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INTERACTION EFFECT OF AM FUNGI AND SALT STRESS ON THE GROWTH OF CURCUMA LONGA L. GROWN UNDER GREEN HOUSE CONDITION

Dr. B. Sadhana

Centre for Research and P.G Department of Botany, Thiagarajar College, India

Abstract

Arbuscular Mycorrhiza is a ubiquitous fungus which is associated with root system of higher plants. The distribution and abundance of AM fungi vary greatly among different sites including natural and manmade ecosystems. *Curcuma longa*, L. is a herbaceous perennial plant belongs to the Family: Zingiberaceae, commonly called as turmeric which is a native of South Asia particularly India. India is a leading producer and exporter of turmeric in the world. It is used as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. The present study dealt with the interactive effect of AM fungi and salt stress on the vegetative growth of turmeric plants grown under green house condition. The study reported that the low concentration of sodium chloride does not affect the plant growth when they treated with AM fungi compared to control plants. Thus this AM fungi stimulated the salt tolerance in turmeric plants against the low concentrations of sodium chloride.

Keywords: AM fungi, Turmeric, Nutrient mobilization and salt stress.

Introduction

Arbuscular Mycorrhiza is an endophytic fungi which is associated with root system of higher plants. Turmeric (*Curcuma longa* L), the ancient and sacred spice of India known as 'Indian saffron' is an important commercial spice crop grown in India. Andhra Pradesh, Tamil Nadu, Orissa, Karnataka, West Bengal, Gujarat, Meghalaya, Maharashtra, Assam are some of the important states cultivates turmeric, of which, Andhra Pradesh alone occupies 35.0% of area and 47.0% of production. It is used in diversified forms as a condiment, flavouring and colouring agent and as a principal ingredient in Indian culinary as curry powder. It has anti cancer and anti viral activities and hence finds use in the drug industry and cosmetic industry. 'Kum-kum', popular with every house wife, is also a by-product of turmeric. It finds a place in offerings on religious and ceremonial occasions. A type of starch is also being extracted from a particular type of turmeric. The increasing demand for natural products as food additives makes turmeric as ideal produce as a food colourant. The present study deals with the assessment of various concentrations of Sodium chloride influence the growth of *Curcuma longa* under green house condition.

Materials and methods

Open pot culture was used for the mass production of AM fungi. A layer of 100g of collected soil samples (inoculam) was spread over pot mixture (sterilized soil and sand=1:3; about 3 kg) in earthen pots (20 cm height and 25 cm diameter). These pots were used for the experimentation. The pot without AM fungal inoculam was used as control. The 2cm size rhizome of *Curcuma longa* was propagated at the depth of 5cm in pot soil. The plant was assigned for the following treatments: T1- 0.1, T2- 0.2, T3 - 0.3, T4 - 0.4 and T5 - 0.5%. Sodium chloride treatment for 7 days period after 90th day of plant growth. The vegetative growth of *Curcuma longa* analysed by Chlorophyll and carotenoid

Corresponding Author. Email: sadhanakarthik2004@yahoo.co.in

estimation method (Arnon, 1949) and free proline content (Bates *et al.,* 1973) was estimated at regular interval of 30 days. The data collected in this study was subjected to analysis of variance (ANOVA) and means comparison has done using Duncan's multiple range test (DMRT) (Little and hills, 1978).

Results and discussion

Soil salinity is a major abiotic stress adversely affecting plant growth and crop production worldwide. Microbes like AM fungi are able to inoculate plants, in their natural environment. Some beneficial microbes like bacteria and fungi can improve the plant growth under stress environments and also enhance yield (Evelin *et al.,* 2009).

In the present study such AM fungi inoculation in *Curcuma longa* plant significantly enhanced the vegetative growth (increase the chlorophyll and carotenoid pigments) and synthesis of physiologically protective compounds (proline accumulation) when compared to control plants. Initial period of plant growth the chlorophyll and carotenoid content were normal (Table: 1&2; Fig: 1) and were decreased during stress period induced for 7 days except in case of proline accumulation (Fig:2), it was higher when the plants grown under various concentrations of sodium chloride. But the lower concentrations 0.1% does not affect the plant growth when they grown under salt stress. These plants were recovered faster than the other higher concentrations of salt induced plants. It is concluded that the AM fungi inoculated plant showed significant growth and showed mild salt tolerance against low concentrations of sodium chloride when compared to non- AM fungi inoculated plants.

AM fungi are associated with the roots of over 80% terrestrial plant species (Smith and Read, 2008). AM fungi have been shown to promote plant growth and salinity tolerance by many researchers. They promote salinity tolerance by utilizing various mechanisms, such as enhancing nutrient uptake (Evelin *et al*., 2012), producing plant growth hormones, improving rhizospheric and soil conditions (Asghar *et al*., 2005), improvement in photosynthetic activity or water use efficiency (Hajiboland *et al*., 2010), accumulation of compatible solutes (Evelin *et al*., 2013) and production of higher antioxidant enzymes (Manchanda and Garg, 2011).

The present investigation showed that the inoculation of AM fungi and low concentration of sodium chloride on *Curcuma longa* plant enhanced the vegetative growth by means of increase in chlorophyll and carotenoid content and tolerance for few days of salt stress. But the higher concentrations affected the growth of *Curcuma longa* plants grown under green house conditions. It is also suggested that the soil application of such Am fungi not only enhanced the vegetative plant growth but also increased the soil fertility and reduced the risk of application of chemical fertilizers in the agricultural field. They are generally termed as eco-friendly fertilizers and do not cause any environmental pollution.

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Appendix

Table: 1 Interaction effect of AM fungi and Salt stress on the Chlorophyll a (mg/g fresh leaf) content of Curcuma longa under green house condition

Sl No	Treatments	60th Day	90th Day	97th Day	120th DAY	150th Day	180th Day	210th Day	240th Day
1	Control	0.1132^{a} ±0.020	0.3212^{c} ±0.012	0.1054^{a} ±0.010	0.2104^{b} ±0.102	0.5261^{e} ±0.027	0.4203^{d} ±0.020	0.4015^{d} ±0.020	0.3209^{c} ±0.010
2	T1	0.3845^{a} ±0.040	0.7532^{b} ±0.012	0.7911^{b} ±0.020	1.1043^{c} ±0.116	3.0241^{d} ±0.020	5.0241^{e} ±0.200	8.1253^{f} ±0.140	5.0126^{e} ±0.122
3	T2	0.3845^{a} ±0.040	0.7532^{b} ±0.032	0.7221^{b} ±0.011	0.8242^{c} ±0.113	1.1023^{d} ±0.103	3.0221^{f} ±0.110	5.0012^{g} ±0.520	2.0134^{e} ±0.310
4	T3	0.3845^{e} ±0.040	0.7532^{b} ±0.021	0.6713^{b} ±0.023	0.8013^{c} ±0.025	1.0242^{d} ±0.102	3.1325^{f} ±0.053	4.1370^{g} ±0.240	2.0143^{e} ±0.126
5	T4	0.3845^{a} ±0.040	0.7532^{c} ±0.010	0.6201^{b} ±0.031	0.7804^{c} ±0.031	1.1432^{d} ±0.028	3.4572^{f} ±0.125	4.0321^{g} ±0.210	2.1187^{e} ±0.031
6	T5	0.3845^{a} ±0.040	0.7532^{c} ±0.040	0.5023^{b} ±0.025	0.7724^{c} ±0.009	1.2314^{d} ±0.027	3.2144^{f} ±0.052	4.1452^{g} ±0.220	2.1658^{e} ±0.113

Values are mean of five replicates ± SD The mean difference is significant at the 0.05

Table: 2 Interaction effects of AM fungi and Salt stress on the Chlorophyll b (mg/g fresh leaf) content of Curcuma longa under green house condition

Sl No	*Treatments*	*60th Day*	*90th Day*	*97th Day*	*120th DAY*	*150th Day*	*180th Day*	*210th Day*	*240th Day*
1	*Control*	*0.0072c ±0.010*	*0.0095d ±0.023*	*0.0064b ±0.002*	*0.0070c ±0.002*	*0.0061b ±0.017*	*0.0103e ±0.030*	*0.0100e ±0.021*	*0.0009a ±0.003*
2	*T1*	*0.0934a ±0.022*	*0.2394b ±0.026*	*0.2441b ±0.007*	*0.3233c ±0.106*	*0.4241d ±0.030*	*0.6231e ±0.030*	*0.6853e ±0.023*	*0.4023d ±0.008*
3	*T2*	*0.0934a ±0.022*	*0.2394b ±0.026*	*0.2100b ±0.011*	*0.2205b ±0.013*	*0.3123c ±0.011*	*0.4125d ±0.033*	*0.5002e ±0.010*	*0.3032c ±0.010*
4	*T3*	*0.0934a ±0.022*	*0.2394c ±0.026*	*0.2101b ±0.063*	*0.2113b ±0.125*	*0.2245b ±0.020*	*0.4226e ±0.062*	*0.5200f ±0.020*	*0.3140d ±0.024*
5	*T4*	*0.0934a ±0.022*	*0.2394d ±0.026*	*0.2013c ±0.004*	*0.1808b ±0.021*	*0.2232c ±0.018*	*0.3802e ±0.015*	*0.4821f ±0.040*	*0.3017d ±0.024*
6	*T5*	*0.0934b ±0.022*	*0.2394e ±0.026*	*0.0900a ±0.025*	*0.1621c ±0.012*	*0.2114d ±0.017*	*0.3704f ±0.022*	*0.3955g ±0.032*	*0.2057d ±0.015*

Values are mean of five replicates ± SD The mean difference is significant at the 0.05

Figure: 1 Interaction effect of AM fungi and Salt stress on the Carotenoid content (mg/g fresh leaf.) of Curcuma longa under green house condition

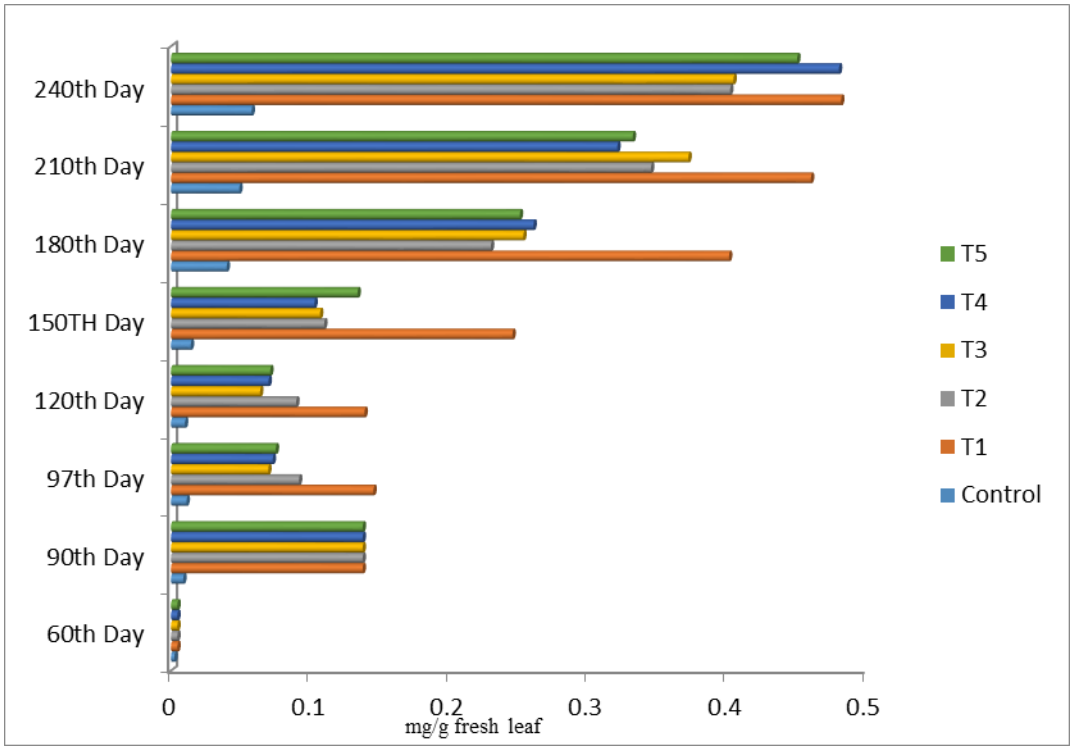

Figure: 2 Interaction effect of AM fungi and Salt stress on the proline content (mg/g fresh leaf.) of Curcuma longa under green house condition