Research Paper Environment

The Potential Use of Vesiculararbuscular Mycorrhizal Fungi of G. Fasciculatum on Medicinal Plants of Tropical Moist Deciduous Forest of Chhattisgarh

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ABSTRACT

An investigation has been made about the potential use of vesicular arbuscula rmycorrhizal fungi of G. fasciculatum on some medicinal plants. Medicinal plants species selected for the study are Asparagus recemosus, Rauwolfia serpentina , Coleus forskholii, Gloriosa superba and Acorus calamus. The percentage of VAM association is 88+1.0 % and the intensity of formation of vesicles and arbuscules are 70+1.5 % and 20+2.0%, respectively in VAM inoculated Acorus calamus plants. The Dry Matter yield (DMY) of plants grown in different soils (shoot and root dry wt), are seen to increase in VAM inoculated plants in comparison to non inoculated plants . In Acorus calamus DMY in Coal mine soil(171.84gm/plant), Copper mine (181.20 gm/plant) , Fly ash(44.76 gm/plant) ,Skeletal soil (114.30 gm/plant) , and Forest soil(231.90 gm/plant) was found as compared to control plants. Percentage root infection was higher in Acorus calamus was found 71.00 in forest soil in comparison to other soil.

KEYWORDS Asparagus recemosus, Rauwolfia serpentina, Coleus forskholii, Gloriosa superba, Acorus calamus, VAM fungi.

Introduction-

The cultivation of medicinal and herbal plants has assumed greater importance in recent years due to their tremendous potential in modern and traditional medicine. They are also used as raw materials for pharmaceutical, cosmetic and fragrance industries. Indian system of medicine (ISM) uses 25,000 species belonging to more than 1000 genera. About 25% species are used by the industries (Jaleel et al,2009).

Inoculation of VAM fungi during an early stage of acclimatization process has become an alternative strategy for better establishment by improving the plant growth.

The occurrence of micro organisms especially VAM fungi on the medicinal plants have been reported earlier (Jaleel,2009;Jaleel et al,2009;Karthikeyan et al ,2008). The VAM fungi association had not only enhanced the growth of medicinal plants but also improve the productivity of medicinal compounds.

Hence there is a need for research in improving the quality and quantity of drugs produced from native medicinal plants in relatively shorter period and at lower expense by using VAM fungi. In the present study, medicinal plants like Buch (Acorus calamus), Kalihari (Gloriosa superba), Coleus (Coleus forskholii), Sarpgandha (Rauwolfia serpentina) and Satawar (Asparagus recemosus) were selected for assessing their responses to VAM fungus.

Materials and Methods-

Pot culture experiments were conducted using natural un-sterilised soil. Four sets of eight pots were taken and each pot was filled with 5 kg soil. Three pots of each set were treated as inoculated by mixing 500g/pot of pure cultures of G. fasciculatum inoculum having 25 spores/100 g of soil, and the other three were treated as control as there was no addition of VAM inoculums. Seedlings of medicinal plants were transplanted in both treated and untreated control pots. Similar experiments was done for Coal mine, Copper mine soil, Fly ash, Skeletal soil and forest soil .

The plants were regularly watered once in three days. The plants at the time of flowering stage (150 days) were harvested along with their root system and roots were cleared by dipping them in water 2 to 3 times till the adhering soil particles were removed.

Assessment of VAM association and its biomass estimation Few representative root samples from both treated and untreated plants were cut into 1 cm bits and fixed in a standard FAA (formalin acectoalcohol) and processed further for the assessment of VAM colonization (percentage mycorrhizal association) by staining (Phillips et al,1970).The plants were oven dried for 72 h at 70°C root and shoot systems were then weighed.

Statistical Analysis The experiment results were statistically analyzed in the Duncans multiple range test (DMRT) using SPSS 7.0 statistical package. The triplicate sets of data (Table 2,3) were subjected to ANOVA in accordance with Completely Randomized Block Design using NPRC statistical package to quantify and evaluate the source of variation. CD (Critical Differences) values were calculated at P level of 0.05%.

Results and Discussion –

It is clearly evident from the data that the root systems of all medicinal plant species grown in both control and VAM fungus infected soils were invariably found to harbor VAM association. The plants grown in the soil without addition of VAM inoculum; recorded VAM association of 18-40% and the intensity of vesicles was 18 to 40% and arbuscules was 8 to 15%. However, these results were found to be in significant . In Acorus calamus 40% VAM association was found without Inoculum which is higher than the other species.In the inoculated plants, the percent VAM association (68 -90%) and vesicles (40-70%), arbuscules (18 -29%) were highly significant. Among the five medicinal plants the maximum association of VAM was 90+ 1.0% colonization and the intensity formation was 70 and 20% for vesicles and arbuscules respectively in Acorus calamus (M1) plant. This was followed by Rauwolfia serpentina (M4),Gloriosa superba (M2) and Coleus forskholii (M3)). The minimum VAM association 60% colonization and intensity of 40% vesicles and 20% arbuscules were recorded in Asparagus recemosus (M5).

The Dry Matter yield (DMY) of the VAM inoculated plant was higher in different types of soil in comparison to control . Dry Matter yield (DMY) was found to higher without VAM inoculated Acorus calamus plants grown in Forest soil (218.70 g/

plant), Copper mine (170.50 g/plant), Coal mine (144.20 g/plant) and Skeletol soil (110.70 g/plant) followed by Gloriosa superba ,Coleus forskholii , Rauwolfia serpentina and Asparagus recemosus. Similarly, Dry Matter yield (DMY) was found to higher with mycorrhiza inoculation in Acorus calamus plants grown in Forest soil (231.90g/plant), Copper mine (181.20g/plant), Coal mine (171.84g/plant)Fly ash (44.76 gm/plant)and Skeletol soil (114.30g/plant)followed by Gloriosa superba ,Coleus forskholii , Rauwolfia serpentina and Asparagus recemosus.

Similar trends was found in Percentage root infection of plants grown in different soils was higher in mycorrhiza inoculation of plants in comparison to control.

The percentage root infection of the VAM inoculated plant was higher in different types of soil in comparison to control . Percentage root infection without VAM inoculation grown in different soils was found to higher in Acorus calamus.In Forest soil (39.0), Copper mine (28.0), Coal mine (32.0) and Skeletol soil (12.0) followed by Gloriosa superba ,Coleus forskholii , Rauwolfia serpentina and Asparagus recemosus. Similarly, Percentage root infection with VAM inoculation grown in different soils was found to higher in Acorus calamus.In Forest soil (71.0), Copper mine (62.0), Coal mine (78.0) and Skeletol soil (40.0) followed by Gloriosa superba ,Coleus forskholii , Rauwolfia serpentina and Asparagus recemosus.

The VAM colonization and growth response of G. fasciculatum was also observed in all the five medicinal plants. All the five medicinal plants inoculated with VAM fungus have shown improved growth and development as compared to control plants. The control plants have VAM associations varying from 18 to 40% ,when grown in un-sterilized soil due to low level natural inoculum. These results confirm the early reports by Bagyaraj and Manjunath (1980). The significant increase was observed not only in VAM colonization but also in biomass production (dry wt of root and shoot) due to inoculation with Glomus fasciculatum in all the four medicinal plants. The increased growth of treated plants due to mycorrhization of. G. fasciculatum and the above results are in conformity with those of Gupta and Janarthanan (1991) and Earanna et al. (2001). Host plants growing in soils with relatively low nutritional level as in gulberga soil (Reddy and Gaud,1989) are predisposed to effective endophytic fungal invasion (Russell,1975). In the present study, similar situation was observed in all the four medicinal plants, which recorded 68 to 90% VAM association. The root and shoot biomass (dry wt) of the inoculated plants were found to be maximum and significant than that of control in all the four medicinal plant species The reason may be due to the formation of external mycelium around the roots by VAM fungi. The results are in agreement with the findings of earlier work by Gupta and Janardhanam (1991). Basu and Srivatava (1998) have earlier reported such enhanced growth in medicinal plant due to VAM fungal association.

Similar improved growth response was also observed in 10 medicinal plants when inoculated with three VAM fungal species (G. mossae, G. fasciculatum and G. monosporum) for their efficiency by Kumar and Murugesh (2002). They reported mycorrhizal inoculation was more advantageous in obtaining healthy vigorous seedlings and results in higher biomass of medicinal plants that were found to grow better in the field. Thus the present study revealed the positive effect of G. fasciculatum on some medicinal plants.

Table 1.Intensity of VAM formation of some medicinal plants with G.fasciculatum

VAM status						
Control plants				VAM inoculated plants		
Plants	% VAM association	Intensity % of formation		% VAM association	Intensity % of formation	
		Vesicles	Arbuscules		Vesicles	Arbuscules
Acorus calamus (M1)	40±1.5	22±2.0	15±1.0	90±1.0	70±1.5	20±2.0
Gloriosa superba(M2)	18±1.5	12±0.5	16±0.5	69±2.5	50±1.5	20±1.5
Coleus forskholii(M3)	20±0.5	10±0.5	8±1.5	68±1.5	50±1.5	18±2.5
Rauwolfia serpentina (M4)	30±1.0	19±0.5	11±0.5	75±3.5	65±1.5	29±1.5
Asparagus recemosus (M5)	35705±1.0	20±0.5	14±1.5	60±1.0	40±1.5	2400±1.5

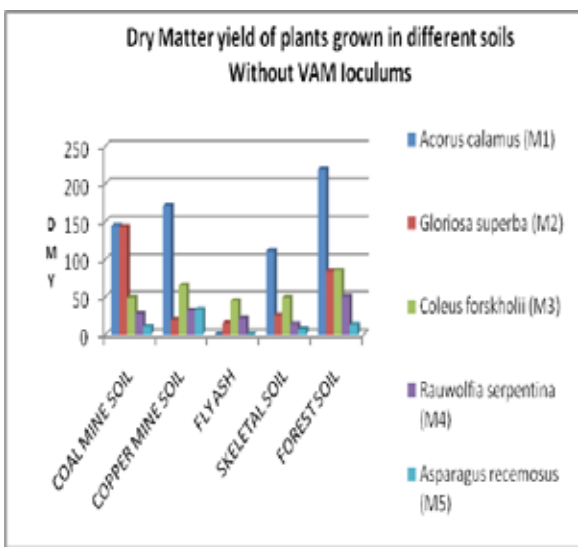
Values are mean of three replicates ± SD.

Table 2: Dry Matter yield (DMY) of plants grown in different soils

SOILS (s) SPECIES (m)	WITHOUT VAM INOCULUM (I_0)					MEAN I_0xM	WITH VAM INOCULUMS (I)					MEAN IxM
	COAL MINE SOIL (g/plant)	COPPER MINE SOIL (g/plant)	FLY ASH (g/plant)	SKELETAL SOIL (g/plant)	FOREST SOIL (g/plant)		COAL MINE SOIL (g/plant)	COPPER MINE SOIL (g/plant)	FLY ASH (g/plant)	SKELETAL SOIL (g/plant)	FOREST SOIL (g/plant)	
Acorus calamus (M1)	144.20	170.50	00.00	110.70	218.70	128.80	171.84	181.20	44.76.00	114.30	231.90	139.84
Gloriosa superba(M2)	143.00	19.20	15.50	25.28	83.62	57.32	215.30	28.74	20.00	26.27	83.78	74.93
Coleus forskholii(M3)	48.90	65.20	44.76	48.94	84.46	58.52	61.49	83.70	46.69	51.63	88.15	66.30
Rauwolfia serpentina (M4)	27.53	31.92	21.50	13.83	50.46	29.05	37.85	42.15	27.70	16.79	60.73	36.89
Asparagus recemosus (M5)	10.54	33.12	00.00	6.95	13.27	12.78	18.43	43.85	4.22	12.64	17.97	19.42
Mean (I_0xS)	74.83	64.05	16.35	41.15	90.10		100.80	75.92	19.72	44.43	96.51	
Interaction LSD P 0.05	I_0xM 9.67		I_0xS 9.67		I_0xSxM 5.35		IxM 17.53		IxS 17.53		IxSxM 9.69	

Table 3: Percentage root infection of plants grown in different soils

SOILS (s) SPECIES (m)	WITHOUT VAM INOCULUMS (I_0)					MEAN I_0xM	WITH VAM INOCULUMS (I)					MEAN IxM
	COAL MINE SOIL	COPPER MINE SOIL	FLY ASH	SKELETAL SOIL	FOREST SOIL		COAL MINE SOIL	COPPER MINE SOIL	FLY ASH	SKELETAL SOIL	FOREST SOIL	
Acorus calamus (M1)	32.00	28.00	00.00	12.00	39.00	18.13	78.00	62.00	00.00	40.00	71.00	55.33
Gloriosa superba(M2)	27.00	9.00	7.00	28.00	12.00	16.67	66.00	29.00	28.00	36.00	51.00	42.13
Coleus forskholii(M3)	17.00	20.00	4.00	12.00	10.00	12.60	54.00	50.00	19.00	31.00	25.00	35.93
Rauwolfia serpentina (M4)	15.00	14.00	11.00	20.00	27.00	17.40	38.00	27.00	44.00	22.00	53.00	36.83
Asparagus recemosus (M5)	19.00	23.00	00.00	10.00	10.00	12.23	33.00	51.00	12.00	22.00	30.00	29.60
Mean (I_0xS)	22.13	18.60	4.40	16.40	15.60		54.00	44.07	20.67	30.20	45.87	
Interaction LSD P 0.05	IxM 4.30	IxS 4.30	I_0xSxM 2.32				IxM 3.21	IxS 3.21			IxSxM 1.16	



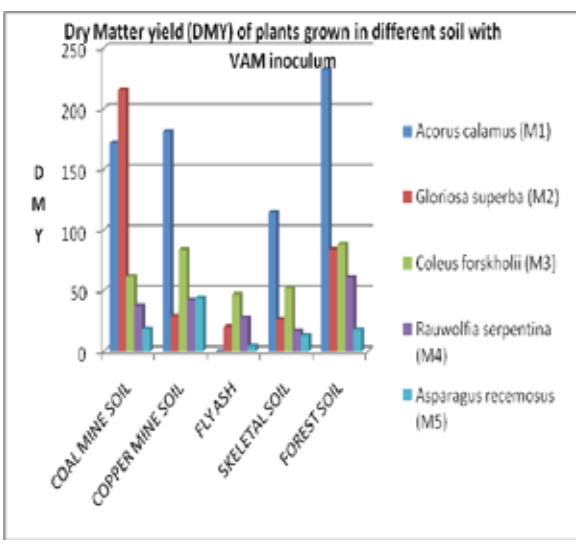


Fig1: Dry Matter yield (DMY) of plants grown in different soils

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