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TOXICITY OF A BIOPESTICIDE ABAMECTIN, A BOTANICAL BIOSAL (NEEM EXTRACT) IN COMPARISON TO A SYNTHETIC PARATHYROID LAMBDA CYHALOTHRIN AGAINST COTTON LEAFHOPPER *AMRASCA DEVASTANS* (DISTANT) (HOMOPTERA:CICADILIDAE), A SUCKING PEST OF COTTON AND VEGETABLES

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ABSTRECT

Toxicity of a bacterial product abamectin, a plant extract biosal and a synthetic pyrethroid lambda cyhalothrin was determined and compared by topical method. The insects were exposed at five different dozes of pesticides for 24 hours. The LC_{50} value was calculated by log-probit graph paper. The range of mean % mortality and P-values were determined statistically at 95% CI. The mortality was 20.0% ± 2.88, 31.3% ± 1.84, 58.0% ± 3.27, 77.0% ± 1.84, and 94.0% ± 2.0 at 0.0123 µg/cm^2, 0.02456, 0.0489, 0.0982 and 0.1964 µg/cm^2, respectively and the calculated LC_{50} was found to be 0.04 µg/cm^2. The percent mortality was found to be 28.0% ± 2.0, 50. % ± 3.16, 62.0% ± 2.0, 72.0% ± 3.74, and 92.0% ± 2.0 at 78.77 µg/cm^2, 118.14, 157.54, 196.91 and 236.0 µg/cm^2, respectively and the calculated LC_{50} was 120.0 µg/cm^2. The mortality by cyhalothrin was 15.0% ± 0.54, 31.1% ± 2.88, 58.42% ± 2.75, 78.3% ± 3.51, and 94.0% ± 4.0 at 0.04195µg/cm^2, 0.0982, 0.1964 , 0.3928 and 0.7856 µg/cm^2, respectively against the adults of *A. devastans* and the LC_{50} was calculated to be 0.16 µg/cm^2. The bacterial extract found to be more toxic as compared to synthetic pyrethroid and plant extract.

Key words: Toxicity, LC_{50}, Biopesticide, Botanical extract, Pyrethroid, Sucking pest, Leafhopper,

INTRODUCTION

Cotton is among the leading cash crop in Pakistan. It is largely cultivated in Punjab and Sindh. Raw cotton and its related products contribute 10 percent to gross domestic product (GDP). It is important over 64% of domestic edible oil production. It sustains domestic industries like cotton ginning, cotton textile, cotton seed oil extraction, etc. As a result millions of peoples and expertise are employed in cotton based industries.

Poor conventional agricultural practices, insect's pests, leaf curl (CL CuD) and other viral disease, fertilizer and uncontrolled usage of agrochemicals have been addressed by many researcher and agencies since long-ago. Cotton leaf hopper is found to be well known sucking pest of a wide variety of crops including vegetables and cotton. Distant (1908) discovered it from Nagpur (India) now the species is considered as an extremely important sucking pest of cotton and other vegetables in all around the subcontinent. According to Ahmed (1980) 30 – 40% damage in cotton crop occurs due to insect pests only. Nymphs and adult of the leafhopper are equally injurious to plant health and brought about significant economic loss in all ecological conditions. Ghouri (1976) stated that two leafhoppers per leaf are considered as the economic damage threshold of this pest.

Uses of conventional (synthetic) pesticides are found to be the most effective insect pest management strategies throughout this subcontinent. But the indiscriminate use of such chemicals causes serious ecological hazardous like residual pollution, bioaccumulation, resistance, mortality of non-target species (Akobundu, 1987: Singh and Sarivastava 1999), contaminate aquatic and land ecosystem (Carvalho (2006); Tilman *et al*. (2002) and even deteriorate human health as well (Soomro *et al*., 2008).

Pesticides of biological origin either plant extract or bacterial products are gaining attention as an alternative to synthetic insecticides in agriculture and public health sectors. Gupta and Dikshit (2010) discussed much about the ecofriendly approach of biopesticides. The active ingredient of Abamectin is avermectin, derived from the soil bacterium *Stryptomyces avermitilis*, (Hayes 1990). The compound is classified by the U.S. Environmental Protection Agency (EPA) as Class IV toxicity, or practically non- toxic. Abamectin and its degrading metabolites are insoluble in water, immobile in soil and unlikely to contaminate ground water, showing low mammalian toxicity, Bai and Ogbourne (2016).

Extract of plant *Azadirachta indica* has active constituent azadirachtin, Butterworth and Morgan (1971). Its potential and mode of action was revealed by (Islam 1984, Nizam *et al*. 1986, Naqvi *et al*. 1989, 1990, 1992 a,b, Nurulain *et al*. 1989, Singh and Kataria 1991,Tabassum *et al*. 1996, 1998, Tabassum and Naqvi 2001, Kumar 2015, Rajput, *et.al.*, (2020)

In view of the aforementioned importance of sucking pests of cotton *A. devastans* (Distant), our poor and hazardous agricultural practices. The object of present work is to find out safer means of insect pest control. The possible inclusion of organic biopestides in formulation of a sustainable and more ecofriendly integrated pests' management (IPM) system for the cotton leafhopper *A. devastans* (Distant) in Pakistan.

MATERIAL AND METHODS

For the treatment of leafhoppers topical method is adopted the counted number of insects were exposed for 24 hours in the seven petri dishes (each of 9-cm diameter) provided with leaves of alternate host of ladyfinger (okra). The dilution of abamectin and lambda cyhalothrin was made in distilled water and of biosal in ethanol. 0.1mL of five different concentrations were spread on each petri dish by means of micro pipette. One petridish was treated with 0.2mLof ethnol and marked as check to determine the effect of solvent in biosal and one petridish kept remain untreated and was marked as control to observe the effects of environment.

After preliminary experiments the selected concentrations of bacterial product abmectin for the treatment of adult *A. devastans* were 0.0123 µg/cm^2, 0.02456 µg/cm^2, 0.049 µg/cm^2, 0.0982 µg/cm^2 & 0.1964 µg/cm^2 and for botanical extract or Biosal was 78.77 µg/cm^2, 118.14 µg/cm^2, 157.54 µg/cm^2, 196.91 µg/cm^2 and 236.0 µg/cm^2. Similarly the selected concentrations of synthetic lambda cyhalothrin for the treatment of adult *A. devastans* were 0.0419 µg/cm^2, 0.0982 µg/cm^2, 0.1964 µg/cm^2, 0.3928 µg/cm^2 and 0.7856 µg/cm^2.

The mortality was observed after 24 hours of treatment and was corrected following Tattersfield and Morris (1924) and Abbot 1925. The LC_{50} was determined by plotting corrected percentage mortality against each doze g / 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 Minitab11, computer Package 1996.

RESULT

In the present study biopesticide (abamectin), neem extract (biosal) and synthetic pesticide (lamda cyhalothrin) were used against adults of *A. devastans* and were found toxic at all doses. The mortality of adults pest increased with increasing concentration of all pesticides. Maximum mortality (94%) was observed by abamectine at 0.1964 µg/cm^2 followed by 77% at 0.0982 µg/cm^2. and the calculated LC_{50} was found to be 0.04 µg/cm^2 against the adults of *A. devastans* (Table: 1, Fig: 1). The maximum mortality (92%) was observed by biosal at 236.0 µg/cm^2 followed by 18.77% at 196.91 µg/cm^2 and the calculated LC_{50} of biosal against Adults of *A. devastans* was 120.0 µg/cm^2. (Table: 2, Fig: 2).

Maximum mortality caused by synthetic lambda cyhalothrin against the adult of *A.devastans* after 24 hours of treatment was found to be 94.0% ± 4.0 at 0.7856 µg/cm^2 followed by 78.3% ± 3.51 at 0.3928 and the calculated LC_{50} was 0.16 µg/cm^2 (Table: 3, Fig: 3).

DISCUSSION

Finding of many researchers found to be supportive and comparable with present investigations. Gist and Charles (1985) reported the synergistic activity of synthetic pyrethroid with piperonyl butoxide (1:8) against armyworm *Sporoptera frugiperda* and calculated the LD_{50} range between 0.213 µg/insect to 5.41 µg/insect among 6th instar larvae, while in the present investigation the cyhalothrin also showed higher toxicity as compared to neem extract and abamectin against adult of *A.devastans* by topical method the LD_{50} was found to be 0.16 µg /cm^2. The higher toxicity may be due to difference in insect pests. Synergistic approach of pesticide was not taken in to consideration presently.

Nizam *et al.* (1986) also investigated the LD_{50} dose i.e. 5.0 µg /insect of neem extract (factor b) against the nymph and adults of *B. germenica.* In the present investigation the toxicity of biosal against adults of cotton leafhopper with LC_{50} value was 120 µg/cm^2, the variations in the present findings might be due to difference in treatment technique and also due to difference in different insect pests.

Table 1. Toxicity of Abamectin against adult of *A. devastans* after 24 Hours of Treatment.

Dosage µg /cm^2	% Mortality	S.E. (±)	P Value
Control	4.00	2.45	0.00
0.0123	20.88	2.88	0.00
0.0245	31.30	1.84	0.00
0.049	58.6	3.27	0.001
0.098	77.30	1.84	0.001
0.1964	94.00	2.00	0.208

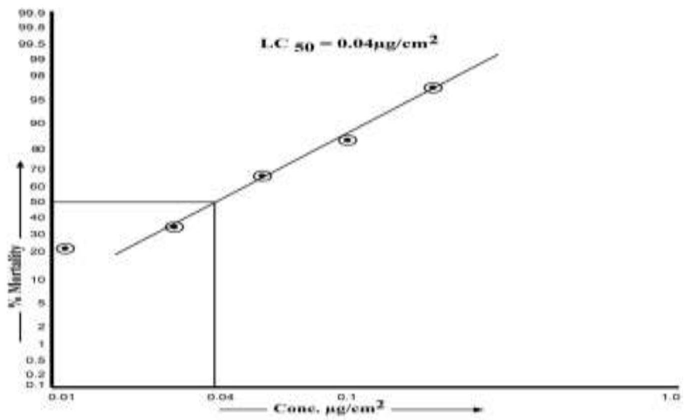

Fig. 1. LC_{50} curve of Abamectin gainst adult of *A. devastans* on log probit graph.

Table 2. Toxicity of Biosal against adult of *A. devastans* after 24 Hours of Treatment.

Dosage µg /cm^2	% Mortality	S.E. (±)	P Value
Control	4	2.45	0.18
Check	12	2.0	0.003
78.77	28	2.0	0.0002
118.14	50	3.16	0.0001
157.54	62	2.0	0.000
196.9	72	3.74	0.000
236.0	92	2.0	0.000

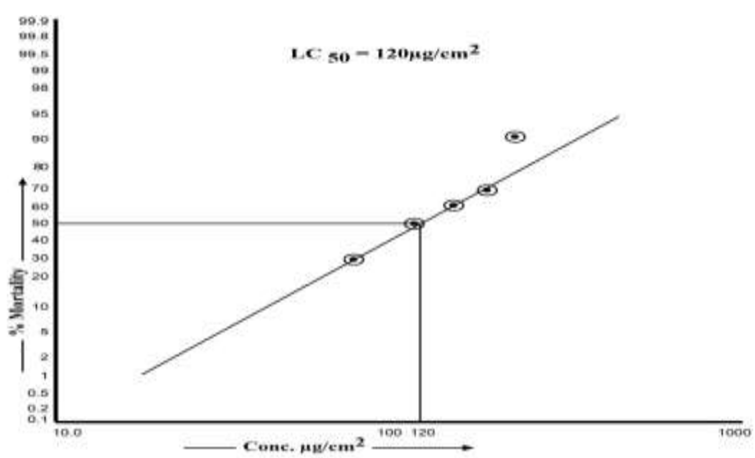

Fig. 2. LC_{50} curve of Biosal against adult of *A. devastans* on log probit graph.

Table 3. Toxicity of Cyhalothrin against adult of *A. devastans* after 24 Hours of Treatment.

Dosage **μg /cm^2**	**% Mortality**	**S.E.** (±)	**P Value**
Control	04	2.00	0.00
0.0419	15.88	2.37	0.00
0.0982	31.10	4.15	0.00
0.196	58.42	2.94	0.002
0.392	78.30	2.15	0.002
0.785	94.00	2.24	0.285

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

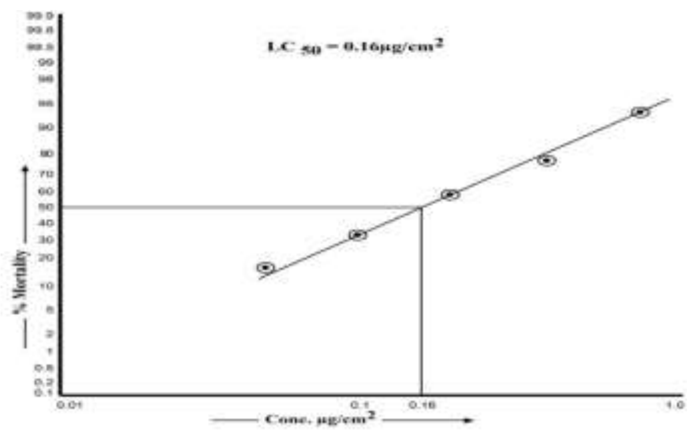

Fig. 3. LC_{50} curve of cyhalothrin against adult of *A. devastans* on log probit graph.

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 the present work also the synthetic pyrethroid cyhalothrin proved to be more toxic than the biosal and somewhat lower toxic against the sucking pests of cotton.

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 as compare to neem extract biosal

The present result is found to in agreement with the finding of Ahmad *et al.* (1999) reported the effect of cyhalothrin, sevin dust and neem extract against pulse beetle. LC_{50} of cyhalothrin was found to be 0.01 μg / cm^2 and neem extract was found to be 250μg/ cm^2 and regarded cyhalothrin as the most effective insecticide.

Verghese (2000) tested and compared the toxicity of lambda cyhalothrin with azadirachtin against mango leafhopper *Idioscopus niveosparsus* and concluded that the cyhalothrin appeared more toxic and its toxicity is comparable with monocrotphos and the efficacy of azadirachtin seemed to depend on the level of hopper population density. At lower densities (< 4 per panicle) it was as effective as synthetic chemicals. In the present investigation the cyhalothrin appeared to be more toxic against cotton leafhopper *A.devastans* than the neem compound biosal under laboratory conditions.

The present findings are also supported by the finding of Ahmad *et al.* (2001), reported higher toxicity of cyhalothrin in comparison to neem extract (NA) on *Sitophilus oryzae* in laboratory condition.

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 120μg/cm^2 of biosal brought about 50% of mortality in laboratory condition.

The field work of Dhingra *et al*. (2008) also support present findings, as they tested derivative of neem extract (Azadirachtin-A) in comparison with endosulfan against the complex pests of okra including jassid and whitefly and found endosulfan was the most effective as compared to azadirachtin-A against jassid (about 62% with endosulfan) followed by other fractions including neem.

The present finding is found to be in agreement with the finding of Ahsan *et al*. (2014) reported higher toxicity of abamectin as compared to lambda cyhalothrin and biosal against 2^{nd} and 3^{rd} instar nymphs of *A.devastans* in laboratory trail. The lower value of LC_{50} indicated immature nymphs are more susceptible to experimental pesticides.

The present work is supported by the finding of Javed *et al*. (2018) reported emamectin benzoate and indoxacarb caused the most significant reduction of okra borers, followed by abamectin and lambda-cyhalothrin. They evaluated botanical *Azadirachta indica*, *Citrullus colocynthis* and *Nicotiana tabacum* caused the most significant reduction of okra borers. The average reduction in infestation on okra fruit 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 programmes against lepidopterous borers of okra and other vegetables.

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 abacmectin showed more toxicity over cyhalothrin and biosal against cotton leafhopper 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 abamectin found to be more toxic then lambda cyhalothrin against leafhopper in laboratory condition showing its better possibility to control this sucking insect pests.

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