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Validation of Chemical Control of Gram Pod Borer, *Helicoverpa armigera* (Hub.) With New Insecticides

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ABSTRACT

The study on chemical control of *Helicoverpa armigera* on cjikcpea was carried out in the field and laboratory. In field, the two sprays of Arrivo (cypermethrin) 10EC @ 250 ml, Lannate (methomyl) 40SP @ 300 g, Tracer (spinosad) 240SC @ 60 ml and Steward (indoxacarb) 150SC @ 150 ml acre^{-1}, at interval of 15 days, using Randomized Complete Block Design with three replications, were applied. Results revealed Tracer was the most effective treatment in restricting the pest infestation followed by Steward and Lanante whereas Arrivo was unable to do the same. In the laboratory bioassay on plants treated with different concentration ofd the insectidies aslso presented that the Tyracer (1 ppm) was toxic to 2nd instar larvae of the pest and Arrivo (216 ppm) was least effective. The presence of tolerance to cypermethrin in the field indicates a wide spread genetic factor or possibly a common mechanism of resistance to cypoer tmrjhin. Steawrds and Tracer along with Lannate provide with alternate insecticide to cypermethrin for the control of *H. armigera* on chickpea.

Key Words: Spinosad; Indoxacarb; Methomyl; Cypermthrin; *H. armigera;* Chickpea

INTRODUCTION

In Pakistan, chickpea is grown under three farming systems; rain fed (88%), rice based system (11%) and irrigated system (1%). The major chickpea production belt in Punjab (Pakistan) is "Thal" comprising of Distt. Bkakkar, Mianwali, Leiah, Rawalpindi, Attock, Jehlum, Chakwal and parts of Sargodha and Jhang.

Gram pod borer, *Helicoverpa armirgera* constitute a world wide pest complex of great economic importance and is the major constraint in chickpea production in Pakistan causing losses ranging from 6-20% in spite of several rounds of insecticidal applications (Ahmad *et al*., 1986; Rashid, 1990). Due to wider host range, multiple generations, migratory behavior, high fecundity and existing insecticide resistance this became a difficult pest to tackle (Hussain *et al*., 1991; Khan *et al*., 1993; Ahmed *et al.*, 2000). Chickpea in particular are a major first generation host for *H. armigera* after the winter. If pest numbers are not contained in the first generation, population levels of subsequent generations could be substantially higher and result in severe crop losses later in the season. The chickpea is followed by cotton and thus the application of insecticides becomes imperative to check the survival and multiplication of *H. armigera* on former so that pod borer should not be carried over to the latter.

Resistance to pyrethroids and carbamates is an important consideration when dealing with *H. armigera*. Biopesticides have an increasingly important place in the management of heliothis in grain crops, but they are not robust products whose single applications will handle high density infestations, large spread of larval sizes and persistent egg lays (Bhagwat, 2001; Amrit *et al*., 2002). No attempt has been made to introduce biopesticides for the control of *H. armigera* in Pakistan.

In order to evaluate recently introduced insecticides, on cotton, for *H. armigera* management, Tracer 240SC and Steward 150SC were compared with chemicals already in use for the pod borer on chickpea.

MATERIALS AND METHODS

Comparative efficacy of insecticides under field conditions. Chickpea variety, Bital-96, was sown in October, 2003 and all agronomic practices were followed at Post Graduate Agricultural Research Station, Jhang Road, Faisalabad in Randomized Complete Block Design with five treatments including a control and replicated thrice. Plot size was 3.4 x 10.2 m^2 and row-to-row and plant-to-plant distance was 30 and 15 cm, respectively. Four insecticide treatments included Arrivo (cypermethrin) 10EC @ 250ml, Lannate (methomyl) 40SP @ 300 g, Tracer (spinosad) 240SC @ 60 ml and Steward (indoxacarb) 150 SC @ 150 ml acre^{-1}.

All infested and healthy pods on ten tagged plants in one plot were counted and percent damage was worked out. The observation on pod borer were taken 24 hr before and then after 48, 72, 96 hrs and one week following the insecticide application. Interval between two sprays was 15 day. Mean infestation at each interval after insecticides application was compared through One Way ANOVA using LSS at 5% level of probability.

Efficacy of insecticides in the laboratory. Potted chickpea plants in completely randomized design with three applications were sprayed with different concentration of insecticides and plants were air dried at room temperature. Five larvae of *H. armigera* of 2nd instars were released on the plants when there was no wetness on the leaves. The mortality of these larvae was observed after 24-48 hrs and LC_{50} of these insecticides was calculated using probit analysis.

RESULTS

The percent infestation before and after application of Tracer 240SC, Steward 150SC, Lannate 40SP and Arrivo 10EC is given in Table I. In plots treated with Arrivo, infestation increased after the insecticide application. An After 24 hr difference in per cent infestation was 0.86 and that difference rose to 2.11 at 7th day following the application. There was significant difference between infestation level before 24 hr and at all post treatment intervals. The infestation level at post treatment intervals had a non-significant difference e among themselves.

In plots treated with Lannate, though there was a slight increase in the infestation after insecticide application and a difference of 0.48 between infestation level before and 7th day following insecticide treatment was noted, but infestation recorded after application of insecticide had non-significant difference among themselves at 24, 48, 72, 96 and 7th day. In plots treated with tracer and steward there was no increase in infestation after 24, 48 and 72 hrs however, a difference of 0.37 was noted between 24 hr before and 7th day following tracer and this difference was 0.50 in case of steward application. The infestation levels had non-significant differences among themselves at all post treatment intervals. The control plots showed increase in infestation level at post treatment intervals and a difference of 7.02 between infestation level 24 hr before and at 7th day following water only application was observed.

Table II shows toxicity of Arrivo, Lannate, Tracer and Spinosad. Tracer appeared to be most toxic in bringing down 50% mortality of treated population at 1.08 ppm. Lannate and steward were almost equitoxic toward *H. armigera* as fiducial limits of both insecticides overlapped. However, Arrivo was least effective with LC_{50} of 216 ppm. λ^2 and heterogeneity value were less than 1, which shows a homogenous response of *H. armigera* towards insecticides.

DISCUSSION

In Pakistan, almost for the control of *H. armigera*, the insecticides recommended for use in cotton are used on chickpea. Mostly pyrethoids are recommended and amongst these cypermethrin has been extensively used. Pyrethroids historically have provided excellent control of many agricultural insect pests, however, their widespread use has resulted in increased tolerance among heliothine population Owing to control failure of *H. armigera* on cotton by cypermethrin and record of resistance development to this insecticide by the pest, there is need to search for chemicals that can be effectively used in chickpea. The present studies also depicts the less effectiveness / increased tolerance of cypermethrin on chickpea but these results contradicts with Chandrakar and Srivastava (2001) who found cypermethrin effective insecticide in preventing the infestation by *H. armigera* on chickpea. The possible reason for discrepancy may be the temperature fluctuation, crop variety, phenology and previous exposure of the pest to the insecticide.

Many studies in the scientific literature on the chemical control of *H. armigera* on chickpea revolve around the use of biopesticide particularly microbial insecticides, but they are not robust products whose single applications will handle high density infestations, large spread of larval sizes and persistent egglays. Quite clearly we need more tools in our armoury (Bhagwat, 2001). Due to non-availability of such insecticides in the local market, one has to rely insecticides from the groups other than pyrethroids. Steward (indoxacarb) is recently introduced insecticide for the control of *H. armigera*. It is more effective than pyrethoids as it acts as antifeedant that destroy the pest's capacity to get food and thus provides immediate protection (DuPont, 1997). Tracer (spinosad) follows the same use. Tracer contains active ingredient spinosad - a new class of naturally produced metabolite from a bacterium. Tracer is registered for the control of cotton bollworms in the Pakistan. The result of effective control by Lannate is in confirmation of Biradar *et al.* (2001) who studied the efficacy of methomyl 40SP applied alone or in combination with fenvalerate, cypermethrin and quinalphos.

Table I. Percent infestation before and after application of Arrivo 10EC, Lannate 40SP Tracer 240SC and Steward 150SC

	Treatments				
Intervals	Arrivo	Lannate	Tracer	Spinosad	Control
24 hr before	7.19±0.23c	6.67±0.43a	6.50±0.20a	6.62±0.16a	10.50±0.50a
After 24 hr	8.05±0.21 (0.86) ab	6.67±0043 (0.00) a	6.50±0.20 (0.00) a	6.62±0.16 (0.00) a	11.92±0.28 (1.33) a
48 hr	8.63±0.42 (1.44) a	6.67±0.43 (0.00) a	6.50±0.20 (0.00) a	6.62±0.16 (0.00) a	12.77±0.79 (2.18) ab
72 hr	8.82±0.06 (1.63) a	6.67±0.43 (0.00) a	6.50±0.20 (0.00) a	6.62±0.16 (0.00) a	14.37±0.84 (3.78) bc
96 hr	9.01±0.06 (1.82) a	7.07±0.50 (0.40) a	6.58±0.21 (0.58) a	6.72±0.16 (0.10) a	15.85±0.70 (5.26) cd
7th day	9.30±0.14 (2.11) a	7.15±0.55 (0.48 a	6.95±0.17 (0.37) a	7.12±0.14 (0.50) a	17.61±6.48 (7.02) d

Values are means±SE. Means (average of two sprays) with same letter in a column are not significantly different at $\propto$=0.05. Parentheses show difference in % infestation levels before 24 hr and at various post treatment intervals.

Table II. Toxicity of different insecticides against *H. armigera*

Insecticides	LC_{50}	Fiducial Limits (95%)	Fit of Probit Line		
			Slope±SE	λ^2	Heterogeneity
Arrivo	216	140-342	1.82±0.41	0.08	0.03
Lannate	15	9-23	1.85±0.41	0.40	0.13
Tracer	1.1	0.70-1.71	1.82±0.41	0.08	0.03
Steward	21	14-34	1.82±0.41	0.08	0.03

The scientific literature on the use of Steward and Tracer has no comparable data, hence, it is difficult to relate the results of present study with any one repeated elsewhere. The same is true for results of the toxicity of Steward, Tracer, Lannate and Arrivo in the laboratory as no parallel data is available. In the laboratory, Tracer appeared to be most toxic compound in bringing about 50% mortality of the treated population and these results, hence, reflect validity of those obtained during field trial. The tests in the laboratory were carried out at room temperature (25°C) during the month of April, 2004. Only 2nd instar larvae of *H. armigera* were used whereas this may not corroborate with population age in the field. Environmental conditions might not factor in the low toxicity of cypermethrin in the field and laboratory trials. The presence of tolerance to cypermethrin in the field indicates a wide spreads genetic factor or possibly a common of resistance to cypermethrin. Therefore, steward and tracer along with Lannate provide with alternative to the cypermethrin.

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