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.

TABLE 1. Effect of *Pasteuria penetrans* and oil cakes on tomato and *Meloidogyne javanicaxy*.

Treatments	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Galls/ plant	Final nematode population (soil+root) (in 1000)	% reduction in population over inoculated control
Control (Inoculated)	21.46a	3.44a	3.13a	508.7g	69.2h	—
Control (Uninoculated)	33.57i	4.81g	5.03h	—	—	—
P. peneterans	25.43d	3.93cd	3.69bc	231.0d	34.3d	50.4
Castor cake	24.65d	3.91cd	3.64b	314.8e	43.3e	37.4
Gingelly cake	23.53c	3.85bc	3.63b	337.2ef	45.2f	34.7
Groundnut cake	22.58b	3.76b	3.62b	348.4f	47.3g	31.6
Neem cake	25.37d	3.97de	3.74c	234.6d	42.1e	39.1
P. penetrans+Castor cake	29.77g	4.29f	4.31f	109.0b	21.3b	69.3
P. penetrans+Gingelly cake	28.23f	4.09e	4.03e	136.0c	22.3b	67.7
P. penetrans+Groundnut cake	26.74e	3.99de	3.87d	142.6c	26.7c	61·4
P. penetrans+Neem cake	32.36h	4.35f	4.61g	87.4a	17.2a	75.1

x : Mean of 5 replications.
y : Data in columns followed by a common letter were not statistically different (p=0.05) by DMRT.

MATERIALS AND METHODS

The inoculum of *P. penetrans* in the form of spore powder was obtained by multiplying on *M. javanica* following the method described by Stirling and Wachtel (1980). The spore density in the inoculum of *P. penetrans* was estimated according to Stirling (1981) and one mg of spore powder contained 2 x 10^6 spores. An experiment was carried out under pot culture conditions wherein 15-cm-diam. earthen pots were filled with one kg of moist sterilized soil and sand mixture (3 : 1). The inocula of *P. penetrans*, and *M. javanica* and powdered oil cakes were mixed well in pot soil @150 mg (sub-lethal level), 3000 second-stage juveniles and 30 g per kg soil, respectively. Four-week old tomato seedlings cv. Pusa Ruby were transplanted in all the pots. Suitable control treatments were included and all the treatments were replicated five times. Observations on plant growth characters, host infestation and nematode population in soil and root were recorded after 60 days. A 250 ml soil sample was drawn from each pot and processed following Cobb's sieving and sifting method followed by modified Baermann's funnel method. One gram of root taken from homogenous root mixture was stained in acid fuchsin-lactophenol for 1 minute, cleared and macerated for 45 seconds in a waring blender for counting the number of eggs, juveniles and adult stages within the roots. The remaining root was air-dried, powdered and examined for presence of bacterial spores after staining an aqueous suspension following the standard procedure (Mehrotra, 1980).

All data were analysed following the standard procedures for analysis of variance. Differences between means were evaluated for significance according to modified Duncan's multiple range test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

When *P. penetrans* and oil cakes were applied to soil individually and in combinations, growth characteristics such as fresh and dry weight of shoot and fresh weight of root significantly improved (Table 1). Dry weight of shoot increased by 14.2 and 9.3 to 15.4 per cent due to application of *P. penetrans* and oil cakes, respectively. But, when *P. penetrans* was applied in combination with oil cake, there was an appreciable increase in dry weight of shoot ranging from 16.0 to 26.5 per cent. Further, *P. penetrans* and neem cake combi-

nation was found to be the best treatment in improving growth characteristics of tomato plants.

Sixty days after planting, the root galling and the final nematode population showed significant decrease in treatments with *P. penetrans*, oil cakes and *P. penetrans* + oil cakes, with the combination treatments being the most effective among the three (Table 1). Among the combinations, *P. penetrans* + neem cake was found to be the most effective treatment resulting in 82.2 and 75.1 per cent reduction in galling and final nematode population, respectively. Examination of root powder from plants inoculated with *P. penetrans* and *P. penetrans* + oil cakes showed the presence of the bacterium. The effectiveness of *P. penetrans* as well as oil cakes in suppressing root-knot nematodes has been demonstrated by several workers. The results prove that *P. penetrans* and oil cakes are compatible in soil and the multiple stresses exerted by the two, each having a different mode of action, is more effective in suppressing the nematode.

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Management of sheath Blight Disease of Rice with *Trichoderma viride* and some soil amendments in relation to the Population of Pathogen in soil.

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ABSTRACT

Incidence of sheath blight disease of rice was reduced in plots receiving *Glyricidia* leaves, rice husk or lime (main treatment) as well as *Trichoderma viride* (subtreatment). Interactions between *Glyricidia* leaves and *T. viride*/Carbendazim and rice husk/lime with carbendazim were significant. Maximum stimulation of saprophytes and suppression of pathogen were observed in plots amended with *Glyricidia* leaves or rice husk.

KEY WORDS: Rice Sheath blight control, soil amendments, *Trichoderma viride*, carbendazim.

The sheath blight disease of rice caused by *Rhizoctonia solani* Kuhn is soil-borne in nature. Chemical control of the pathogen is extremely costly and quite laborious. Hence, a field experiment was carried out at the Agricultural Research Station, Mannuthy, during the Kharif season (July-August to October-November) of 1985-'86 to study the effect of the biological control agent *Trichoderma viride*, some soil amendments, and fungicide carbendazim on the populations of *R. solani* and soil saprophytes, intensity and incidence of sheath blight disease and yield of grain and straw.

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MATERIALS AND METHODS

The treatments consisted of five soil amendments (rice husk, punna cake, *Glyricidia*