda cyhalothrin and a bacterial product abamectin against immature of cotton mealybug might be used to formulate further control strategies.

Ali and Aly (2020) reported acetamiprid greatest toxic insecticide against cabbage aphid followed by abamectin and indoxacarb after 24 and 48-h of treatment. In present investigation cyhalothrin is found to be more toxic over abamectin against cotton mealybug after 24-h in laboratory condition.

Ella *et al*. (2022) reported higher toxicity of chlorpyrifos, lambda cyhalothrin as compared to abamectin against green lacewing *Chrysoperla carnea* in field trial, in present investigation lambda cyhalothrin found to be more toxic as compared to bacterial product abamectin against 2$^{nd}$ and 3$^{rd}$ instar of cotton mealybug in laboratory condition. In addition marginal differences in the efficacy between the two gives it an opportunity to be an alternative of synthetic pyrethroid.

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