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Effect of thuricide on rice stem borers*

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Abstract. The effect of thuricide, a commercial preparation of *Bacillus thuringiensis* Berliner var. *Kurstaki* was studied on different stages of rice stem borers *Scirpophaga incertulas*, *Sesamia inferens* and *Chilo auricilius*. It was found to be ineffective on the eggs, pupae and adults of these borers. All the age groups of the larval stages got infected. Thuricide was almost equally effective at 1·0, 0·75, 0·50 and 0·25% concentrations. 1% concentration, sprayed at the time of hatching of the larvae, reduced the incidence of dead hearts by 76·36%, white heads by 67·45% and the number of living larvae inside the tillers by 76·87%. It persisted for 15 days or more under green house conditions.

Keywords. Thuricide; rice stem borers; persistence.

1. Introduction

The indiscriminate use of modern organic insecticides do not take into account the importance of various biotic agents like parasite and predators which play a key role in regulating pest population. Biocides do play a definite role in pest control without any harmful effect on other animals. Various commercial preparations of *Bacillus thuringiensis* have been reported to be quite effective against many Lepidopterous insects without any deleterious effect on human being, domestic animals, honey bees, wildlife and also other beneficial insects. The present paper deals with the results on the effect of such a commercial preparation thuricide, on the rice stem borers.

2. Materials and methods

Thuricide$^{(R)}$ HP was procured from USDA through Sandoz India Ltd. It is a high potency WP formulation of *B. thuringiensis* Berliner var. *Kurstaki* (Serotype 3a, 3b, Strain HD-1). The final dried technical product based on the HD-1 strain contained approximately 1·5–2·0% each of protein crystal (-endotoxin), spores and sporangium material, the balance being residual fermentation solids. It contains 30×10^6—52×10^6 viable spore counts per mg of formulated product.

Laboratory evaluation of this biocide was done with different stages of the borers, *Scirpophaga incertulas* (*Tryporyza incertulas*) Walker, *Sesamia inferens* Walker and *Chilo auricilius* Dudgeon. Freshly laid egg masses were exposed to 1% concentration of thuricide. Individual egg masses were maintained in separate glass

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vials of 5× 1 cm size and hatching of the larvae was watched. The effect on different age groups of the larvae was studied by cut stem technique. Rice cut stems of 3–5 cm long were soaked in different concentrations of thuricide suspension and the larvae were allowed to feed on such stems kept in glass vials of 10×2 cm size for 24 hr. Daily observations were recorded on the disease development and mortality of the larvae at the time of changing the fresh cut stems. Freshly emerged moths were released on plants covered with glass cages and sprayed with 1% thuricide. Daily observations on the egg laying capacity and mortality of the moths and hatching of the eggs were recorded. Check treatments in all the cases were similarly treated with distilled water. The temperature of 26±1°C was maintained throughout the period of experimentation.

Green house evaluation of this biocide was done in caged microplots of 1×1 m size. Healthy seedlings of the rice variety Jaya were planted with a spacing of 15×15 cm. 20 field collected moths of *S. incertulas* were released per plot and were allowed to lay eggs for one night. Next morning all the moths were removed from each cage. The number of egg masses was fixed at 10 per cage. Thuricide was sprayed at 1·0 and 0·5% concentrations, an hour before hatching of the larvae. Check plots were sprayed with water. Each treatment was replicated four times. Observation on the extent of damage was recorded on the 20th day after spraying.

In order to study the persistence of thuricide, potted rice plants were sprayed with 1·0% concentration and covered with lamp chimneys. Check treatments were sprayed with water and were isolated from treated pots to avoid contamination. Each treatment consisted of daily careful release of 10 freshly hatched larvae each of *C. auricilius* and *S. incertulas* in three replications. Observation on the number of dead hearts and the number of living larvae present inside the tillers was recorded on the 20th day after each release up to 25 days.

3. Results and discussion

3.1. *Laboratory evaluation*

There was normal hatching of the eggs of all the three borers indicating that thuricide was not effective against the egg masses. Larval stages of all the three borers were found susceptible. In general they lost appetite and stopped feeding once the lethal dose was injected. The infected larvae became sluggish and did not react to stimuli indicating derangement of nervous system. The cadaver emitted a foul odour. Isolation yielded typical *B. thuringiensis* colonies. All the age groups of the larvae

Table 1. Time taken for complete mortality by stem borer larvae due to thuricide (1·0%) application

	Age of larvae (days)				
	Freshly hatched	7	10	15	21
S. incertulas	2	4	5	5	7
S. inferens	2	5	4	4	5
C. auricilius	2	4	3	5	5

Table 2. Time taken for mortality of 7 days old stem borer larvae at different concentrations of thuricide

	Concentrations (percentage)					
	1.00	0.75	0.50	0.25	0.125	0.0625
S. incertulas	5	6	5	6	8	10
S. inferens	6	6	5	6	15	15
C. auricilius	5	5	5	5	6	8

Table 3. Effect of thuricide on the incidence of dead hearts, white heads and number of living larvae present in the plant

	Dead hearts		White heads		Living larvae	
Concentration (%)	Incidence (%)	Reduction (%)	Incidence (%)	Reduction (%)	Incidence (%)	Reduction (%)
Check	38·19	—	29·86	—	68·06	—
0·5	23·61	38·18	13·19	55·83	36·81	66·87
1·0	9·03	76·36	9·72	67·45	18·75	76·87

were found susceptible to 1 % concentration of thuricide. However, there was a delay in mortality with increase in the age of the larvae (table 1). When the larvae pupated after a lethal dose, the pupae were found dead.

Thuricide was almost equally effective on larve of all the three species of borer at concentrations of 1·0, 0·75, 0·50 and 0·25 %. However, at lower concentrations there was a delay in getting cent per cent mortality, the delay being more for *S. inferens* (table 2).

Thuricide was ineffective on the pupal stages. Healthy adults emerged from pupal, even when these were kept at 1 % concentration for 24 hr. It was also not effective at 1 % concentration against the adults of all the three borers in so far as their egg laying capacity, mortality and hatching of the eggs was concerned.

3.2. *Green house evaluation*

The results revealed a considerable decrease in the extent of damage due to the treatments over check plots, 1·0 % being superior over 0·5 % spray (table 3). The eggs started hatching an hour after spraying by which time a thin film of the biocide appeared on the leaf surface. Normally the larvae take 10–133 min from the time of hatching till they get entry into the tillers (Yadava *et al* 1973; Puttarudriah 1945; Banerjee and Pramanik 1964). They caught infection within this time and the cadavers were seen on the leaf surface next day. Some larvae carried the infection and got entry inside the tiller but were found dead when the tillers were dissected open.

3.3. *Persistence*

Results on the persistence of thuricide revealed 90–100 % mortality of the larvae during the first fortnight with 0–9·65 % incidence of dead hearts, beyond which there

Table 4. Effects of thuricide on mortality of larvae and incidence of dead hearts.

5-day period	*S. incertulas*		*C. auricilius*	
	Mortality (%)	Dead hearts (%)	Mortality (%)	Dead hearts (%)
First	98·67	0·76	99·33	0·84
Second	97·33	3·47	98·00	2·46
Third	90·67	9·65	94·00	9·24
Fourth	71·33	15·38	73·67	13·91
Fifth	57·33	30·63	50·00	30·83
Check	20·00	72·72	13·33	60·87

was a rapid fall in mortality rate with increase in the incidence (table 4). It is, therefore, necessary to repeat the spray once in every fortnight. Our earlier results on the field efficacy of thuricide revealed no significant difference in the incidence of white heads between weekly spray and fortnightly spray (Annual Report, PL 480 Project, 1975). Hall *et al* (1961) observed the persistence of commercial preparations of *B. thuringiensis* only up to 12 days in the control of cabbage looper, *Trichoplusia ni.* Heimpel (1967) reported the effective persistence of *B. thuringiensis* in the field to be not more than two weeks. In the present experiment, even though the persistence was found to be more than 15 days under green house conditions, its field efficacy has to be judged keeping in view, the findings of Cantwell and Franklin (1966), Cantwell (1967) and Yadava and Vyas (1968) who reported that the spores, although quite resistant to temperature extremities, desiccation and many bacteriostatic compounds, are relatively sensitive to sunlight and ultraviolet irradiation.

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