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Evaluation of biological control potential of a thermophilic microbe against *Rhizoctonia solani*

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At different phases of composting of paddy straw for button mushroom cultivation, i.e., outdoor composting, pasteurization and conditioning, different mesophilic and thermophilic microorganisms were isolated. After screening the microorganisms for their antagonistic activities, a thermophilic microbe *Actinomyces* sp. was found to be inhibitory to soil borne plant pathogens e.g *Fusarium oxysporum, Helminthosporium sativum, Rhizoctonia solani*. Infection of *Rhizoctonia solani* in jute was found to be suppressed when the seeds were treated with *Actinomyces* sp.

Key words : Composting, thermophilic microbe, *Actinomyces* sp., *Rhizoctoma solani,* biological control.

INTRODUCTION

Soil borne plant diseases are responsible for 20 per cent crop loss. These are not easy to manage by virtue of their vast host range and difficult to kill resting structures. Control with chemicals is uneconomical and not advisable to avoid ground water pollution, death of non-target beneficial flora and risk of new resistant pathogenis strains (Kim *et al.*, 1992 ; Weter, 1998).

Effective ecofriendly biocontrol agents are best suited for the control of soil borne plant pathogens. During past two decades, several reports discussed the effects of composts to a variety of soil borne plant pathogens and it was suggested that properly stabilized composts do have suppressive activities. Addition of composts to soil from the edge of the compost heap from medium temperature region (45°-55°C) render the compost suppressive to the soil borne plant pathogens such as *Rhizoctionia, Pythium* and *Fusarium* (Hoitink and Fahy, 1986). In view of the above findings the present investigation was undertaken to screen the microflora of mushroom compost for their antagonistic activity against some soil borne plant pathogens and to explore the possibilities of using their astagonistic activities in the biocontrol of the harmful pathogens of plants.

MATERIALS AND METHODS

Paddy straw was moistened with water for 48 hrs. All the ingredients (paddy straw, poultry manure, urea, calcium ammonium nitrate and neem cake) were mixed and watered adequately and stacked into heaps (5' high × 5' wide). On the 4th day, 1st turning was made followed by the 2nd turning on 7th day. During the third turning on the 10th day, gypsum was added.

The compost then was filled in pasteurisation tunnel when the temperature reached to 60°C, the temperature was maintained at the level for 6 hrs for pasteurisation and then gradually brought down to 55°C and maintained at 55°–45°C for 72 hrs for conditioning. Compost was then gradually cooled down to ambient temperature and filled in polythene bags and transferred to cropping rooms. One g of compost was suspended in 10 ml sterilized distilled water, shaken well for 15 minutes, allowed to stand for 5 minutes and serially diluted to suitable dilution. The supernatant was plated on PDA medium and nutrient agar for fungi bacteria and

actionycetes respectively. The plates were incubated at suitable temperature (25°C for mesophilic organisms and 40°C for thermophilic organisms).

Actinomyces sp. was grown at 40°C on nutrient broth in 50 ml medium placed in 250 ml conical flasks along with broken glass pieces. *Actinomyces* sp. was grown for 7 days. Afterwards the flasks were shaken vigorously for 10 minutes and 5 ml of the growth suspension was mixed with 15 ml PDA in petridishes. The plates were inoculated with 0.7-mm diameter blocks of growth of test organism.

In carboxymethyl cellulose gel, growth of antagonist microorganism, *Actinomyces sp.* and the test pathogens *Rhizoctonia solani* were mixed thoroughly. Jute seeds were coated with the gels and dried in ambient temperature for 24 hs. Germination and seedling growth of gel treated seeds were tested by Inclined Glass Plate Blotter Method (Punjabi and Basu, 1982). Mean seed germination, root and shoot lengths were recorded.

RESULTS

Similar types of microflora were found in the surface layer of 25-30°C and deeper layer of 40-50°C temperature ranges. The list of mesophilic and thermophilic organisms are presented in Table 1. The microflora during conditioning after pasteurization in tunnel (45-55°C) consisted of *T. thermophila, Humicola* sp. and *Actinomyces* sp. In primary assay the thermophilic organism *Actinomyces* sp. was found to be antagonistic to most of the mesophilic

Table 1 : Microorganisms isolated at different stages of composting of paddy straw for button mushroom (*Agaricus bisporus*) cultivation.

Phases	Microflora		
	Fungi	Bacteria	Actinomycetes
Compost during outdoor composting			
Surface layer of heaps (25°C-30°C)	*Aspergillus* sp. *Penicillum* sp. *Coprinus* sp. *Doratomyces* sp. *Thielavia* sp.	*Pseudomonas* sp. *Bacillus* sp.	
Deeper layer of heaps (25°C-30°C)	*Chaetomium* sp. *Aspergillus* sp. *Torula thermophila, Humicola* sp.		*Actinomyces* sp.
Compost during conditioning after pasteurization (45°C–55°C)	*Torula thermophila, Humicola* sp.		*Actinomyces* sp.

Table 2 : Evaluation of antagonistic potential of *Actionmyces* sp. against some soil borne plant pathogens.

Antagonistic microorganisms	Plant Pathogens (after 10 days growth)					
	Fusarium oxysporum		*Rhizoctonia solani*		*Helminthosporium sativum*	
	MCD* (cm)	Inhibition (%)	MCD*(cm)	Inhibition (%)	MCD*(cm)	Inhibition (%)
Actinomyces sp.	0.8	85.45	1.45	75.00	1.1	68.57
Control	5.5		5.8		3.5	
C.D. (P=0.05)	0.18		0.26		0.21	

MCD–Mean Colony Diameter

Table 3 : Efficacy of seed treatment with *Actinomyces* sp. on the suppression of infection of *Rhizoctonia solani* on jute.

Seed treatment	Mean seed germination (%)	Mean root length(cm)	Mean shoot length(cm)
Peletted seeds with *Rhizoctonia solani*	25	0.5	0.5
Peletted seeds with *Actinomyces* sp. and *Rhizoctonia solani*	80	2.3	2.75
Peletted seeds with *Actinomyces* sp.	100	2.75	2.9
Seeds peletted without antagonistic microbe	100	2.7	2.9
Untreated seeds	100	2.8	3.0
C.D. (P=0.05)	5.8	0.52	0.63

organisms.

Fusarium oxysporum, Rhizoctonia solani (stem root of jute) and *Helminthosporium sativum* (root rot of wheat) are important soil borne plant pathogens. Bioassay of the antagonist organism was conducted on the mycelial growth of above pathogens. The antagonist *Actinomyces* sp. reduced the growth of all the pathogens significantly.

It is apparent in jute seed peletted with *R. solani* that there was reduction in percentage of seed germination and mean root and shoot length, to the extents of 75, 72.5 and 83.3 per cent. But when seeds peletted with *R. solani* were treated with *Actinomyces* sp. there was significant improvement of germination, to the extent of 55 per cent and also increased shoot and root length to the extent of 64.2 and 77.6 per cent respectively.

DISCUSSION

Bioassay of the antagonist organism against some soil borne plant pathogens produced very interesting results. The mycelial growth of soil borne plant pathogens such as *F. oxysporum, R. solani* and *H. sativum* were found to be inhibited by *Actinomyces* sp. Application of *Actinomyces* sp. by peletting the seeds were found to suppress the infection of *R. solani* in jute seeds significantly. The results of the preliminary investigation have opened up an avenue for further research on the possibility of biocontrol of soil borne plant pathogens under field condition.

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