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EVALUATION OF *BACILLUS THURINGIENSIS* BERLINER AGAINST CHICKPEA POD-BORER

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Commercial preparations of Bactospeine (Bactospeine WP 16000 IU serotype H-3a3b) and a USDA standard strain HD-1-S-1980 were evaluated in different concentrations against the 1st and 3rd instar larvae of chickpea (*Cicer arietinum* L.) pod-borer (*Heliothis armigera* (Hubn.)). Both the toxins were found equally effective at same larval stages but each one was found more effective against the 1st larval instar. Both the toxins showed similar toxicity at 7 and 11 days exposure periods against the 3rd instar larvae.

Key words: Bacillus thuringiensis, Heliothis armigera, Cicer arietinum.

INTRODUCTION

Many modern day biological hazards like environmental pollution, phytotoxicity, development of resistant strains of insect pests, endangered beneficial insects, fishes and birds, and toxic residual effects, etc., have appeared as a result of increasing indiscriminate use of insecticides. Unfortunately, in developing countries use of insecticides like chlorinated hydrocarbons is indispensable owing to the lack of alternate non-hazardous measures of pest control.

Biological control of insect pests has shown promising results all over the world during the last two decades and as a result several commercial preparations of insect pathogens have appeared against a variety of lepidopterous insect pests.

Strains of *Bacillus thuringiensis* are some of the most studied of all lepidopterous bacterial pathogens (Creighton *et al.* [1], Rogoff and Ignoffo [2], Abdul-Nasr and Abdallah [5], Abdallah and Abul-Nasr [3,4], McGarr *et al.* [6], Somerville *et. al.* [7], Ignoffo *et al.* [8], Dulmage and Martinez [9], Kaya [10], Patti and Carner [11] Gingrich *et al.* [12], Fast [13], Smirnoff [14], Dulmage *et al.* [15], Burges *et al.* [16], Rajamohan and Jayaraj [17], Dabi *et al.* [18], Khalique *et al.* [19,20], Pantuwatana and Youngvanitsed [21], Bell and Romine [22] and Herbert and Harper [23].

The present study elaborates the bio-efficacy of a *Bacillus thuringiensis* strain present in Bactospeine commercial preparation and its comparison with USDA's standard *Bacillus thuringiensis* strain (HD-1-S-1980) against chickpea pod-borer, *Heliothis armigera* (Hubn.), a serious pest of chickpea, *Cicer arietinum* L.

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MATERIALS AND METHODS

Test insect. First and 3rd instar healthy larvae of *Heliothis armigera* (Hubn.) procured from the mass-rearing facility, established according to the method of Ahmad *et al.* [24], were used in the present experimentations.

Bacterial toxins. A commercial preparation of *Bacillus thuringiensis*, namely, Bactospeine (R) wettable powder (WP, 16000 IU Ak/mg, serotype H-3a3b, Biochem Products, Brussels-Belgium > and USDA's standard strain, namely, HD-1-S-1980 < WP, 16000 IU/mg) were used presently.

Preparation of toxin dilutions. Nine and six serial dilutions of the bacterial toxins were used against the 1st and 3rd instar larvae respectively. The dilutions were prepared in fresh liquid diet using USDA's serial dilutions technique elaborated by Shaikh *et al.* [25]. The dilutions were kept in 250 ml capacity sterilized beakers, maintaining diet temperature at 70°. The batches of nine and six serial dilutions ranged from 60.00 to 960.00 Iμ/ml and 120.00 to 720.00 Iμ/ml, respectively, and were detailed as 60.00, 90.00, 120.00, 180.00, 240.00, 360.00, 480.00, 720.00, 960.00 Iμ/ml diet. The diet formula (unpublished) used was agar 40 g, bean powder (*Vigna unguiculata* L.Walp) 500 g, ascorbic acid 7 g, dried active yeast 20 g, methyl-para-hydroxybenzoate 10 g, formaldehyde (10 %) 6 ml and tape water 2.25 litre.

Four to 5 ml of the liquid diet, kept at 70°, containing different toxin dilutions was poured in sterilized standard size glass capsule vials (2.5 cm dia. and 5.5 cm height).

Bioassay with first instar larvae. For each dilution and each replicate, a batch of 25 vials was filled with the diet containing the respective toxin dilution. Each vial was infested with a single Ist instar larva of *H. armigera.* The vials were plugged with sterilized cotton wool and placed

inverted to retard escape of moisture from the diet. Four replications of each concentration were maintained with their respective control.

Bioassay with third instar larvae. In the case of the third instar larvae, the same procedure as above was followed except that batches of 10 vials (each replicate) were used and three replicates along with their respective control were maintained.

Records. After 7 days of incubation, the number of live and dead larvae were counted in the vials of the 1st experiment and after 7 and 11 days in the second experiment. The study with 1st instar larvae was terminated at the first recording after 7 days. However, the study with the 3rd instar larvae was continued and further mortality was recorded after 11 days.

The LC(50) values of the toxins were worked out through probit analysis method [26]. All experiments were carried out at 26° ± 2° and 65-80 r.h.

RESULTS AND DISCUSSION

Table 1 reports the toxicity of the *Bacillus thuringiensis* standard strain and Bactospeine strain determined

Table 1. Toxicity of the standard and bactospeine strains of *B. thuringiensis* at different larval stages and survival periods of *H. armigera.*

Strain	Larval instar	Days after exposure	Mean* LC50	95 % Confidence interval	
				Lower* limits	Upper* limits
Standard	1st	7	56.16	23.84	88.32
Bactospeine	1st	7	63.52	31.04	95.68
Standard	3rd	7	126.40	94.04	159.68
Bactospeine	3rd	7	177.60	145.44	210.88
Standard	3rd	11	65.60	38.56	105.44
Bactospeine	3rd	11	116.80	81.60	151.84

* Iμ/ml

at the 1st and 3rd larval stages of the chickpea pod-borer, *Heliothis armigera* at the 7 days survival period, and that of the latter stage also at the 11 days survival period. The LC(50) values of both the toxins differed significantly at the different larval stages at the 7 days survival period. However, the LC(50) values of the two toxins significantly different from each other at the same larval stage at the 7 and the 11 days survival periods. The LC(50) values of either toxin did not differed significantly for the 3rd instar larvae at the 7 and the 11 days survival periods. The mean LC(50) values along with the standard errors of the estimates are represented diagramatically in Fig. 1.

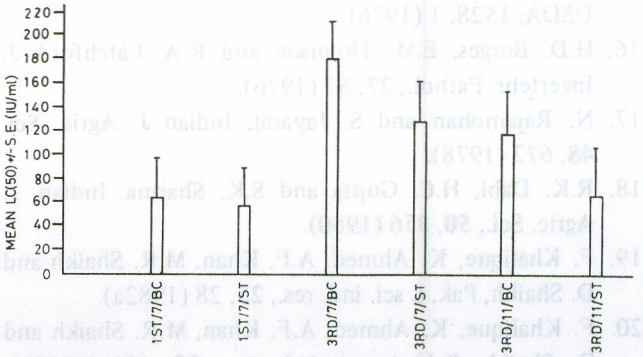

Fig. 1. Larval instar/survival period/strain. BC = Bactospeine; St=Standard.

Only a few workers have studied the comparative toxicity of *B. thuringiensis* strains against lepidopterous larvae on the basis of LC(50) values (Abul-Nasr [3], Burges *et al.* [16], Dulmage and Martinez [9]). Most of the earlier work relied upon percentage mortalities of the test insects (Kaya [10], Patti and Carner [11], Dabi *et al.* [17]). Present findings revealed that a comparative study of LC (50) values gave useful information about the influence of bacterial toxins on diverse test materials.

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