J.Biol.Control, **8** (2), 133-135, 1994

Pathogenicity of *Beauveria bassiana* (Bals.) Vuill, on Developmental Stages of Rice Hispa, *Dicladispa armigera* (Olivier)

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Phenological studies on the white muscardine fungus *Beauveria bassiana* (Bals.) Vuill., and *Dicladispa armigera* (Olivier), a serious insect pest of rice in Assam, India (Hazarika and Dutta, 1991), revealed that the fungus was adapted to the rainfed rice ecosystem. The fungus occurred naturally as an effective biocontrol agent suppressing *D.armigera* populations (Hazarika and Puzari, 1990; Puzari and Hazarika 1991, 1992). Agarwal (1990) showed the association of *B.bassiana* with egg, larva, pupa and adults of different insects with variable susceptibility to different stages. This investigation depicts such effects on the embryonic and post embryonic stages of *D. armigera*.

Pathogenicity of *B. bassiana* to different stages of *D. armigera* was studied. Pathogenicity of *B. Bassiana* on rice hispa adults was performed as per method of Puzari *et al.* (1994). Mated 6 - day adult females were caged for oviposition on rice seedling of the same age (Culture 1) and fifty eggs (24 h old) were sprayed *in situ* with the conidial suspension and allowed to air - dry for 30 min. These treated seedlings were offered for oviposition by 6 day-old mated females for 24 h. Eggs were observed for the development of fungal growth as well as hatching upto 10 days beginning from 3rd day since the incubation period ranged from 3-5 days with hatching percentage of 56.79 to 76.25. Fifty 4th instar larvae (24 h post moult) were allowed to crawl on seedlings sprayed with conidial suspension 30 min prior to their release. Fifty pieces of rice leaves containing one pupa per piece were cut and sprayed with the inoculum. Each pupa was kept individually inside a test tube after air drying and incubated at 25 ± 1^{0}C. All the treatments were replicated three times. Controls were sprayed with 0.023% Tween-80 solution. Per cent mortality due to fungal infection was calculated using Abbott's formula (Abbot, 1925). Data were subjected to analysis of variance.

In order to study the efficacy of the fungus in the field, twenty days - old Culture-1 seedlings were transplanted in 4 x 4 m plots at a spacing of 25 x 25 cm. Adults were released 10 days after transplanting at a rate of 10 adults/hill. Each plot was covered by mosquito proof nylon net of size 4.5 x 4.5 x 2.75 m. Four days after the release of insects, *B. bassiana* spores at a concentration of 10^7 spores/ml in water mixed with Tween 80 (0.23 ml/l) was sprayed @ 700 l/ha with high volume knapsack sprayer. Each treatment was replicated three times in RBD and the experiment was repeated in 1991 and 1992. Control Plots were sprayed with water mixed with Tween - 80 and drifting was prevented by erecting aluminium sheets around each plot during spraying operations. Mortality of eggs, larvae, pupae, and adults due to infection was recorded after 10 days of inoculation. These data were subjected to ANOVA.

Table 1shows the percentage of infecton by *B. bassiana* on different post embryonic stages on inculation under laboratory and field conditions. Except the egg stage, more than 90% infection of the post embryonic stages by *B.bassiana* under laboratory conditions was recorded. There was no infection on 24 h old eggs. When the ovipositing females were allowed to lay eggs on *B.bassiana*-treated leaf surfaces, 77.78% eggs were infected in the laboratory and 98.61% under field condition. Eggs were laid individually by partial insertion

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Table 1. Effects of *B. bassiana* on developmental stages of *D. armigera* in laboratory and field condition (artificial inoculation)

Stage	Mean % Infection ± SD	
	Laboratory	Field
Egg	a 0.00	98.61 ± 0.75
	b 77.78 ± 6.93	
Larva	98.98 ± 1.18	12.85 ± 0.98
Pupa	94.33 ± 1.93	12.94 ± 1.26
Adult	91.60 ± 2.97	34.38 ± 4.80
CD (P = 0.05)	8.4220	3.7452
(P = 0.01)	12.7534	5.6713
F (Calculated)	15.7582	747.6718

a Inoculation after egg laying, b Inoculation before egg laying. df = 3,6.

into the lower leaf epidermis and covered by a "gummy substance" from the malphigian tubules (Deka, 1990). In field condition, *B.bassiana* spores remained on the leaf surface (Rombach *et al.*, 1988), and during the process of oviposition, eggs may get infected with such spores on plant surface. In laboratory and field inoculation, the eggs which were already laid escaped *B.bassiana* attack whereas, those eggs laid after inoculation did not. The eggs laid on sprayed leaves came in contact with the ino culum during the process of egg laying and got infected.

The rate of infection of larvae, pupae and adults were comparatively lower under field condition than in the laboratory. Larvae and pupae of *D.armigera* showed 98.98% and 94.33% mortality under laboratory inoculation. As we allowed the 4th instar larvae to retunnel into the treated leaf they came in contact with the spores and got infected within 12 days of inoculation. Beavers *et al.* (1972) reported that 76.9% of *Diapreps abbreviatus* larvae were killed by this fungus. We applied the spore suspension directly to the cut leaf pieces containing pupae due to which they were also infected. In contrast, Agarwal (1990) observed pupae of *Heliothis armigera* (Hbn) and *Hyblaea puera* Cramer to be less affected (0% and 20% respectively) by *B.bassiana. D. armigera* larvae are leaf miners. Hence, the larvae do not come in contact with the fungus sprayed on leaf surface under field condition.

More than 90% of the adults were killed when caged and treated with the fungus under laboratory condition as also reported earlier (Harzrika and Puzari, 1990; Puzari and Hazarika, 1991, 1992) and 34.38% on field inoculation. Low level incidence by this fungus under field condition was also reported by Goyer and Benjamin (1971) and Feng *et al.* (1990). Such a comparatively low level of incidence under field condition may be justified because *Beauveria* rarely caused epizootics on aerial plant surface but commonly in more cryptic habitats. Besides, the low field infection may be due to the high temperature that prevailed inside the net in the rice field (max. 35 ± 2^{0}C during bright sunny hours) since, the temperature optima of *B.bassiana* for spore formation was 30^{0}C and for mycelial growth and spore germination 24^0 to 30^{0}C (Teng, 1962). The fungus may also be required to apply in higher doses in the field which needs further studies.

KEY WORDS : *Dicladispa armigera, Beauveria bassiana*, developmental stages

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