ISSN: 2230-9926

*Available online at http://www.journalijdr.com*

IJDR

International Journal of DEVELOPMENT RESEARCH

*International Journal of Development Research*
*Vol. 5, Issue, 09, pp. 5623-5626, September, 2015*

## *Full Length Research Article*

# MYCORRHIZAL COLONIZATION IN RELATION TO AGE OF CASSAVA PLANT IN DIFFERENT SOIL TYPES OF SEMIARID TROPICS OF TAMILNADU

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**ARTICLE INFO**

***Article History:***

Received 16th June, 2015
Received in revised form
12th July, 2015
Accepted 08th August, 2015
Published online 30th September, 2015

***Key words:***

AM Cassava Semiarid tropics
*mycorrhizal, G.mossae Acaulospora.*

**ABSTRACT**

*Arbuscular mycorrhizal* spore population and AM root colonization were positively correlated with different micronutrients viz., Zn Mn and Cu analyzed from cassava soil semiarid tropics of Tamil Nadu. Loamy soil recorded the highest number of AM spores (123.30 100 g of soil) while the root colonization is 49.24 per cent was the highest in clay loam soils of semiarid tropics of Tamil nadu. Red soil recorded the least of 100 spore 100 g of soil and 40.70 per cent root colonization. The surface layer (0-15 cm) contained the highest spore population. The increase in soil depth up to 90cm showed gradual reduction in spore numbers. A negative correlation existed between the soil depth and number of AM spore present. The genus *Glomus* was the most predominant followed by either *Acaulospora* or *Gigaspora*. The occurrence of *Glomus* accounted for 45 to 60 per cent of total AM fungi in different soil type's studies except sand and red soil, which accounted for 35.02 and 38.00 percent of total AM fungi. It was found that more than 50 per cent of total AM spore belonged to *Glomus* and the remaining 50 per cent of the population of AM spore were found to be shared by *Gigaspora*, *Acaulospora* and others. The AM fungus, G. Fasciculatum was found to be most effective for the cassava varieties tested viz., CO-1, M-4, MVT-1 and H-165 followed by G. mosseae, *Acaulospora* laevis and *Gigaspora* margarita. However, no specificity existed between varieties and AM fungal species tested.



## INTRODUCTION

The benefits of mycorrhizal fungi in experimental condition with individual fungi are generally related to the rate and extend of Mycorrhizal formation (Abbott and Robson, 1991 Graham *et al*., 1991). Mycorrhizal infection enhances plant growth by increasing nutrient uptake via increase in the absorbing surface or by mobilizing sparingly available nutrient sources or by excretion of chelating compounds or coenzymes (Marschner and Dell, 1994). Competition between the fungus and the roots for photosynthetic is the main factor responsible for the large shoot: root dry weight ratio in favor of the shoots in mycorrhizal plants (Berta *et al*., 1990). A close correlation exists between root colonization and active hyphae within the roots (or) those attached to the root surface (Abbott and Robson, 1985). 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). Cassava (Manihot esculenta Grantz.), one of the major tube crops is one among the group of plants inhabited by AM fungi.

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## MATERIALS AND METHODS

### Arbuscular Mycorrhizal Fungi used

Four different *Arbuscular mycorrhizal* fungi viz., *Glomus* fasciculatum. *Glomus* mossae *Gigaspora* Margarita and *Acaulospora* Laevis were obtained from Department of Microbiology, Faculty of Agriculture, and Annamalai University and four isolates viz *Glomus*. NM-1.Glomu NM-2 *Acaulospora* NM-3 and *Gigaspora* NM-4 were used. Soil: S and (1:1) mixture containing extrametrical chlamydospore (650-850 spore per cent 50g soil) and infected roots of individual AM fungi served as inoculum source.

### Plant Material Method

Cassava (Manihot esculenta Grantz) Varieties, M-4, CO-1, and H-165 were used for the presents study. Stem cuttings of 15 cm length were used as planting Material and used were in the pot culture experiments.

### Manures and fertilizers

Well decomposed farm yard manure, vermicompost, press mud, nitrogen through urea, phosphate through single super

phosphate and potassium through muriate of potash as per recommended doses were used in all the experiments unless otherwise specifically stated. For conducting experiments on different phosphate sources, single super phosphate and rock phosphate were used. Nitrogen, phosphate and potassium application rate however, was modified as per the specifications in the experiment.

**Preparation of field**

The field was ploughed with tractor drawn cultivator in cross manner, so as to obtain a desirable tithe and leveled. For each treatment, three replications were maintained with a spacing of 90 cm x 90 cm.

**Method of AM inoculation**

The method of inoculation was by placement @ 30 g of soil inoculums (containing 650-850 numbers of infective porpagules per 50 g of soil) per plant. The inoculum was applied at the base of the planting cassava sets. Suitable controls were maintained.

**Fertilizer application**

The recommended fertilizer dose of 100: 100: 100 kg of N, P and K per ha was adopted for the present study. However, the application of phosphorus varied to study its effects on AM colonization. The phosphorus and potassium were applied as basal dose, whereas the nitrogen was applied in three split doses therefore 50 per cent as basal, 25 per cent on 30 DAP and remaining 25 per cent on 60 DAP. Two types of phosphorus sources viz, single super phosphate (SSP) and mussoorie Rock Phosphate (MRP) were employed at different doses.

**Multiplication of AM cultures and preparation of soil inoculums**

The only way to produce *Arbuscular mycorrhizal* inoculums is on the live roots of susceptible host plant. The isolated spores of AM fungi from soil were surface sterilized and introduced in to pot cultures by the funnel technique (Nicolson, 1967). These pot cultures can be maintained in a greenhouse. The pots were sown with maize (*Zea mays* L.) and onion (Allium cepa) seeds for multiplying AM inoculums. After the maturity of the host plant, the plants were pulled out and roots were tested for AM colonization. A-mycorrhizal spores were estimated form the rhizosphere soil by wet sieving and decanting method (Gerdemann and Nicolson, 1963) Thus the inoculums raised from surface sterilized spores were designated as "Starter Culture". The AM colonized roots were cut into small bits and the soils from the inoculated pots were incorporated into the pots containing sterilized substrate. The maize seeds were sown in AM inoculated pots for multiplication. After 40 days, the roots and soil were tested for the colonization by AM fungi and AM spore numbers. This stage was called as Mother Culture-1". The root piece from the mother culture1 as well as the top soils were incorporated again into cement pots containing the substrates and sown with the seeds of maize. After 40 day, the roots and soil were tested for colonization and for the presence of sufficient number of spores. The soil along with root piece was taken. This was called as "soil inoculums". Ari-dried substrate and chopped root bits were used as mycorrhizal inoculums in further experiments.

**Determination of number of leaves per plant**

Cassava leaves were collected from each treatment at monthly intervals and total number of leaves per plant recorded.

**Determination of spore population**

Rhizosphere soil was collected from each treatment at monthly intervals up to 8 months after planting and the average spore number per 100 g of the soil was calculated.

**Estimation of copper, manganese, iron and zinc**

The aliquot of 10 ml of the acid digested plant samples were used of estimating micronutrients viz., copper, iron, manganese and zinc using Atomic Absorption Spectrometer with appropriate hollow cathode lamp (Lindsay and Norvell, 1978).

**Estimation of Phosphatase enzyme activity in Rhizosphere and Non- Rhizosphere soil of cassava**

One gram of soil was from each treatment and placed in 50 ml of Erlenmeyer flask, 1 ml of 1 % disodium monophony l phosphate, 2 drops of toluene and 4 ml of distilled water were added. The contents of the flask were thoroughly mixed and incubated at room temperature ($28+2^0$C). At the end of the 24 hours 1 ml of supernatant liquid was taken and 1 ml of fresh reagent prepared by mixing 1 part of Folin- Ciocalteu reagent and one part of distilled water and 2 ml of 20 per cent sodium carbonate were added and boiled exactly for 1 minute. Then it was immediately cooled, the solution was made up to 25 ml and the color intensity was read in "Spectronic plus 1001 Spectrometer "at 725 nm. The standard curve was drawn using known quantity of phenol. The phosphates activity was expressed in mg of phenol released per ml of enzyme source (Morton, 1952).

## RESULT AND DISCUSSION

In general, cassava soils of different locations were loamy, sandy loam, loamy clay, clay loam, and red, sand and clay soils. However variation in population and colonization in soil types was noted between locations (Table 1).

**Table 1. Mycotrophy of cassava as Infloenced by soil types in semiarid tropics of Tamil Nadu**

| Soil Types | AM spore population 100 of soil. | AM root colonization (-2) |
|---|---|---|
| Loam | 120.3 | 46.72 |
| Sandy loam | 100.00 | 44.26 |
| Loamy clay | 100.80 | 44.59 |
| Clay loam | 120.00 | 47.24 |
| Red soil | 100.00 | 40.70 |
| Sandy | 112.00 | 46.90 |
| Clay | 114.00 | 47.41 |

**Table 2. Distribution of am spores as influenced by depth of the soil**

| Soil Depth (in cm) | AM spore population per 100 g of soil | | | | Sandy loam |
|---|---|---|---|---|---|
| | Loam | Sand | Clay | Loam clay | |
| 0-15 | 100 | 82 | 100 | 86 | 90 |
| 15-30 | 84 | 22 | 30 | 30 | 25 |
| 30-45 | 20 | 12 | 17 | 18 | 16 |
| 45-60 | 10 | 7 | 8 | 7 | 7 |
| 60-75 | 2 | 2 | 3 | 4 | 3 |
| 75-90 | 2. | 1 | 1 | 3 | 1 |

**Table-3. Mycorrhizal colonization as influenced by the age of the cassava plants in different soil types of semiarid of Tamil Nadu**

| Soil types | Age of the crop in Month* | | | | |
|---|---|---|---|---|---|
| | I | II | III | IV | V |
| Loam | 18.6 | 30.6 | 49.4 | 69.7 | 78.2 |
| Loam clay | 19.0 | 32.3 | 40.3 | 58.6 | 69.2 |
| Sand | 17.4 | 30.2 | 44.2 | 52.5 | 58.1 |
| Sandy loam | 18.0 | 31.2 | 42.3 | 54.3 | 62.9 |
| Clay loam | 18.2 | 28.6 | 41.4 | 48.7 | 52.2 |

*percentage of root colonization by AM fungi

Sample collected from Omalur, Idappadi, Konganapuram and Kottamangalam belonged to loamy soil. Sample collected from Mettur, Kulathur, Kumarapalayam, Attur, Satyamangalam and Bhavanisangar belonged to sandy loam soil. Samples collected from Puthur, Ammapettai and Malayapalayam belonged to loamy clay soil. Samples collected from Mallur and Attayyampatti belong to red soil. Samples collected from Bhavani and Gopichettipalayam belonged to clay soil. Samples collected from Chennimalai and Attani belonged to sandy soil. The sample collected from Anthiyur belonged to clay loam. AM spore population (123.30 per 100g of soil) was the highest in loamy soil, while the root colonization (49.24 per cent) was the highest in clay loam soil. The least spore number of 100 per 100 per 100 gram of soil and 40.70 per cent of root colonization was recorded in red soil. The AM spore number recorded per 100 g of soil were 123.3 in loam, 110.00 in sandy loam, 110 in loamy clay, 121 in clay loam, 114 in sand 116 in clay and 100 in red soil. The per cent root colonization recorded were 47.12, 45.26, 45.59, 49.24, 40.70, 48.90, and 45.41 in loam, sandy loam, clay loam, red, sandy and clay soil respectively. The soil type did not show consistent variation on the AM root colonization and spore population. The AM spore population of different soil type's viz., loam, sand, clay loamy clay and sandy loam at different depths were estimated (Table 2). The soil sample were collected up to 90 cm depth in layers of 15 cm each, the AM spore population reduced with increase in depth. The occurrences of AM spore number at various depths in different soil types were studied. In general the surface layer contained.

Higher AM spore population. The surface layer (10-15cm) of different soil types viz., loam, clay, sandy, loam, loamy clay and recorded 110, 101, 90, 88 and 84 per 100g of soil respectively. The increase in soil depth recorded of radial reduction in AM spore number. The bottom most layer (75-90 cm) recorded the least AM spore number of 4,2,1,3, and 1 per 100 g of soil with loam, clay, sandy, loam, loam clay and sandy soil respectively. A negative correlation existed between the soil depth and number of AM spores present. The AM spore number recorded at different depth viz., 0-15, 15-30, 30-45,45-60,60-75 and 75-90 cm were respectively 110, 86, 20,10, 4 and 4 with loam, 84,24,14, 7,3 and 2 with sandy soil, 88, 30, 18, 9, 4, and 3 with loamy clay and 90, 25, 16,7, 3 with sandy loam per 100 g of soils. Cassava root colonization by AM fungi increased with age of the crop plant from 1st to 5th Month (Table 3).

The root colonization by AM fungi was recorded up to 5th month after planting the percentage root infection in different soil types increased with age of the cassava plant. The increase in the root colonization from 1st to 5th month was from 17.82 to 78.2 per cent. The cassava plants grown in different soil type's viz., loam loamy, clay, sandy loam sandy, and clay loam recorded 78.2, 69.20, 62.90, 58.1 and 52.20 percent of root colonization respectively. Growth response to mycorrhizal symbols depends on three major components viz., the plants, the mycorrhizal fungi and the soil environment. A positive response of plants to mycorrhizal colonization of root during early growth stages of the host is highly essential. In cassava, the host response to AMF varied with different soil types. The percentage root infection in different soil types increased with age of the cassava plant. AM species in relation to soil characteristics expect that the members of this genus *Glomus* found to be more predominant in all the soil types. The occurrence of the *Glomus* accounted for 45 to 60 per cent of total AM fungi in different soil types studied expect sand and red soil, which accounted for only 35.09 and 38.02 per cent respectively. Interestingly sandy soil accounted for 41.23 per cent of *Acaulospora*.

The population of *Gigaspora* in different soil types ranged from 10-23 per cent. It was found that more than 50 per cent of AM spore population belonged to the genus, *Glomus* and remaining 50 per cent of AM spore population put together belonged to *Gigaspora*, *Acaulospora* and other categories. Cassava grown in all soil types recorded higher mycorrhizal colonization with maximum length of root (Potty, 1980 & 1982). Plants having the thick root system were considered to be more dependent on mycorrhizal association. Symbiotic status is very important for plant mineral nutrition and plant health, but the degree of mycorrhizal dependence differ with plant species (Hayman, 1986). Root characteristics are known to influence the inherent capacity of plant to absorb soil P and thus influence the dependency of plant species on AM fungi (Manjunath and Habte, 1991). Four cassava varieties popularly grown in the soil of semiarid Tamilnadu were chosen to study its preferential association with different AM species.

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