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Toxicity of Steward (Indoxacarb) Against Cotton Bollworm, *Helicoverpa armigera* (Hub.)

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Abstract .- Various concentrations of Steward 150 SC, indoxacarb *viz*., 50, 100, 200, 300 and 500 ppm were tested against different larval instars of cotton bollworm, *Helicoverpa armigera* (Hub.) to determine its toxicity range under controlled laboratory conditions. Percent mortality of the insect was recorded after 12, 24, and 48 hours exposure to insecticide. The results showed that mortality of second instars varied significantly in between treatments after 12 hours but non-significantly with cent per cent mortality after 24 and 48 hours. Third and fourth instars exhibited variable mortality range after 12, 24 and 48 hours. It was 46–73%, 47–80% and 13–1 00% in third instar and 33%, 13–40% and 20–100% in fourth instar after 12, 24 and 48 hours respectively. The overall results conclude that fourth instars are more resistant to insecticide at all concentrations than third and second instars.

Key Words: Insecticide toxicity, *H. armigera*, larval instars.

INTRODUCTION

The average yield of seed cotton in Pakistan is 511 kg/hectare that is still lower than that in countries like Australia, USA, Egypt and Turkey (Ahmed, 1999a). The reason is that heavy yield losses occur due to insect pests, diseases and weeds. Insect pest alone cause 20-40 per cent losses in yield potential of cotton (Ahmed, 1999b). Among sucking and chewing insect pests' complex, cotton bollworm, *Heticoverpa armigera* (Lepidoptera: Noctuidae) is currently the most devastating pest. It is a highly polyphagous in nature. Its host species include important agricultural crops such as cotton, maize, chickpea, pigeon pea, sorghum, sunflower, soybean and groundnuts (Fitt, 1989). Due to its wider host range, multiple generations, high migratory behavior, fecundity and insecticide resistance, it has become a difficult pest to tackle (Hussain *et al.,* 1991; Khan *et al.,* 1993; Ahmed *et al.,* 2000).

The only way to avoid its economic damage to cotton is the use of pesticides in United States (Knipling, 1979). Complete reliance on pesticides for the control of this cosmopolitan pest has resulted in the development of resistance against insecticides especially pyrethroids (Gunning *et al.,* 1984). In Pakistan, the indiscriminate use of insecticides, particularly during 80s and 90s, contributed to the emergence of the cotton bollworm, *Helicoverpa armigera* as a primary pest of cotton. In recent years, *H. armigera* became the major cause of cotton yield reduction in Pakistan. Moderate to high level of resistance to pyrethroides and organo-phosphorus insecticides was recorded in field population of *H. armigera* (Ahmed *et al.,* 1995). Control of this pest with pesticides was not always adequate probably due to the development of resistance. To overcome this resistance and to sustain cotton production, the agrochemical industry has recently introduced new chemistries with novel modes of action unrelated to previous chemical classes (Ahmed *et al.,* 2002). Keeping in view the probable effectiveness of new chemicals, it was planned to test Steward 150 SC thoroughly against various larval instars of Faisalabad strain of cotton bollworm, *Helicoverpa armigera* in bio-assay laboratory, before application under field conditions.

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MATERIALS AND METHODS

Test insect

Cotton bollworms were collected from local cotton field and reared in the laboratory on a pre-standardized modified semi-synthetic diet,

consisting of chickpea flour, sorbic acid, Wesson's salt, vitamins, ascorbic acid, yeast (Brewer's), choline chloride, Agar agar, formaldehyde, streptomycin sulphate and methyl-p-hydroxy benzoate, under laboratory conditions of 27±2°C, 65±5% RH and 14:10hrs Light: Dark (Ahmed and McCaffery, 1991). A homogeneous stock of second, third and fourth larval instars were obtained for respective insecticidal treatments.

Leaf dips method

Five different concentrations *viz*., 50, 100, 200, 300 and 500 ppm of agricultural grade insecticide, Steward 150 SC (indoxacarb) were used for their bio-efficacy. Leaf dip method (Busvine, 1971) was used to determine toxicity of different instars of *H. armigera.* Cotton leaves were dipped in test concentrations prepared in distilled water for 10 seconds and then dried on blotting paper for 5 seconds. Leaves were placed in Petri dishes having wet blotting paper on base to avoid desiccation of leaves. Five larvae of second, third and fourth instars per replicate were released on leaves in each Petri dish. The experiment was replicated thrice. Larvae in control were released on leaves treated with distilled water and dried (Hamed and Khan, 2003).

Laboratory conditions and test insecticides

Bioassays were carried out under controlled temperature, humidity and light conditions as described in culture maintenance of the insect. Cumu1ative mortality was recorded at 12, 24 and 48-hour intervals after the releases of insects on treated leaves. A serial dilution of the formulated test insecticide was prepared as ppm of the active ingredient.

Statistical analysis

Data on mortality were converted into percentage and analyzed statistically using a software MSTAT-C Ranking of insecticide concentrations and conclusions were made after data were subjected to ANOVA and LSD tests.

RESUL TS AND DISCUSSION

The results regarding percent mortality of second, third and fourth instar larvae of cotton bollworm against different concentrations of Steward 150 SC are given in Table I.

Percent mortality varied significantly in between the insecticide concentrations. Significantly high and cent per cent mortality of second instar larvae occurred with the concentrations of 300 and 500 ppm after 12 hours followed by 200, 100 and 50 ppm. After 24 and 48 hours complete mortality was obtained at all concentrations. The results regarding mortality percentage of third instar larvae after 12 hours showed significant variations among different concentrations. The concentration of 500 ppm resulted in 73.3 percent mortality that signify its variation from others at 300, 200, 100 and 50 ppm with 60, 45.7, 40 and zero percent mortalities respectively. Percent mortality of 45.7 at 100 ppm was slightly high (non- significant) than that at 200 ppm after 12hrs exposure that might be due to variations in the vigor of tested larvae and their feeding response in replicates, however the final mortality level at 48hrs was less than that at 200 ppm. Mortality was less severe after 24 as compared to 12 hours. However data after 24 hours exhibited significant variations in treatments. The maximum mortality was achieved at 500 ppm and the minimum at 50 ppm. After 48 hours exposure, mortality declined and it remained non-significant in between all concentrations except at 50 ppm where it was 13.3 percent because of lower concentration near baseline toxicity. Mortality percentage of fourth instar larvae was reduced at all exposure times as compared to third and second instars. However it was non-significant at 200, 300 and 500 concentrations. No morality resulted at 50 and 100 ppm. Exposure times of 24 and 48 hours increased mortality percentage that was statistically equal and significant at all concentrations except 50 ppm wherein 13.3 and 20 percent mortalities were - recorded. The overall results indicate that high concentrations (300 and 500 ppm) had quick knockdown effect against second instars even after 12 hours exposure than low concentrations, whereas all concentrations gave complete knockdown after 24 and 48 hours. Fourth instars are more resistant to Steward 150 SC as compared to third and second instars. In addition, the exposure time to all insecticide concentrations increases the mortality

percentage in all larval instars. These findings are in conformity with Johnson *et al.* (2000), who concluded that new insecticides provided good

Table I.- Relative toxicity of different concentrations of Steward 150 SC against different larval instars of *H. armigera*

Concentrations (PPM)	Mortality (%) of larval instars after different time exposures (Hrs)								
	Second instar			Third instar			Fourth instar		
	12	24	48	12	24	48	12	24	48
50	53.3 D	93.3 a	100	0.0 a	0.0 c	13.3 D	0.0 b	13.3 D	20.0 D
100	66.7 b	100 a	100	45.7 c	46.7 b	73.3 a	0.0 b	16.7 ab	73.3 a
200	73.3 ab	100 a	100	40.0 c	72.3 ab	86.7 a	33.3 a	40.0 a	86.7 a
300	100 a	100 a	100	60.0 b	73.3 ab	93.3 a	33.3 a	40.0 a	93.3 a
500	100 a	100 a	100	73.3 a	80.0 a	100 a	33.3 a	40.0 a	100 a
Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0..0

Means sharing column-wise similar letters are not significantly different by DMR test at P 0.05.

control to cotton bollworm. Further, new chemistry insecticides *viz*., fipronil, chlorfenapyr, indoxacarb, spinosad, abamectin and emamectin benzoate had been evaluated (Anonymous, 2003, 2004) against *H. armigera* and it was suggested that judicious and in rotational use of these new chemistry insecticides restore the profitability of crop production. Ramasubramanian and Regupathy (2004) used indoxacarb at recommended dose exerted 73.25-76.65% reduction in larval population under field conditions after first and second spray, respectively. Under laboratory conditions the percentage mortality was more than 70% even at the lowest rate of 10 g a.i ha^{-1} and the percentage survival or resistance was in the range of just 7.5-20.0% at recommended dose of indoxacarb. This increased activity of carboxyl esterase in *H. armigera* has been reported to enhance the toxicity of indoxacarb by converting it to more toxic metabolite DCJW (N decarbomethoxyllated JW 062) (Gunning and Devonshire, 2002).

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