The Pharmaceutical and Chemical Journal, **2017, 4(1):77-81**

Available online ***www.tpcj.org***

Research Article

ISSN: 2349-7092
CODEN(USA): PCJHBA

Influence of arbuscular mycorrhizal fungi on bio-mass yield and biochemical in *Coleus aromaticus* benth

M. Panneerselvam

Senthil College of Education, Periyavadavadi, Vriddhachalam, Cuddalore District-606 104, Tamil Nadu, India

Abstract The coleus belongs to the Lamiaceae family of plants, often called the mint family of herbs. The coleus is indigenous to the plains of India and was traditionally used in folk medicine. The effect of inoculation of AM fungi on growth performance of coleus was evaluated for their symbiotic response in field condition. Two AM fungi, *Glomus fasiculatum* (Gf) and *Gigaspora margirata* (Gm) and mixed (Gf and Gm) were used as inoculums. The results show, number of leaves, Dry weight of total biomass and chlorophyll, protein, carbohydrate and total sugar in mixed (Gf and Gm) inoculated plants increased when compared to other inoculated plants and control. The results of present study indicated that mixed (Gf and Gm) AM fungi can be considered as good growth promoter for better biomass yield and Biochemical in *Coleus aromaticus* Benth.

Keywords *Arbuscular mycorrhiza*, *Coleus aromaticus*

Introduction

Mycorrhizal fungi interact with plants at different levels which can be grouped into obligately mycorrhizal, facultative mycorrhizal and non-mycorrhizal plants [1]. Facultative mycorrhizal plants as the name denotes, are not solely dependent on the fungus for phosphorus or other nutrients, but can also derive their nutrients from the soil when soil phosphorus levels are high. Thus, this level of association is dependent on soil fertility as mycorrhizal plants can reduce their association with the fungus in cases where the association provides little benefit [1].

Mycorrhizal fungi, upon root colonization, develop an external mycelium which is a bridge connecting the root with the surrounding soil microhabitats. Therefore, the mycorrhizal symbiosis, by linking the biotic and geochemical portions of the ecosystem, can contribute to nutrient capture and supply. Particularly, the arbuscular mycorrhizal (AM) symbiosis plays a direct role in nutrient cycling rates and patterns in agro-ecosystems and natural environments. The establishment of the AM symbiotic status affects the chemical composition of root exudates while the development of a mycorrhizal soil mycelium also introduces physical modifications in the environment surrounding the roots.

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. In fact the fungus serves as highly efficient extension of the host root system. The fungi derive most of their required organic matter from their symbiotic niches in roots and in turn, help their host plants in better growth by enhancing phytochrome levels in absorption of phosphorus and other mobile elements from soil, impact tolerance to heavy metals and afford protection against disease, salinity drought and temperature extremes.

The objective of this paper is comparative analysis of the effects induced by two AM fungi *Glomus fasciculatum* (Gf), and *Gigaspora margarita* (Gm) on biomass yield and Biochemical content in *Coleus aromaticus* Benth.

Materials and methods

Experimental Design and Plant Culture

This study was performed on a loamy sandy soil. To assess the indigenous AM fungi from rhizosphere soils of Coleus aromaticus which were collected from Three different sites Karmangudi, Valliyam and Devankudi (located at latitude 11.46'N Longitude 79o48'E. The altitude is 4.6 m MSL) Vriddhachalam taluk, Cuddalore district of Tamil Nadu, India (Fig. 1).

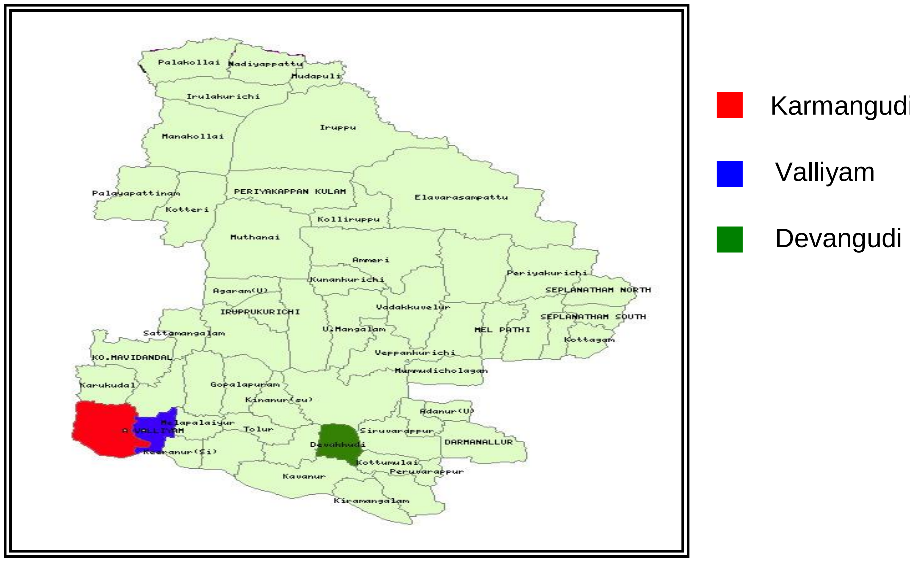

Figure 1: Map showing Soil sampling site

Soil samples were collected from the field at the flowering stage of the plant. Soil samples of about 1kg were collected from the root zone (rhizosphere) of the plant species with the help of soil user at the depth of 10-15 cm. near the root zone. The soil samples were collected in sterile polythene bags and brought to the laboratory for analysis. The samples were kept at ambient temperature in clearing room and used as per the need for further analysis.

Soil properties were: pH (1:5 H2O) 7.2, EC 0.45 dS m-1, CaCO3 7.2%, organic matter 13 g kg-1, P 9.65 mg kg-1, K 165 mg kg-1 and the DTPA (Diethylenetriamine pentaacetate)-extractable Zn, Fe, Mn and Cu were 0.80, 1.80, 2.2 and 1.1 mg kg-1, respectively.

Factor	**Study Sites S1 Sandy loam**
Soil pH	7.2 ± 0.04
Moisture (%)	8.0 ± 0.05
Organic carbon (%)	8.0 ± 0.05
Available nitrogen (mg kg^{-1})	460 ± 6.5
Available phosphorus (mg kg^{-1})	1.2 ± 0.02
Available potassium (mg kg^{-1})	220 ± 6.2
Copper (ppm)	1.1 ± 0.04
Zinc (ppm)	1.2 ± 0.02
Manganese (ppm)	3.2 ± 0.02
Iron (ppm)	60.2 ± 0.2

Treatments

The field experiment was carried out in a complete randomized design with 4 replicates. Four treatments were considered: Control plants or non-mycorrhizal (NM), plants inoculated with *Glomus fasciculatum* (Gf), *Gigaspora margarita* (Gm) and *G. fasciculatum* (Gf),+ *G. margarita* (Gm).

Cultivation Method

The experimental fields were prepared as per usual method for Coleus cultivation. The fertilizers input was applied as half on N (20kg), whole of P_2O_5 (30 kg) and K_2O (25 Kg) were applied as a basal dose followed by the remaining ½ N at 30 days after planting as top dressing in addition to Farm yard manure 4 ton per acre. The crop was propagated through terminal and cuttings were planted in well prepared nursery beds under shade and AMF inoculants was applied to plants as per the treatments by following standard method, after about a month's time it was transplanted to main field. The field was divided into plots of convenient sizes which were prepared into ridges and furrows at a spacing of 60 cm and the rooted cuttings were planted at 30 cm apart within the row. The first irrigation was given immediately after transplanting. During the first two weeks after planting, the crop was irrigated once in three days and there after weekly irrigation was given. In order to obtain economic yield frequent weeding during the early growth period was done. Plant protection was done by following standard method. The crop was ready for harvest after about 130-150 days of planting. The crop was harvested manually by uprooting the individual plants. The tubers were separated, cleaned chopped into pieces and shade dried to bring about 12 per cent moisture

After 30, 60 and 90 days growth, the plants were harvested and the following parameters including shoot fresh weight (SFW) and root fresh weight (RFW), were measured by standard methods. Furthermore, Biochemical content in shoot and root were determined at the 30, 60 and 90 days of experiment.

Results and Discussion

The data representing the effects of AMF inoculation on the fresh weight are shown in Table-1. The fresh weight was significantly affected by AMF inoculation on *Coleus aromaticus* Benth. The higher fresh weight (63.28, 58.30 and 97.83 g plant-1) was recorded in *G. fasciculatum* + G. margarita application at 30, 60 and 90 DAS. The lower fresh weight (21.34, 38.63 and 62.55 g plant-1) was recorded at 30, 60, 60 and 90 DAS control plants. The fresh and dry weights are the most part based on their growth performance of a particular plant. In the present study the *G. fasciculatum + G. margarita* application increased the fresh and dry weight of the *Coleus* plant when compared to control. The highest fresh and dry weights were recorded in 90 days old plants. Gill *et al.*, [2] reported that biomass of the plant increased by mycorrhizal infection. Our results showed that root/shoot ratio in terms of dry weight increased AM treated plant and supplementary increase was noticed of duel inoculation treatments. Abbot and Robson [3], Menge [4] and Powell [5] reported that high level of N, P, and other nutrients. The findings agree with Tahat et al., [6], Mustafa et al., [7] and Akhtar & Siddiqui [8].

Table 2 represented the effects of AMF inoculation on the Biochemical content of *Coleus aromaticus* Benth. The higher total chlorophyll (1.49, 3.47 and 5.89 mg g^{-1} fr. wt.), protein (1.91, 2.81 and 3.61 mg g^{-1} fr. wt.), carbohydrate (1.98, 3.63, and 5.71 mg g^{-1} fr. wt.) and total sugar (2.99, 3.89 and 5.41 mg g^{-1} fr. wt.) content was recorded *G. fasciculatum* + *G. margarita* application at 30, 60 and 90 DAS. The lower total chlorophyll (0.88, 2.44 and 3.84 mg g^{-1} fr. wt.), protein (0.81, 1.38 and 1.96 mg g^{-1} fr. wt.), carbohydrate (0.78, 1.36 and 3.18 mg g^{-1} fr. wt.) and total sugar (1.43, 1.91 and 2.83 mg g^{-1} fr. wt.) was recorded in control plants at all sampling days. The highest chlorophyll content was recorded in *G. fasciculatum + G. margarita* plants when compared to control plants. Similar findings were recorded in various plants such as *Brassica oleracea* [9] and Winter wheat [8, 10]. The increasing chlorophyll content was due to the presence of microorganisms in the soil that colonize in the rhizosphere and stimulate the plant growth and Biochemical contents. The AM fungi symbiosis increased leaf gas exchange and photosynthetic rate and enhanced water uptake through improved hydraulic conduction. The sugar contents (reducing sugar, non-reducing sugar and total sugars) are higher in *G. fasciculatum + G. margarita* fungi applied plots. Similarly the control plants have lowest sugar content. The highest sugar content was recorded at 120 days old plants when compared to other sampling days of *Coleus* plants. The increased amount of sugar is a characteristic feature of high P-plants [11]. The accumulation of sugars and a number of other organic solutes are important factors involving carbohydrate metabolism [12]. Protein is one of the reservoir for food materials which are utilized for the growth of seedlings and auxiliary growth. The highest protein content of *Coleus* plant was recorded in the treatment *G. fasciculatum + G. margarita* fungi application when compared to control and other treatments. Almost 20% increase of protein content was recorded in the treatment in *G. fasciculatum + G. margarita* than in control. The effect has been attributed to quantitative and qualitative changes in protein composition of mycorrhizal inoculated plants [13]. The relative distribution of protein between the shoot and root demonstrated that mycorrhizal plants possessed a higher root, shoot, protein content than non-mycorrhizal ones [14-16].

Table 1: Effect of native AM fungi on fresh weight (g) of *Coleus aromaticus* Benth

Treatments	**Sampling Days**		
	30	**60**	**90**
Control	21.34	38.63	62.55
G. fasciculatum	30.65	54.63	78.63
G. margarita	25.63	42.63	65.80
G. f + G. m	63.28	58.30	97.83

Table 2: Effect of native AM fungi on Biochemical content (ppm) of *Coleus aromaticus* Benth

Treatments	**Sampling Day**											
	Chlorophyll			**Protein**			**Carbohydrate**			**Total Sugar**		
	30	**60**	**90**	**30**	**60**	**90**	**30**	**60**	**90**	**30**	**60**	**90**
Control	0.88	2.44	3.84	0.817	1.385	1.963	0.781	1.36	3.18	1.43	1.11	2.83
G. fasciculatum	1.22	3.11	4.75	1.513	2.411	3.108	1.635	2.87	4.263	2.03	2.96	3.99
G. margarita	1.11	2.86	4.05	1.118	2.152	2.913	0.965	1.08	2.568	1.57	2.27	3.06
G. f + G. m	1.49	3.47	5.89	1.913	2.815	3.618	1.983	3.63	5.718	2.99	3.89	5.41

Conclusion

Biochemical contents were high in mycorrhizal plants particularly in mixed (*G. fasciculatum + G. margarita*) treatments. Among studied fungus species, inoculation of *Coleus aromaticus* with Gf+Gm resulted in significant increase in biomass indices and Biochemical contents in comparison with other AM fungal species. Colonization rate of roots with Gf+Gm was higher than other species, which may indicate efficient symbiotic potential of this species with *Coleus* roots. It is concluded that *G. fasciculatum + G. margarita* extensively colonized *Coleus aromaticus* roots and considerably improved biomass as well as Biochemical.

References

1. Brundrett, M., 2004. Diversity and classification of mycorrhizal associations. *Biological Reviews*, **79:** 473-495.
2. Gill, T.S., R.S. Singh and J. Kaur, 2002. Comparison of four arbuscular mycorrhizal fungi for root colonization, spore population and plant growth responses in chickpea. *Ind. Phytopath.*, **55:** 210-212.
3. Abbott, L.K. and A.D. Robson, 1991. Factors influencing the occurrence of vesicular-arbuscular mycorrhizas, *Agric. Ecosyst. Environ.*, **35:** 121-150.
4. Menge, J.A., 1981. Mycorrhiza agriculture technologies. *In:* Background papers for innovative biological technologies for lesser developed countries (eds.), *Congress Office of Technology Assessment*, us Government Printing Office, Washington, DC, pp. 383-424.
5. Powell, C.L., 1984. Field inoculation of VA mycorrhizal fungi. *In:* C.L. Powell and D.J. Bagyaraj (eds.), *Mycorrhiza*, CRC Press, Boca Raton, FL, pp. 205-234.
6. Tahat, M.M., S. Kamaruzaman, O. Radziah, J. Kadir and H.N. Masdek, 2008. Responses of (*Lycopersicum esculentum* L. Mill.) to different arbuscular mycorrhizal fungi species. *Asian J. Plant Sci.*, **7:** 479-484.
7. Mustafa, A.A.A., R. Othman, M.A. Zainal Abidin and V. Ganesan, 2010. Growth response of sweet corn (*Zea mays*) to *Glomus mosseae* inoculation over different plant ages. *Asian J. Plant Sci.*, **9:** 337-343.

8. Akthar, M.S. and Z.A. Siddiqui, 2010. Effects of AM fungi on the growth and root-rot diseases of chickpea. *Am. Eurasian J. Agric. Environ. Sci.,* **8:** 544-549.
9. Nelson, R. and P.N. Achar, 2001. Stimulation of growth and nutrient uptake by VAM fungi *Brassica oleraceae* var. *Capitata. Biol. Plantarum,* **44:** 277-281.
10. Arumugam, R., S. Rajasekaran and S.M. Nagarajan, 2010. Response of arbuscular mycorrhizal fungi and *Rhizobium* inoculation on growth and chlorophyll content of *Vigna unguiculata* (L.) Walp. var. Pusa 151. *J. Appl. Sci. Environ.,* **14:** 113-115.
11. McArthur, D.A.J. and N.R. Knowless, 1993. Influence of species of vesicular-arbuscular mycorrhizal fungi and phosphorus nutritio on growth, development and mineral nutrition of potato. *Plant Physiol. Sci.,* **103:** 771-782.
12. Kameli, A., 1990. Metabolic responses of wheat plants in water stress and their role in drought resistance. *Ph.D. Thesis*, University of Sheffield, UK.
13. Dumas-Gaudot, E., G. Armelle, C. Cordier, S. Gianinazzi and V.G. Pearson, 2000. Modulation of host defense system. *In:* Y. Kapulnik and J.D.D. Douds (eds.), *Arbuscular mycorrhizas: Physiology and Function*, Kluwer Academic Publishers Netherlands, pp. 173-200.
14. Selvaraj, T. and P. Chellappan, 2006. Arbuscular mycorrhizae A diverse personality. *J. Central Eur. Agric.,* **2:** 349-358
15. Wright, S.F. and A. Upadhyaya, 1998. A survey for aggregate stability and glomalin: A glycoprotein produced by hyphae of arbuscular mycorrhizal fungi. *Plant Soil,* **198:** 97-107.
16. Farahani, A., H. Lebaschi, M. Hussein, A.H. Shiranirad, A.R. Valadabadi and J. Daneshian, 2008. Effects of arbuscular mycorrhizal fungi, different levels of phosphorus and drought stress on water use efficiency, relative water content and proline accumulation rate of Coriander (*Coriandrum sativum* L.). *J. Med. Plants Res.,* **2:** 125-131.