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Preliminary Studies on the Pathogenicity of *Metarhizium anisopliae* (Metschn.) Sorokin var. *anisopliae* to Cutworm *Agrotis segetum* (Schiff.)

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ABSTRACT

The entomopathogenic fungus, *Metarhizium anisopliae* (Metschn.) Sorokin var. *anisopliae* was found pathogenic to the larvae of *Agrotis segetum* (Schiff.), *Agrotis ipsilon* (Hufnagel) and *Agrotis spinifera* (Hubn.). It was also found pathogenic to eggs of *A. segetum*. Soil application of the fungus gave 45% mortality of last instar larvae of *A. segetum* at a concentration of 1.2×10^7 spores/g of soil. The fungal spores at 10^7/ml sprayed on *A. segetum* eggs gave 100% mortality. Field application of spores on the eggs proved effective in controlling the pest. The study indicates the scope of using the fungus against the pest in the field.

KEY WORDS: *Metarhizium anisopliae*, pathogenicity, *Agrotis Segetum*

Cutworms are well known pests of potato, oats, tobacco, pulses, cabbage, beet root, groundnut, peas etc. (David and Kumaraswami, 1982). In Gujarat, three cut worm species *viz.*, *Agrotis ipsilon* (Hufnagel), *Agrotis segetum* (Schiff.) and *Agrotis spinifera* (Hubn.) are known to occur. Of these, *A. segetum* is a predominant species. A fungal pathogen, *Metarhizium anisopliae* (Metschn.) Sorokin var. *anisopliae* isolated from the field population of white grubs (Patel *et al.*, 1986) was tested against the cutworms. Pathogenicity of this isolate was tested against the eggs and larvae of *A. segetum* in laboratory as well as in the field. The results obtained are presented in this paper.

MATERIALS AND METHODS

For preliminary pathogenicity testing, twenty five healthy larvae of each species of cutworm were infected by the topical application of the fungus (Thomas, 1974). For testing the efficacy of the fungus against the larvae of *A. segetum*, three kg of sterilized soil was treated with *M. anisopliae* spore suspension prepared in distilled water containing 0.1% Tween-80 solution to have concentrations of 1.2×10^6, 3.6×10^6, 6.0×10^6, 8.4×10^6 and 1.2×10^7 spores/g of soil. Treated soil was transferred into round galvanized iron-sheet cages (30 x 10 cm). In controls, soil was moistened with 0.1% Tween-80 only. Same moisture level was maintained in all the cages. Fifty laboratory-reared final instar larvae of *A. segetum* were released in each cage. They were provided daily with potato

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leaves. The larvae were observed for the development of mycosis.

Laboratory-reared eggs of *A. segetum* were transferred in a Petri plate lined with filter paper. Spore suspensions of the fungus at the concentrations of 1×10^9, 1×10^8, 1×10^7, 1×10^6, 1×10^5 and 1×10^4 spores/ml of water containing 0.1% Tween-80 were prepared. Five millilitre of each suspension was distributed into Petri plates containing eggs by a potters tower at a constant air pressure of 25 kg/cm^2. In all, 100 eggs of *A. segetum* were used under each concentration. In control, 100 eggs were sprayed with sterile Tween-80 solution After 4 days of incubation at 27°C, the number of infected and hatched eggs was counted under the sterioscopic microscope. Eggs showing white mycelial growth indicated infection. A larva half way out of the egg shell was considered as hatched. Hatched larvae were transferred onto potato leaves in plastic bowls and observed for 5 days.

In field testing, four different spots of one sq.m. each were selected in a potato field at Anand. In each plot, laboratory-reared mated females were allowed to lay eggs by encaging them. After the eggs were laid, the females were removed. One, five and ten g samples of *M. anisopliae* spore powder (1×10^6 spores/g powder) were suspended in one litre of sterile distilled water containing 0.1% Tween-80 and the suspensions thus obtained were thoroughly sprayed in three different plots with the help of a Ganesh hand sprayer. In control plot, potato plants were sprayed with water containing Tween-80 solution only. Leaves and twigs of potato plants bearing *A. segetum* eggs were collected next day and observed for hatching and development of mycosis in the laboratory.

RESULTS AND DISCUSSION

Results showed that the fungus was pathogenic to larvae of all the three species of cutworm when tested in the laboratory by topical application. When tested through soil application, the fungus induced 6 to 45% mortality in the larvae of *A. segetum* (Table 1).

TABLE 1. Effect of soil treatment with *M. anisopliae* on *A. segetum* larvae.

Number of spores per g soil	Percentage died with *M. anisopliae**	Percentage* pupated
1.2×10^7	45.0a	42.9e
8.4×10^6	32.5b	58.0d
6.0×10^6	20.0c	72.0c
3.6×10^6	14.0c	75.9bc
1.2×10^6	6.0d	84.3ab
Control	0.02e	90.0a

* In vertical columns, means followed by similar letters are not different statistically (p=0.05) by L.S.D.

Maximum mortality was obtained at a concentration of 1.2×10^7 spores/g soil.

The results revealed that the fungus was also pathogenic to eggs of *A. segetum*. When tested in the laboratory at different concentrations by spraying the spores on the eggs, it was found that 37 to 100% of the eggs were infected (Table 2). The infected eggs first showed white mycelial growth which later developed into green sporulating growth. Infection of hatching larvae through chorion and through integument during the movement

TABLE 2. Effect of *M. anisopliae* on the eggs of *A. segetum*.

spores/ml	% mortality due to *M. anisopliae*	% hatched	% larval survival after 5 days
10^9	99.9a	0.02e	0.02d
10^8	99.9a	0.02e	0.02d
10^7	99.9a	0.02e	0.02d
10^6	92.0b	7.1d	0.18d
10^5	75.0c	24.9c	7.9c
10^4	36.9d	63.0b	24.9b
Control	0.02e	98.3a	70.1a

In vertical columns, means followed by similar letters are not different statistically (p=0.05) by DMRT.

or feeding on the treated part can result in considerable mortality in young larval population (Rodriguez and Fargues, 1980). This is clear from the results where with the increase in spore concentration, percentage of larvae living after five days decreased.

The eggs are generally laid on the leaf surface or on moist soil. The possibility of controlling the pest population right at the

TABLE 3. Effect of *M. anisopliae* on the eggs of *A. segetum* under field conditions.

spores/ml	No. of eggs collected	% infected with *M. anisopliae*	% hatched	% larvae living after 5 days
1 x 10^7	39	51.28	48.71	26.31
5 x 10^6	48	29.16	70.83	47.05
1 x 10^6	35	14.29	82.85	62.06
Control	25	—	96.00	79.16

egg stage was examined by treating the eggs with spores of *M. anisopliae* under field conditions. Here a maximum infection of 51.28% was observed with the highest concentration tested. Percentage of larvae living after five days increased with decrease in the spore concentration (Table 3).

Thus, *M. anisopliae* offers much scope as a biocontrol agent of larval population of *A. segetum* through soil application or by mixing the fungal spores with attractive baits at high concentration to ensure the infection. Also, the pest population can be checked by application of the fungal spores on foliage during the egg laying period. Foliar application of the fungus can also help in checking the larval population of *Agrotis* spp. as they feed on the leaves during night.

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Efficacy of the Bacterial Spore Parasite, *Pasteuria penetrans* and oil cakes in the Control of *Meloidogyne javanica* on Tomato

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ABSTRACT

The efficacy of the bacterial spore parasite, *Pasteuria penetrans* (Thorne, 1940) Sayre and Starr, 1985 in combination with four oil cakes *viz.*, castor (*Ricinus communis* L.), gingelly (*Sesamum indicum* L.), groundnut (*Arachis hypogaea* L.) and neem (*Azadirachta indica* Juss.) was tested under greenhouse conditions for the control of *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949 on tomato cv. Pusa Ruby. The bacterium as well as oil cakes reduced nematode infestation and improved plant growth, but the combination treatments were significantly superior. Among these, *P. penetrans* applied in combination with neem cake was the best treatment giving 75.1 per cent reduction in final nematode population.

KEY WORDS: Biocontrol, *Pasteuria penetrans*, oil cakes, combined efficacy, *Meloidogyne javanica*.

The bacterial spore parasite, *Pasteuria penetrans* (Thorne, 1940) Sayre and Starr, 1985 has been identified as an efficient biocontrol agent of root-knot nematodes (Sayre, 1980; Stirling, 1984). Brown and Nordmeyer (1985) suggested the use of *P. penetrans* in combination with other agents like nematicides for providing a long-term sustainable control of *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949. The results of an investigation conducted to test the efficacy of the bacterium in combination with certain oil cakes on the control of *M. javanica* on tomato, *Lycopersicon esculentum* Mill. are presented.