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RESEARCH ARTICLE

BIODIVERSITY OF AM FUNGI IN THE CASSAVA GROWN SOILS OF SEMIARID TROPICS OF TAMILNADU

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ABSTRACT

The distribution of Arbuscular mycorrhizal fungi and the mycotrophy of cassava in the soils semiarid tropics of Tamilnadu in relation to physico-chemical properties, nutrient status, depth and types of soils were studied. he native AM spore populations were significantly low and ranged from 90-170 100 g of soil. The cassava root colonization by native mycorrhizal fungi ranged from 38.85 to 56.50 per cent. The organic carbon content of the different soil samples was poor and ranged from 0.38 to 0.62 per cent. A positive correlation existed between organic carbon content and AM root colonization. The overall efficiency of both introduced and indigenous cultures was ranked in the order of G fasciculatum > G mossae>Arbuscular mycorrhizal sp NM-1>Acaulosporalaevis>Acaulosporasp NM-3 >Gigaspora margarita> Arbuscular mycorrhizal sp, NM -2 >Gigaspora

INTRODUCTION

Arbuscular mycorrhizal fungi are ubiquitous soil microorganisms. These fungi have great potential to enhance plant growth and soil aggregation. However the extent to which they do this in the field is unclear (Fitter, 1989 and Read, 1991). The growth enhancement effects of root infection with mycorrhizal fungi are caused by increased in P absorption particularly from sparingly soluble P sources (Bolan *et al*., 1987). When root exploration is restricted, up to 80 percent of plant phosphorus can be delivered by the external hyphae to the host plants over a distance of more than 10 cm from the root surface (Li *et al*., 1991a). About 53 per cent of the total P uptake, 24 per cent of N uptake and 10 per cent of total K uptake in mycorrhizal plant is attributed to the uptake and delivery by the external hyphae (George *et al*., 1992).Cassava possesses high potential for yielding large amount of food per unit area and also it is an efficient producer of calorie (135 calories/ 100 g fresh tuber) compared with other cereal crops. Cassava is highly mycotrophic and there exists variability in harbouring AM fungi in its root system. The present study was undertaken with the following objectives to fill the gap and to develop a technology package for *Arbuscular mycorrhizal* fungi inoculation so as to recommend to the cassava growers with a view to minimize the cost on P fertilizer and to work out the savings of P due to mycorrhizal inoculation.

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MATERIALS AND METHODS

The soil used for conducting the pot culture experiments was obtained from cassava cultivated eves of semiarid tropics of Tamil Nadu. The physic- chemical properties of various soils of semiarid tropics of Tamil Nadu were estimated as per the Procedure Described. Physiochemical Properties of Semiarid AM Fungi grown soils.

Determination of pH

Soil reaction (pH) was determined in Elico Model Lt- 10T pH meter by preparing 1:2:5 using soil and water suspension and stirring by means of a glass rod (Jackson, 1973).

Estimation of Electrical Conductivity

The organic carbons content of the soil samples were estimated following the method of Walkley and Black (1947). One gram of finely ground soil samples was transferred to 500 ml conical flask, to which 10.0 ml 1N K_2 Cr_2 O_7 solution and 200 ml of concentrated H_2 SO_4 were added and allowed to stand for 30 minutes. After 30 minutes, 10.0 ml of Na F solution and 2.0ml of diphenylamine indicator were added.The solution was titrated the standard $FeSO_4$ solution to brilliant green colour from dark blue colour.

Enumeration of *Arbuscular mycorrhizal* spore population from soil

The cassava rhizosphere soil samples were analyzed for AM spores by employing us sieving and decanting method, as described by Schenck (1982) and Sieverding (1983).

A quantity of 100 g soil and root materials were suspended 1400 ml of water and mixed well. After 10-20 seconds (for sedimentation of coarse sand), the suspension was decanted over a series of sieves fixed one above the other with mesh size highest at the top and lowest at the bottom (0.350 mm, 0.125 mm and 0.045 mm size). The residue was resuspended in water and sieving was repeated. Root materials in the top sieve was carefully washed with water and then transferred with water to a petridish. The suspensions obtained from medium sieve and of the finest sieve were separately transferred with little water to 100 ml centrifuge tubes the sieving were brought in suspension and 30-40 ml sugar solution (70 g sugar dissolved in 100 ml water) were injected into the bottom of the tube with the aid of a 50 ml syringe of which the needle has been replaced by a plastic pipe of 15-20 cm long and with an inner diameter of 0.5 cm. The samples was centrifuged at 1,500 -2,000 rpm for 1.5-2.0 min. In this process, the soil paricles settled at the surface of the sugar gradient. The spores extracted with the syringe from the gradient and placed in a clean sieve with 0.045 mm mesh size. Then the spores were washed with water for 2-3 times before transferring. It in water to a petri dish.

Determination of per cent of *Arbuscular mycorrhizal* infection

The roots of cassava plants were analyzed for *Arbuscular mycorrhizal* infection by cleaning and staining method of Phillips and Hayman (1970).The roots were thoroughly washed in tap water, without disturbing the external mycelium. The roots were cut into 1 cm pieces and immersed in 10 per cent KOH solution. The roots were cleared by autoclaving for 30 minutes at 15 lbs. Pressure in 10 per cent KOH. Then the root were rinsed in water for two to three times and acidified by soaking in 2 per cent HCL for five minutes. The acid was poured off and the root segments were stained by immersing in 0.05 per cent tryphan blue and boiled for 3 minutes. The excess stain was poured off and added with lacto phenol and kept overnight to destain the host tissues. The root bits were arranged on glass slides and examined under a microscope for mycorrhizal infections.

The mycorrhizal colonization was expressed using the following formula:

Table 1. Mycotrophy of cassava in realtion to physicochemical properties soil of semiarid tropics of Tamil nadu

S.N0	Location	Soil pH	Electrical conductivity (EC) mmhos/cm	Soil organic carbon/ (%)	AM spore population/ 100 g soil	AM root colonization (%)
1.	Omalur	7.10	0.45	0.62	170	56.50
2.	Mettur	7.30	0.41	0.39	110	48.10
3.	Puthur	7.50	0.62	0.56	134	52.25
4.	Kulathur	7.40	0.58	0.48	120	48.15
5.	Idappadi	7.20	0.52	0.38	106	45.19
6.	Kumarapalayam	6.98	0.49	0.51	110	44.85
7.	Attur	6.96	0.39	0.56	118	46.18
8.	Mallur	7.22	0.36	0.42	98	40.25
9.	Attayyampatti	7.12	0.44	0.49	102	41.15
10.	Konganapuram	7.01	0.48	0.52	115	45.24
11.	Ammapettai	6.80	0.38	0.40	98	41.00
12.	Satyamangalam	6.81	0.56	0.45	90	38.85
13.	Bhavani	7.02	1.42	0.56	108	40.54
14.	Gopichettipalayam	7.08	0.48	0.49	120	50.24
15.	Malayampalayam	7.10	0.42	0.41	100	43.52
16.	Chennimalai	6.98	0.44	0.48	108	46.85
17.	Attani	6.88	0.51	0.54	124	51.25
18.	Kottamangalam	6.80	0.43	0.48	102	41.58
19.	Anthiyur	6.91	1.11	0.45	121	49.24
20.	Bhavanisangar	7.10	1.01	0.41	112	45.45

Table 2. Mycotrophy of cassava in relation to nitrogen, phoshorus and potassium contents soils of semiarid tropics of Tamil Nadu

S.No	Location	Soil nitrogen in kg/ ha	Soil phosphorus kg/ha	Soil potassium kg/ha	AM spore potassium kg/ha	AM root colonization (%)
1.	Omalur	200.18	13.51	231.15	170	56.50
2.	Mettur	198.28	16.25	241.15	110	48.10
3.	Puthur	210.21	14.12	240.12	134	52.25
4.	Kulathur	205.21	15.15	238.12	120	48.50
5.	Idappadi	220.15	16.00	239.58	106	45.19
6.	Kumarapalayam	218.18	15.94	240.54	110	44.85
7.	Attur	219.18	14.59	239.64	118	46.18
8.	Mallur	222.56	17.25	250.54	98	40.25
9.	Attayyampatti	220.12	16.81	249.52	102	41.15
10.	Konganapuram	209.58	16.00	239.42	115	45.24
11.	Ammapetti	221.28	17.25	252.51	98	41.00
12.	Satyamangalam	222.98	18.10	250.11	90	38.85
13.	Bhavani	217.21	16.00	248.54	108	40.54
14.	Gopichettipalayam	205.12	15.10	238.54	120	50.24
15.	Malayapalayam	221.54	17.00	244.54	100	43.52
16.	Chennimalai	219.56	15.84	245.51	108	46.85
17.	Attani	204.15	15.00	238.45	124	51.25
18.	Kottamangalam	219.14	16.34	241.25	102	41.58
19.	Anthiyur	212.15	15.00	237.12	121	49.24
20.	Bhavanisangar	219.11	16.11	241.25	112	45.45

Table 3. Biodiversity of Arbuscular mycorrihzal fungi in the cassava soils of semiarid tropics of Tamil nadu

Soil types	Number of AM spores per 100 g of soil								
	Arbuscular mycorrhizal spp.		Acaulospora spp.		Gigaspora spp.		Others		
	No	Relative %	No.	Relative %	No.	Relative %	No.	Relative %	
Loam	69	56.10	10	8.13	29	23.58	15	12.20	123
Sandy loam	50	45.45	18	16.36	24	21.82	18	16.36	110
Loamy clay	60	54.55	24	21.82	12	10.91	14	12.73	110
Red soil	48	38.00	21	21.00	20	20.00	21	21.00	100
Sandy soil	40	35.09	47	41.23	14	12.28	13	11.40	114

$$\text{Per cent root colonization} = \frac{\text{Number of root segments positive for colonization}}{\text{Number of root segments examined}} \times 100$$

The root segment was considered positive for *mycorrhizal* colonization even if one of the three structures therefore hyphae *arbuscules* or vesicles are present.

Estimation of AM spores in the rhizosphere soil

The rhizosphere soil was examined for the presence of *Arbuscular mycorrhizal* spores by wet sieving and decanting method described by Gerdemann and Nicolson (1963). About 100 g soil was suspended in 500 ml of water in 1 liter conical flask and stirred thoroughly. The suspension was then passed through 750, 450, 250, 105, and 45 m sieves arranged one below the other in the above said order. The *Arbuscular mycorrhizal* spores on the bottom sieves viz., 105, and 45m were transferred onto the nylon mesh with a pore size of 45 m in a petriplate and examined under a stereo zoom microscope. The spore number of spore density from the rhizosphere soil samples of each treatment was counted in replicates of three; average was taken and calculated for 100 g of soil. The spore count data were transformed to log (x+1) values.

RESULTS AND DISCUSSION

The mycotrophy of cassava and the spore population in the rhizosphere soil in relation to physic chemical properties viz pH ,EC and soil organic carbon content was studied. Native vesicular *Arbuscular mycorrhizal* spore population and percent root colonization of cassava by fungi in soils of semiarid tropics of Tamil Nadu were studied (Table-1). The native AM spore population and percent root colonization by AM fungi were correlated with the soil Properties viz., PH, EC and soil organic Carbon. The spore population from the soil samples and AM root colonization in cassava were estimated at different locations of semiarid tropics of Tamil Nadu. Content and AM root colonization, between AM spore population and AM root colonization and a negative correlation obtained between EC content and AM spore population, between PH and AM spore population. The total AM spore population and per cent root colonization by AM fungi in cassava soils M relation to N, P and K. content are presented in (Table-2). Chemical analysis cassava soils of semiarid tropics of Tamil nadu revealed that the P and K content of the soil samples were medium and ranged from 13.51 to18.10kg ha-1 of available phosphorus and 231 to252 kg ha-1 of potassium. The nitrogen status was low and ranged from 198 to 222 kg. The study on the N,P and K content of the soils in relation to AM revealed that a negative correlation between nitrogen content and spore population, between nitrogen content and AM root colonization between P content and AM spore population, between P content and AM root colonization K content and AM spore population, between K content and root colonization. The AM spore population and root colonization by AM fungi were found to be poor in cassava soils of semiarid tropics Tamilnadu although cassava was a highly mycorrhizal dependent crop. The AM spore diversity was studied in seven different soil types of semiarid tropics Tamilnadu. The spores of *Arbuscular mycorrhizal* , Gigaspora and G. Acaulospora were identified and accounted separately and the remaining unidentified spores were categorized as other (Table -3). In general *Arbuscular mycorrhizal* was the most predominant in all the soil types followed by either Acaulospora or Gigaspora. The number of spores per 100 g of soil ranged, from 40 to 69 for *Arbuscular mycorrhizal* from 12 to 29 for Gigaspora and from 10 to 47 for Acaulospora. The occurrence of *Arbuscular mycorrhizal* accounted for 45 to 60 per cent of total AM fungi in different soil types studied except sand and red soil, which accounted for only 35.09 and 38.00 percent respectively.

The chlamydospore population ranged from 90-170 per 100 kg of soil and per cent root colonization ranged from 38.85 to 56.50 . The AM spore population for 100g of soil was 90 to 110 in 11 location viz , 110 to 120 in 5 location viz .121 to 170 in 4 location viz. The cassava soils of these different location were belonged to any one of the textural groups viz. loam, sandy loam, loamy clay , and clay loam and clay soil .Spore population and mycorrhizal colonization of cassava recorded between samples although varied no considerable difference could be obtained . However an attempt was made to correlate the different physic chemical properties of soils with the mycotrophy of cassava. A positive correlation between organic carbon content , and AM spore population between organic carbon content , and AM root colonization , between AM root colonization, and AM spore population and negative correlation obtained between EC content and AM spore population and between pH and AM spore population . The poor mycorrhizal colonization in cassava grown in semiarid tropics soils may be attributed to the low organic matter content . The role of organic matter in augmenting the microbial population is well documented (Johnson 1991) .The mycorrhization helper bacteria also get stimulated by high level of organic matter .The poor organic matter contents recorded in semiarid tropics soils might not have favored the mycorrhizal colonization.

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