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ORIGINAL RESEARCH ARTICLE

Management of *Meloidogyne incognita* on Tobacco through *Glomus aggregatum* and Oil Cakes

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ABSTRACT

The management of *Meloidogyne incognita* on tobacco var. VR2 (*Nicotiana tabaccum* L.) through arbuscular mycorrhizal fungus (AMF) *Glomus aggregatum* Schenck and Smith in combination with oil cakes were conducted. Amending the soil with *G. aggregatum* in combination with different oil cakes was effective in reducing root-knot nematode in chewing tobacco var. VR2. Combination of *G. aggregatum* and neem cake significantly increased plant growth characters *viz*., shoot and root length, plant biomass and leaf yield of tobacco followed by application of *G. aggregatum* plus peanut cake. Similarly, reduction in root-knot nematode population, egg mass production, root galling and root-knot index was recorded in *G. aggregatum* plus neem cake.

Key words: Root-knot nematode, *Meloidogyne incognita*, AM fungus, *Glomus aggregatum*, Oil cakes, Tobacco and Management.

1. INTRODUCTION

Tobacco (*Nicotiana tabaccum* L.) is an important commercial narcotic cash crop in Tamil Nadu, India and ranks third in the world. Root-knot nematode, *Meloidogyne incognita* is one of the most important biotic limiting factors in the successful and profitable cultivation of chewing tobacco. Nematodes affect seedling establishment in the nursery, growth and yield in the main field. Among various control measures evolved so far, the biocontrol has the advantages of being safe and economical. Many reports have shown a beneficial effect of AM fungi in improving plant protection or tolerance to soil borne pathogens [1, 2, 3]. The use of AM fungi was reported to be antagonistic to several phytoparasitic nematodes besides being beneficial to a wide range of host plants [4, 5, 6, 7]. Similarly, the soil amendment with oil cakes was reported to suppress plant parasitic nematodes in different crops [8, 9, 10]. Although, the use of AM fungi and oil cakes against nematodes is being examined to a limited extent [11]. The use of AM fungi in combination with oil cakes in transplantable crops was found to be highly beneficial [12, 13, 14]. Earlier studies indicated that *Glomus fasciculatum* alone inoculated flue cured tobacco plants reduced 48.52 per cent root-knot nematode infection [15]. The present study examined the individual and interactive effects of *G. aggregatum* and three oil cakes *viz*., mustard, peanut and neem oil (i) plant growth and leaf yield of chewing tobacco var. VR2 local (ii) on root-knot nematode, *M. incognita* and (iii) on the root colonization and chlamydospore number of *G. aggregatum* and their role in the management of *M. incognita*.

2. MATERIALS AND METHODS

The experiment was conducted in earthen ware pots (30 cm × 18 cm) containing 7 kg autoclaved sandy loam soil (pH 6.5, P, ($NaHCO_3$ extractable) 11.2 mg/kg, total N 0.4 g/kg, silt 112 g/kg) and mixed with rock phosphate @ 22.40 mg P/kg. The soil was made nematode sick by thoroughly mixing freshly hatched second-stage juveniles (J2) of *M. incognita* @ 4000 J2/plant. The AM fungus, *G. aggregatum* Schenck and Smith was mass multiplied on onion (*Allium cepa* L.) and an inoculums rate of 1000 chlamydospores / plant was used. Three oil cakes employed were mustard

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(*Brassica juncea*) (Hook & Thomas), peanut (*Arachis hypogaea* L.) and neem (*Azadirachta indica* A. Juss.) each @ 20 g/plant. The treatments included nematode infested soil check, mustard cake (Mc), peanut cake (Pc), neem cake (Nc), *G. aggregatum* (Ga), Mc + Ga, Pc + Ga and Nc + Ga. Autoclaved soil without nematode infestation served as non-infested soil check. Each treatment was replicated five times in completely randomized block design.

Initially, oil cakes were incorporated into the soil followed by placing mycorrhizal inoculums as thin layer, 5 cm below the soil surface in each pot involving mycorrhizal treatment. Five days later, 30 days old chewing tobacco var. VR2 local seedlings raised in seed pans containing autoclaved soil were transplanted individually into each treated pot. After 60 days of transplantation, five plants (replicates) from mycorrhiza-treated pots were depotted; roots cleared of soil and washed in water. AM fungal colonization of roots was estimated by trypan blue staining technique [16] along with root-knot index (RKI) was scored by using 0-5 scale [17]. Rest of the plants were harvested after 90 days of transplantation for recording plant growth characters *viz*., root and shoot length, shoot and root dry weight, number of leaves, leaf length and leaf breadth, leaf moisture and nematode reproduction rate (NRR) and number of galls and egg masses/plant. The soil was also analyzed for mycorrhizal chlamydospores through wet-sieving and decantation technique [18]. The data were statistically analyzed for variance [19].

3. RESULTS AND DISCUSSION

The AM inoculated with oil cakes significantly increased plant growth and leaf yield of chewing tobacco var. VR2 local compared to that of nematode infested soil (Table - 1). However, the magnitude of increase in each character under report varied with the combinations of *G. aggregatum* and oil cakes. Plant height under mustard cake and *G. aggregatum* treatments was same as that of infested soil indicating that these treatments individually did not give any boost or stimulation to the plant in terms of plant height, whereas, the peanut and neem cakes individually as well as in combination with *G. aggregatum* increased plant height significantly compared to infested and non-infested soil. Similar results also have been reported by Reddy *et al.* [20] in tomato, Nagesh and Reddy [14] in *Crossandra* and Sumathi *et al.* [7] in patchouli. Further, mustard cake did not individually enhanced shoot and root dry weights significantly over the non -infested soil, although it increased plant height over that of infested soil (**Table 1**). These results are in conformity with the findings of previous reports of Vadhera *et al.* [10] who also reported that application of mustard cake did not influence the shoot and root dry weights significantly in ginger. Maximum plant height, dry weight and leaf yield were recorded on plants treated with *G. aggregatum* plus neem cake followed by *G. aggregatum* plus peanut cake. Results further indicated that integration of oil cakes with *G. aggregatum* promoted better growth than their individual applications. Similar observations on enhanced plant response to AM fungi in combination with oil cakes were reported by Reddy *et al.* [11] in acid lime and Nagesh and Reddy [14] in *Crossandra undulaefolia*.

At harvest, the root-knot nematode population in soil was minimum in plants treated with combination of *G. aggregatum* and neem cake. This combination had minimum number of egg masses, root galls and root-knot index (**Table 2**). Application of neem and peanut cake individually resulted in lower RKI and number of egg masses under *G. aggregatum*. However, RKI and number of egg masses under individual application of neem cake, peanut cake and *G. agregatum* were significantly lower as compared to RKI and number of egg masses of infested soil (Table - 2). Further, NRR was also significantly lower in *G. aggregatum* plus neem cake treated plants followed by *G. aggregatum* plus peanut cake treated plants (Table 2). These results are in conformity with the findings of previous reports of Vadhera *et al.* [10], who reported that application of different oil cakes inhibited reproduction in females and penetration of second stage juvenile into ginger roots, besides increasing the yield as per findings of Goswami and Vijayalakshmi [8].

Root colonization by *G. aggregatum* and number of chlamydospores / 50 cc soil was significantly increased when integrated with oil cakes than its individual application (Table 2). Among three oil cakes, neem cake enhanced root colonization by *G. aggregatum* to the maximum and the number of chlamydospores. The observed differences in root colonization and spore number of *G. aggregatum* among its three oil cake combinations could be possibly due to the differences inherent nitrogen, phosphorus and potassium profiles of the three oil cakes. The native N, P and K content of oil cakes were 4.2, 1.9 and 1.4 in mustard, 4.8, 1.1

and 1.4 in peanut and 5.1, 0.9 and 1.7 in neem respectively. It was earlier reported that the response of AM fungi in terms of root colonization and spore number was better under P-deficient soil condition that at normal or high P-conditions [21]. Relating these facts to the present study, the lower root colonization and spore number of *G. aggregatum* when integrated with mustard cake could be due to its higher P-content than that of neem and peanut cakes. The difference in P-content between peanut and neem cakes may not significantly influence *G. aggegatum* root colonization and spore number.

Table 1: Effects of *Glomus aggregatum* and oil cakes on growth of tobacco var. VR2 local infested with *Meloidogyne incognita*

Treatments*	Plant height (cm)		Plant dry weight (g/plant)		Number of leaves / plant	Leaf length tapped (cm)	Leaf breadth tapped (cm)	Leaf moisture (%)
	Shoot	Root	Shoot	Root				
Infested soil check	32.5	18.4	350.85	96.52	18	44.3	28.5	70.5
Non-infested soil check	52.5	27.5	582.60	130.50	20	60.2	36.5	73.4
Mustard cake (MC)	50.5	25.2	525.40	128.47	21	60.5	35.5	74.1
Peanut cake (PC)	54.4	28.5	585.60	132.45	20	61.5	37.4	75.2
Neem cake (NC)	56.5	29.6	610.54	133.50	21	62.0	38.2	76.4
Glomus aggregatum (Ga)	50.5	27.5	580.80	132.45	22	62.5	38.7	75.0
Ga + MC	54.5	30.8	615.45	134.00	21	63.0	38.8	76.5
Ga + PC	58.6	32.5	675.60	135.30	23	63.9	39.1	77.5
Ga + NC	62.5	36.4	685.40	136.45	24	64.2	39.2	78.5
SEM ±	5.2	3.2	5.45	6.25	1.0	1.5	1.8	2.2
CD (P = 0.05)	15.7	9.1	46.90	18.25	4.0	4.1	5.2	6.4

* All cakes @ 20 g/plant and Ga @ 1000 spores/plant were applied.

Table 2: Effects of *Glomus aggregatum* and oil cakes on multiplication of *Meloidogyne incognita*, % mycorrhizal root colonization and spore number of rhizosphere soil

Treatments*	Number/plant		Root-knot index (RKI)	Final nematode population / 250 cc soil	Nematode reproduction rate	AM fungal root colonization, %	AM fungal spore / 50 cc soil
	Shoot	Root					
Infested soil check	183.13	93.20	4.0	678.3	3.46	-	-
Non-infested soil check	-	-	-	-	-	-	-
Mustard cake (MC)	85.10	65.33	3.2	485.6	2.51	-	-
Peanut cake (PC)	80.42	52.46	2.9	425.6	2.58	-	-
Neem cake (NC)	75.53	45.28	2.8	412.3	2.36	-	-
Glomus aggregatum (Ga)	62.40	23.40	2.4	380.4	2.10	56	156.0
Ga + MC	58.42	22.24	2.1	370.3	1.98	62	210.0
Ga + PC	45.23	20.55	2.0	283.3	1.86	64	240.0
Ga + NC	32.46	12.66	1.6	265.4	1.42	72	326.0
SEM ±	1.43	0.67	0.001	3.08	-	2.0	4.00
CD (P = 0.05)	4.24	1.98	0.003	9.11	-	4.0	12.00

* All cakes @ 20 g/plant and Ga @ 1000 spores/plant were applied.

4. CONCLUSION

It can be concluded that application of *G. aggregatum* and neem cake combination increased plant growth characters and reduced RKI, nematode reproduction rate, number of galls and egg masses on chewing tobacco var. VR2 local in sandy loam acidic soils.

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