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Pathogenicity and Host Range of *Beauveria* nr. *bassiana*, a Fungal Pathogen of *Chilo infuscatellus* Snellen

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ABSTRACT

Second and third instar larvae of the shoot borer *Chilo infuscatellus* Snell., were more susceptible (51.47 to 65.2%) to the fungus, *Beauveria* nr. *bassiana* even at a low dosage (10^5 or 10^6 spores/ml). At 10^7 spores/ml, the mortality observed was 68.53-75.93 %. Mortality of the larvae decreased with increase in larval age or decrease in the concentration of the fungus. The fungus took less time to cause mortality in second instar larvae and the incubation period increased with increase in the age of the larvae or decrease in the dosage. All the six species of phytophagous insects tested *Viz.*, *Chilo sacchariphagus indicus* (Kapur), *C. partellus* Swinhoe, *Scirpophaga excerptalis* Walker, *Sesamia inferens* Walker, *Heliothis armigera* Hubner and *Spodoptera litura* Fabricius were susceptible to the fungal infection. The mean mortality of third instar larvae varied from 50.0 to 65.0 per cent in the different species. The fungus was not infective to *Sturmiopsis inferens* Tns. the principal larval parasite of the shoot borer.

Key Words : *Beauveria* nr. *bassiana*, *Chilo infuscatellus*, pathogenicity, host range

The shoot borer *Chilo infuscatellus* Snellen is cosmopolitan in distribution (Avasthy and Tiwari, 1986) and poses serious problems to cane cultivation under drought and hot summer conditions. Recently, a fungus *Beauveria* nr. *bassiana* was reported to infect shoot borer (Easwaramoorthy and Santhalakshmi, 1987), but no detailed study has been carried out on this fungus. With a view to find out the possibility of utilising the fungus for the control of shoot borer, detailed studies were carried out on the pathogenicity and host range of the fungus.

MATERIALS AND METHODS

Fungus Culture

The pure stock culture of *Beauveria* nr. *bassiana* maintained in Czapek-dox agar slants was subcultured at an interval of one month on Czapek-dox agar slants. In order to obtain sufficient quantity of inoculum, the pathogen was cultured on 100g of pieces of moist sterile carrots, in 250 ml Ehrlenmeyer flasks. Three weeks' old culture was used in all the experiments by which time the fungus sporulated abundantly. Fully sporulated fungal mat along with carrot pieces was taken out, thoroughly washed in water, filtered and used at the required spore concentration. The spore concentration was determined using a double ruled Neubaur haemocytometer.

Pathogenicity Studies

Different stages of the shoot borer larvae were collected from the fields of the Sugarcane Breeding Institute as well as from cultivators' fields. The larvae were surface sterilized with 1% sodium hypochlorite solution and rinsed in two changes of distilled water before treatment. The excess moisture was removed by blotting them on filter paper. The larvae were separated instar-wise based on head capsule width (Easwaramoorthy, 1984).

Suspensions of fungus having concentrations of 10^3, 10^4, 10^5, 10^6, and 10^7, spores/ml along with 0.05% teepol (wetting agent) were sprayed on the shoot borer larvae. The larvae were then transferred to plastic boxes (7 cm dia x 7.5 cm ht) provided with

filter paper at the bottom to absorb excess moisture and two pieces of sugarcane shoot bits split open at one end. Two or three larvae were maintained in a box. Each treatment was replicated thrice with 10 larvae per replication. A suitable control was also maintained. The filter paper and shoot bits were changed daily after recording mortality due to fungus and other causes. The per cent mortality due to fungus infection and time taken for kill were calculated.

Host Range

The pathogenicity of the fungus on third instar larvae of sugarcane internode borer, *Chilo sacchariphagus indicus* (Kapur), sugarcane top borer, *Scirpophaga excerptalis* Walker, sorghum stem borer, *Chilo partellus* Swinhoe, pink borer, *Sesamia inferens* Wlk., tobacco leafworm, *Spodoptera litura* Fab. and gram caterpillar, *Heliothis armigera* Hubner was studied by spraying a spore suspension containing 10^6 or 10^7 spores/ml. Each treatment was replicated thrice with ten larvae per replication. A suitable control was also maintained. The internode borer, sorghum stem borer and pink borer larvae were maintained on artificial diet developed by Mehta and David (1978), Taneja and Leuschner (1985) and Easwaramoorthy *et al.* (Unpubl.) respectively after treatment. In the case of top borer, larvae were treated *in situ* by longitudinally splitting open the infested cane top. After treatment, the split ends were held in position by rubber bands and the cane tops were planted in moist sand. The sand was moistened every day. The tobacco leafworm was fed with castor leaves and gram caterpillar with soaked bengalgram seeds. Mortality of larvae due to fungus infection and time taken for kill were recorded.

Safety of the fungus to *Sturmiopsis inferens* Tns.

Preliminary studies were conducted to find out the effect of the fungus on the principal larval parasite of the shoot borer. The parasite culture was maintained as per the method described by David *et al.* (1980). In the first experiment, freshly formed puparia were dipped in spore suspension containing either 10^6 or 10^7 spores/ml along with 0.05% teepol. After one minute, the puparia were removed and placed individually on moist synthetic sponge in plastic boxes. The treatments were replicated thrice with 10 puparia per replication. Suitable control was also maintained. Observations were made daily on the adult emergence and mortality if any due to fungal infection.

Table 1. Effectiveness of *Beauveria nr. bassiana* against various stages of shoot borer

Dose (Spores/ml	Mortality (%)+				Mean
	II instar	III instar	IV instar	V instar	
10^3	34.07^{a} (5.73)j	31.10^{a} (6.20)j	30.00^{a} (6.50)j	26.67^{a} (6.83)j	30.46^{a} (6.32)k
10^4	44.07^{a} (5.57)j	37.77^{a} (5.90)hi	33.33^{a} (6.20)ij	30.00^{a} (6.53)i	36.29^{a} (6.05)j
10^5	51.47^{ab} (5.00)i	51.47^{ab} (5.50)h	43.33^{a} (5.80)hi	36.67^{a} (5.87)h	45.73^{b} (5.54)i
10^6	65.20^{bc} (4.20)h	62.23^{b} (5.00)g	50.00^{a} (5.20)gh	40.00^{a} (5.53)g	54.33^{bc} (4.98)h
10^7	75.93^{c} (3.67)g	68.53^{b} (4.60)g	56.67^{a} (4.90)g	46.67^{a} (5.40)g	61.95^{c} (4.64)g
Mean	54.15^{z} (4.83)	50.22^{xy} (5.44)	42.67^{yz} (5.72)	36.00^{z} (6.03)	45.76 (5.51)

+ Mortality corrected using Abbott's formula
In vertical columns means followed by same letters are not different statistically (P=0.05) by F test
Figures in parentheses indicate the time taken for kill in days

In the second experiment, freshly emerged adults were sprayed with the fungus at 10^6 or 10^7 spores/ml along with teepol 0.05%. The treated flies were released into gestation cages (12 x 9 x 12 cm) at the rate of five per cage. The flies were fed with 50% honey and water through cotton swabs. The treatments were replicated thrice with five adults per replication. Suitable control was also maintained. The flies were observed daily for their behaviour and mortality. Data were also collected on the longevity of adults.

RESULTS AND DISCUSSION

Pathogenicity Tests

Data presented in Table 1 shows that the difference in the susceptibility of different stages of shoot borer larvae to the fungus was highly significant. When all the doses were considered together, maximum per cent mortality (54.15) was observed in second instar stage followed by third instar (50.22). The overall mortality of fourth and fifth instar stages were significantly low. Similar results were reported earlier with *B. bassiana* in the case of *Malacosoma neustria* L. (Stefanlak, 1978) and *Hyblaea puera* Cramer and *Pyrausta macheralis* Walker (Agarwal *et al.*, 1985). The study also revealed that the mortality increased with increase in spore concentration. The dosage of 10^7 spores/ml was more effective and caused 61.95% mortality followed by 10^6 spores/ml dosage (54.36%). Walstad and Anderson (1971) also found that the mortality was a function of the quantity of inoculum applied. This clearly showed that the rate of mortality was directly proportional to the dosage of the fungus and the susceptibility of the shoot borer larvae decreased with increase in the larval age. The time taken for kill in second, third, fourth and fifth instar larvae ranged from 3.67 to 5.73; 4.60 to 6.20; 4.90 to 6.50 and 5.40 to 6.83 days respectively at the fungus concentrations ranging from 10^3 to10^7 spores/ml. This revealed that the incubation period increased with increase in age of the larvae. When the different dosages were compared, the incubation period decreased with increase in the dosage of the fungus.

Host Range Studies

All the six species of insects were found to be equally susceptible to the fungus (Table 2). The mean per cent mortality ranged from 50.0 in *S. excerptalis* to 65.0 in *C. sacchariphagus indicus*. The pathogenicity of *B. bassiana* to *Heliothis* (Teakle, 1977), *S. excerptalis* (Steinhaus and Marsh, 1962), *S. inferens*

Table 2. Host range of *Beauveria nr. bassiana*

Host	Mortality (%)+		
	10^6 spores/ml	10^7 spores/ml	Mean
C. sacchariphagus indicus	60.00[a] (6.20)jk	70.00[a] (5.50)ij	75.00[c] (5.80)j
C. partellus	56.67[a] (6.00)ij	66.67[b] (5.60)j	61.67[c] (5.80)j
S. excerptalis	46.67[a] (7.40)l	53.33[b] (6.50)k	50.00[c] (6.95)k
S. inferens	54.80[a] (5.80)i	61.87[b] (5.30)i	58.33[c] (5.55)i
H. armigera	51.10[a] (5.20)g	58.13[b] (4.50)g	54.62[c] (4.85)g
S. litura	58.53[a] (5.50)h	65.20[b] (4.90)h	61.87[c] (5.20)h

+ Mortality corrected using Abbott's formula
In vertical columns means followed by same letters are not different statistically (P=0.05) by F test
Figures in parentheses indicate the time taken for kill in days

Table 3. Effect of the fungus on pupae and adults of *Sturmiopsis inferens*

Dose (Spores/ml)	Time taken for adult emergence (days)*	Adult longevity (days)*
10^6	9.1	12.0
10^7	8.9	11.8
Control	9.2	12.3

* Differences between the means not significant

(Israel and Padmanabhan, 1978) and *S. litura* (Rangasamy *et al.*, 1968) has been already reported. This study shows that the fungus has a wide host range.

There was an increase in the per cent mortality of larvae with increase in the dosage of the fungus in all the species of insects, as noticed in shoot borer. The time taken for kill was found to be highly significant both between hosts and between dosages (Table 2). The minimum incubation period of 4.85 days was observed in gram caterpillar while the maximum was noticed in top borer (6.95 days).

Safety Test

No mortality, either in pupae or adults of *S.inferens* was observed when treated with 10^6 or 10^7 spores/ml. Time taken for adult emergence and adult longevity was not altered significantly by the fungal treatment (Table 3) indicating its safety to the larval parasite.

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