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# Arbuscular mycorrhizal fungi on occurrence and distribution of *Coleus aromaticus* Benth. in Cuddalore District, Tamilnadu

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Abstract

AM fungi are vital for uptake and accumulation of iron from soil and translocation to hosts because of their high metabolic rate and strategically diffuse distribution in upper soil layers. The rhizosphere soils and root samples were collected from *Coleus aromaticus* Benth. fields at eight sites of cuddalore district. They were analyzed for spore number, level of arbuscular mychorrhizal (AM) colonization and AM species. The number of AM spores detected in the field soils ranged from 73 to 485 per soil. Fourteen AM species were isolated, belonging to four genera viz., *Glomus, Gigaspora, Acaulospora* and *sclerocystis*. The species composition of the AM community varied at different fields and study sites.

Keywords: Arbuscular Mycorrhizae fungi, *Coleus aromaticus*

## INTRODUCTION

The term mycorrhiza was first coined by Frank (1885), for the mutualistic associations formed between plant roots and certain fungi. Such associations exist in the majority of terrestial plants and therefore in ecosystems throughout the world. A study of the occurrence of mycorrhiza in the Indian flora provides an example of their distribution; 90 percent of the Angiosperm species, 100 percent of the Gymnosperms and 70 percent of the Pteridophytes are able to form mycorrhizal associations.

Mycorrhizal associations are morphologically and physiologically diverse and their structures and functions depend on the symbionts involved. AM fungi are obligate symbiotic soil fungi which colonize the roots of the majority of plants. These fungi help to ensure an opportunity for the utilization of the symbiosis and contribute to the success of sustainable agriculture. B.K. Bakshi was the first person in India to work on mychorrhiza and published a monographic account on the subject in 1974 (Cf. Kaushik 2000). Rao *et al* (1988) examined root and root zone soil samples of 25 medicinal plants growing in red sandy loam soil of Bangalore.

The AM community and colonization of plant roots may vary greatly in different soils (Schenck & smith 1981; Porter *et al* 1987) and under the cropping practices (Abbort & Robson 1991). The plant received a variety of benefits which may result in increased growth and improved water relation (Davies *et al* (1993). Species of AM fungi that can either directly or indirectly increase plant growth by improving soil conditions need to be selected (Kapoor & Mukerji 1990).

Direct benefits are usually related to the enhancement of phosphate uptake by the plant; however, in some soils enhanced uptake to zinc, copper and ammonium are also important (Stribley 1987). The potential for increasing medicinal plant growth by effective management of AM strains reinforces the need to determine AM colonization of crop plants and the species composition of the AM community indigenous to cultivated soils of a particular location. Such studies are also necessary for isolating indigenous AM strains to be assessed in local crop production in this paper the root colonization, occurrence and distribution of AM species in *Coleus aromaticus* field of different areas at Cuddalore district, have been presented.

## MATERIALS AND METHODS

The study was carried out at the different areas at Cuddalore district, Tamilnadu (Table: 1).the soil is classified as an alluvial with organic matter accumulation in the upper layers. The soil samples (15-30 cores of 3 cm diam. X 10-20 cm length) were collected from the *Coleus aromaticus* Benth. at different sites at Cuddalore. Besides, 100g soil sample were analysed for AM spore number. The spores were obtained by wet sieving (400-45 μm) and decanting by Gerdemann & Nocolson 1963, as modified by Daniels & Skipper (1982). Samples were centrifuged a different density gradients (Daniels & Skipper 1982) and permanent slides prepared according to Schenck & Perez (1990). The root samples were cleared with 10% KOH and stained with trypan blue in lactophenol (Philips & Hayman, 1970). Percentage root colonization was calculated (Krishna & Drat (1980). Altogether, 14 species of AM were isolated and brought into onion (*Allium cepa* L.) as the host crop. After the plants were 60 days old, the spores and sporocarps were then reiosolated for identification (Schenck & Perez, 1988).

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| S. No. | Study sites | Soil Texture | pH | Moisture (%) | N (mg/kg$^{-1}$) | P (mg/kg$^{-1}$) | K (mg/kg$^{-1}$) | Total AM Spores (100g) | Associated AM Fungal species in the roots |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Vriddhachalam | Sandy loam | 7.2 ± 0.04 | 8.0 ± 0.05 | 460 ± 6.5 | 1.2 ± 0.2 | 220 ± 6.2 | 282 ± 2.2 | *Glomus*& *Gigaspora* |
| 2. | Karmangudi | Clay loam | 6.2 ± 0.02 | 14.0 ± 0.03 | 340 ± 4.2 | 3.6 ± 0.6 | 310 ± 1.2 | 85 ± 2.4 | *Glomus*, *Acaulospora*& *Sclerocystis* |
| 3. | Marungure | Sandy clay loam | 6.1 ± 0.05 | 15.0 ± 0.3 | 620 ± 57.8 | 3.2 ± 0.2 | 240 ± 6.3 | 73 ± 2.3 | *Glomus*, *Acaulospora*& *Gigaspora* |
| 4. | Valliyam | Sandy loam | 7.8 ± 0.04 | 9.0 ± 0.05 | 350 ± 4.8 | 2.0 ± 0.4 | 180 ± 1.4 | 210 ± 8.4 | *Glomus*& *Sclerocystis* |
| 5. | Keeranure | Clay | 6.8 ± 0.04 | 5.0 ± 0.04 | 400 ± 6.2 | 1.6 ± 0.6 | 270 ± 1.6 | 232 ±10.4 | *Glomus* & *Gigaspora* |
| 6. | Kavanure | Red sandy loam | 7.4 ± 0.05 | 10.0 ± 0.03 | 650 ± 2.2 | 1.8 ± 0.4 | 150 ± 3.4 | 360 ± 8.2 | *Glomus* & *Sclerocystis* |
| 7. | Devangudi | Red sandy loam | 7.4 ± 0.05 | 9.0 ± 0.05 | 420 ± 6.4 | 1.6 ± 0.6 | 260 ± 3.6 | 485 ± 4.8 | *Glomus* *Gigaspora*& *Sclerocystis* |
| 8. | Thoravalore | Sandy loam | 8.2 ± 0.05 | 0.3 ± 0.04 | 640 ± 7.8 | 1.2 ± 0.4 | 320 ± 2.2 | 145 ± 4.2 | *Glomus*& *Gigaspora* |

Table 1. The Physico-chemical characteristics of rhizosphere soils of *Coleus aromaticus* Benth. from eight different localities of Cuddalore district (n=5; mean ± S. D.)

## RESULTS AND DISCUSSION

A total of 14 morpho-species of AM was found, from the study sites belonging to the four genera viz., *Glomus, Gigaspora, Acaulospora* and *sclerocystis*. The number of AM spores in the root zone soils ranged from 73 to 485 per 100 mg kg$^{-1}$ soil.

Occurrence of AM in all phyla of terrestrial plants from bryophytes to angiosperms (Harley & Smith 1983). AM associations with plants are wide and geographically ubiquitous. AM fungi are found naturally in all terrestrial ecosystems. Several efforts have been made to mass multiply AM inoculate (Raman 1994). Cultures of AM fungi on plants growing in disinfested soil have been the frequently used technique to increase propagule numbers (Menge 1984).

A highly susceptible host plant should be used. It should produce abundant roots quickly and tolerate the high-light conditions required for the fungus to reproduce rapidly. Crop species can exert their effect selectively in determining AM species which become predominant in a mixed indigenous population. In growth chamber studies, pre-transplant rice plant (Dhillion 1992) and forage legumes (Giovannetti & Hepper 1985) exhibited considerable affinity for colonization by AM fungi and the results of these studies suggested the presence of host-mycorrhizal specificity. Out of nineteen plant species tested, Graw *et al* (1979) found that *Glomus gerdemanii* infected only one plant species. Attempts have been made to use the genetic variability in fungal efficiency and host response to select AM fungal isolates which are able to improve plant production Trouvelot *et al* (1986). Variation in the effect of AM colonization has also been linked to the genotype of host plant Krishna *et al* (1985). The recent isolation of myco-plant mutants (Duc *et al* 1989) and the discovery that AM colonization is a heritable trait (Mercy *et al* 1990) suggested the possibility of tailoring plant-fungus combinations for maximum efficiency. This may lead to developing plant that will form endo-mycorrhiza specificity with certain AM fungi (Gianinazzi *et al* 1989). Seasonal functions influence mycorrhizal dynamics. Siguenza *et al* (1996) observed that phenology and seasonality were important factors for the production of spores and mychorrhizal colonization. Our results are similar to those of the latter study in that they also reveal that highest spore production during the dry season and less production in rainy season. Other who has supported these results are Parameswaran and Augustine (1989); Selvaraj & Baskaran (1996). Season played a major role as the seasonal variation in biodiversity of AM fungus was quite evident from the fluctuations of spores in soils (Sampath Kumar 2001). *Glomus* species were the most commonly found in all different sites. *Acaulospora* spp. was reported in Karmangudi and Marungure sites. *Gigaspora* and *Sclerocystis* spores also were frequently observed in the different soils, but they were apparently from only one species. The Marungure site contains least number of AM spores where as Devangudi, Kavanure, Vriddhachalam and Keeranure sites contain the widest variety of AM species. All the eight sites of soils exhibit different physico-chemical and microbiological characteristics. The number of spores in these agricultural soils was similar to those detected in agricultural soils by other workers Hayman & Stovold (1979).

The physico-chemical data revealed that the variation in soil pH ranged from 6.1 to 8.2. however, most of the study sites were either alkaline or neutral. Green *et al*., (1976) showed that AM spores isolated from soil of a particular pH germinated best at that pH. Daniels and Trappe (1980) observed that an isolate of *Glomus epigaeus* from a neutral soil germinated best at a pH of 7 and that germination was less at lower and higher pH. Porter *et al* (1987) concluded that pH was important in limiting the distribution of some AM fungi. The moisture is varied from 0.3 to 14.0 per cent. The available N, P and K in the soil ranged from 340-650 mg kg$^{-1}$, 1.2-3.6 mg kg$^{-1}$ and 150-320 mg kg$^{-1}$ respectively.

The highest AM spores were recorded in Red sandy loam soil and lowest in Sandy clay loam soil. These results are agreement

with the report of Azizah Chulan & Mohammed Omar (1991). Hass & Krikun (1985) reported intraspecies variation in efficacy among isolates of *Glomus macrocarpm* collected from various soils. It can be concluded that, this study provides interesting data and observations on the status of AM in different *Coleus aromaticus* field at Cuddalore district. It will help to demonstrate their impact on Medicinal Crop growth.

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