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Bio-intensive management of collar rot disease of groundnut (*Arachis hypogaea* L.) caused by *Aspergillus niger*

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Abstract
Bio intensive management of collar rot disease using organic amendments were found significantly effective to reduce disease incidence in field conditions. Studied of relative efficacy of various organic amendments with *Trichoderma harzianum* and garlic clove extract in field conditions, Neem cake + soil application with *T. harzianum* was found most effective (58.97%) followed by FYM + soil application with *T. harzianum* (54.59%). Thus, these findings indicated that biological control using bioagents and organic amendments can integrated disease management to manage the collar rot of groundnut incited by *Aspergillus niger*.

Keywords: *Aspergillus niger*, garlic clove, *Trichoderma spp.* and organic amendments

Introduction
Groundnut (*Arachis hypogaea* L.) is a leguminous oilseed crop and India occupies the first position, both with regard to area and production of groundnut in the world. Groundnut is a crop which is mainly cultivated under rain-fed conditions, thus, pathogens have more of a chance to attack the crop. Among the soil borne diseases of groundnut, collar rot caused by *Aspergillus niger* is an important disease. The collar rot (*Aspergillus niger*) of groundnut is an important seed and soil borne disease. This disease appears in two phases viz, pre-emergence and post-emergence phase. In the pre-emergence phase, the seed may rot in the soil or be covered with sooty black masses of spore on germination, the emerging hypocotyls are rapidly killed by these spores. In the post-emergence seedlings collapse and die due to the rotting of the succulent hypocotyls. *A. niger* may cause an average 5 per cent loss in yield but in some areas it may cause as high as a 40 per cent loss. Collar rot causes heavy losses in pod and fodder yield of groundnut. Most of the varieties of groundnut are susceptible to this disease. The bio-intensive method is very needed to keep the disease below the economic threshold level without damaging the agro-ecosystem in soil [8]. *Trichoderma* have been used as biological control agents against soil-borne plant pathological fungi [5]. The main objective of the present study was to find overall efficacy of organic amendments with bio-agent and garlic clove extract to control collar rot disease in field condition.

Experimental
Materials and Methods
Isolation and maintenance of microbes
Groundnut seedlings which showed typical symptoms of collar rot, were cut into small bits using a sterilized blade. The pure pathogen culture (*A. niger*) was made by the hyphal tip isolation method [10]on the solidified PDA medium in petri plates. A typical black mycelium (conidia) growth of *A. niger* was observed after 72 h of incubation, at 25±1°C, in an incubator. This was maintained throughout the study by periodical transfers on (PDA) medium under aseptic conditions, to keep the culture fresh and viable. The bio-agent *T. harzianum* obtained from Department of Plant Pathology, RARI, Durgapura, Jaipur, Rajasthan and maintained throughout the study by periodical transfers on PDA media under aseptic conditions, to keep the culture fresh and viable.

Efficacy of bio-agents and organic amendments against *Aspergillus niger (in vivo)*
The organic amendments (Neem cake, FYM and vermicompost) (Table:1) were thoroughly mixed as per recommended dose in 2×2 m^2 micro-plots. The inoculum was added in furrow at

8-10 cm depth @ 133g/2m row length to increase the disease pressure. In each plot 40 surface sterilized seeds were sown. Sowing was done using *T. harzianum* as soil application with @ 2.5 kg/ha pre-incubated in 100 kg well decomposed FYM, Neem cake and Vermicompost for fifteen days. Surface sterilized seed sown without organic cake in inoculated plot served a control with four replications. Observation on disease incidence recorded up to 45 days and Per cent collar rot incidence was calculated by following formula:

$$\% \text{ disease incidence} = \frac{\text{Number of rotted plants}}{\text{Total number of plants}} \times 100$$

Table 1: Following bio-agents and **o**rganic amendments tested against *Aspergillus niger (in vivo)*

S. No.	Name of treatments
T_1	FYM @ 6t/ha + soil application with *T.* harzianum @ 2.5 kg/ha
T_2	FYM @ 6t/ha + seed treatment with garlic clove extract @ 15% conc.
T_3	Vermicompost @ 2t/ha + soil application with *T.* harzianum @ 2.5kg/ha
T_4	Vermicompost @ 2t/ha + seed treatment with garlic clove extract @ 15% conc.
T_5	Neem cake @ 1t/ha + soil application with *T. harzianum* @ 2.5kg/ha
T_6	Neem cake @ 1t/ha +seed treatment with garlic clove extract @ 15% conc.
T_7	Control

Results and Discussion

Efficacy of organic amendment with bio-agent and garlic clove extract against *Aspergillus niger* in field condition.

All the organic amendments were tested reduced to collar rot incidence of groundnut significantly over control. In the micro-plots of field, the combination of Neem cake + soil application with *T. harzianum* recorded minimum disease incidence of (25.58%) followed by FYM + soil application with *T. harzianum* with (28.31%) as against (61.25%) in control. Neem cake + soil application with *T. harzianum* was found significantly superior over all other treatments resulted maximum disease control with (58.97%) followed by FYM + soil application with *T. harzianum and* Vermicompost + soil application with *T. harzianum* with (54.59) and (50.15%), respectively. Vermicompost + seed treatment with @ 15% concentration of garlic cloves extract was least effective in reducing collar rot incidence. Data depicted in (Table- 2 Fig. 1). [1] reported seed treatment with *T. viride* at 4 g/kg of seed + soil application of *T. viride* at 2.5 kg/ha reduced the collar rot disease in groundnut. *Trichoderma* species are efficient mycoparasites and prolific producers of secondary metabilotes, some of which have clinical importance. Many strains produce elicitors and induce resistance in plants through colonization of root [7]. The *P*. fluorescens strains reduced the root rot infection through several mechenisms including production of lytic enzymes [12], siderophore [9], salicylic acid and hydrogen cyanide [4]. *In vivo* conditions, the combination of Neem cake + *T. harzianum* recorded highest disease control followed by FYM + *T. haziamum*. The efficacy of neem cake and FYM in fungal disease management have been reported by many workers [6][2][11][13]. *Organic* amendments are recommended as biological means to reduce the incidence of several soil borne disease [3]. Soil amendment with FYM led to increase disease control efficacy of fungal antagonistic *Trichoderma spp.* against *Fusarium* wilt of cumin [2]. This indicates that bio-control agent *T. harzianum and* Neem cake + *T. harzianum* might have a significant role in the control of collar rot disease, by reducing the virulence of *A. niger* in the groundnut rhizosphere.

Table 2: Efficacy of organic amendments against collar rot incidence caused by *A. niger (in vivo)*

Treatment	Dose	Germination (%)	PDI*	% disease control
FYM + soil application with T. harzianum	6t/ha+2.5kg/ ha	90.75	28.31	54.59
		(72.29)	(32.15)	
FYM + seed treatment with garlic extract	6t/ha+ 15% conc.	90.25	37.34	40.11
		(71.81)	(37.67)	
Vermicompost + soil application with T. harzianum	2.5t/ha+2.5kg/ha	87.58	31.08	50.15
		(69.36)	(33.88)	
Vermicompost+ seed treatment with Garlic extract	2.5t/ha+ 15% conc.	81.25	39.21	37.11
		(64.34)	(38.77)	
Neem cake + soil application with T. harzianum	1t/hac+2.5kg/ ha	92.75	25.58	58.97
		(74.38)	(30.38)	
Neem cake+ seed treatment with Garlic extract	1t/ha+ 15% conc.	91.34	35.03	43.81
		(72.89)	(36.29)	
Control		72.00	61.25	
		(58.05)	(51.50)	
SEm+		3.55	0.84	
CD (p = 0.05)		10.93	2.60	

Average of four replications

Figures in parentheses are angular transformed values, PDI = Percent disease incidence

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