J. Phytol. Res. **12**(1-2) : 35-38, 1999

IMPROVED GROWTH AND PRODUCTIVITY OF *SESBANIA GRANDIFLORA* (PERS) UNDER SALINITY STRESS THROUGH MYCORRHIZAL TECHNOLOGY

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Inoculation of *Sesbania grandiflora* with VAM fungus, *Glomus macrocarpum* in saline soils showed significant increase in growth and biomass of the plants. The percent VAM colonizattion of roots, production of VAM fungal spores in the rhizosphere soil and number of root nodules were significantly higher. *Sesbania grandiflora* was highly dependent on vesicular arbuscular mycorrhiza and maximum dependency was at early stages of plant growth. VAM fungus, *Glomus macrocarpum* protected *S.grandiflora* against salinity stress by increasing its establishment and survival in saline soils.

Keywords :Dependency; *Glomus macrocarpum*, salinity; *Sesbania grandiflora*.

Introduction

Soil salinity is a wide spread problem and is becoming a major factor for restricting plant growth and biomass production in arid, semiarid and tropical areas. Salinity changes physiological and metabolic pathways of plants and causes rapid decline in crop production. The role of VAM fungi under different stress conditions is well documented in literature[1-5]. Increased growth of plants in saline soil is mainly through improved uptake of nutrients[6],enhanced soil fertility anb by increased tolerance of salt stress by inoculated palnts[7]. Reclamation and revegetation of degraded/waste lands with multipurpose tree species (MPTS) such as *Acacia, Leucaena*, and *Prosopis* spp. has been successful in some arid and semi-arid regions of the world, but not in saline soil[8]. Thus reclamation of saline soil using MPTS, *Sesbania grandiflora* a fast growing and salt tolerant tree legume[9] through mycorrhizal technology may help in overcoming salinity stress problem. Keeping this in mind, the present experiment was conducted to determine the effect of VAM fungus, *Glomus macrocarpum* (Tul and Tul) on growth, productivity and dependency of *S. grandiflora* in soils where salinity stress restricts plant growth.

Soil was chemically analyzed at Soil Science Laboratory, Department of Soil Science, Indian Agricultural Research Institute, New Delhi. The physical and chemical characters of soil were as follows : pH-8.9, N-11.9 kg/ha, P-13.5 kg/ha, K-295.7 kg/ha, $CaCO_3$-15.5 kg/ha, Na-9.99 mg/10gm and soil texture-loamy.

Study of growth parameters : Plants were uprooted at 30, 45, 60 Days After Germination (DAG) and washed thoroughly in tap water to remove soil debris adhering to roots. The growth parameters were evaluated in terms of root and shoot length, root and shoot fresh and dry weights and number of nodules formed.

VAM Colonization and spore counts : The roots of mycorrhizal and non-mycorrhizal plants were cleared and stained[10], and percent mycorrhizal colonization was estimated[11]. VAM fungal spores were isolated from the rhizosphere soil by wet sieving and decanting technique[12] and quantified as number per 10 gm of soil. Mycorrhizal dependency was calculated[13]. Statistical analysis of data was done using student's t-test.

Results and Discussion

Under conditions of salinity stress the inoculation of *Sesbania grandiflora* with VAM fungus, *Glomus macrocarpum* led to significant increase in all the growth parameters observed.

The percent VAM colonization and number of VAM spores in rhizosphere soil was higher in the inoculated plants at all the growth stages (Fig. 1,2) and increased with increasing age of the plants. All the characteristic VAM structures i.e. the intra and intercellular hyphae, vesicles and arbuscules were obseved in the plant roots.

There was a significant increase in growth and biomass accumulation in inoculated plants (measured in terms of root and shoot length, fresh and dry weights)(Table 1). The root and shoot length of mycorrhizal plants was greater than the uninoculated control plants at all the growth stages. Young plants (30DAG) showed maximum dependency on *G. macrocarpum*, which decreased with the increasing age of the plants (Table 1).

The number of nodules formed on the plant roots was also significantly higher in VAM inoculated plants especially at 60 DAG (Fig.3).

It has been shown by earlier workers that soil salinity significantly lowers concentration of phosphorus in the tissue[6]. The major beneficial effects of VA mycorrhizal fungi are throgh their ability to augment the supply of phosphorus to plants, especially in sites where phosphorus is a factor limiting plant growth. The improved phosphorus nutrition seems to be the most likely mechanism for the increased plant growth and biomass accumulation in *G.macrocarpum* inoculated *S.grandiflora* plants. In addition to this the VAM fungal hyphae which extend more than 7 cm beyond the root surface and thereby increase the volume of depletion zone, may also be responsible for improved water relation of VAM inoculated plants. As reported earlier[14] this may lead to improved plant growth. It was observed in the present study that VAM inoculation resulted in increased nodulation (Fig. 3).

The inoculation of leguminous plants with VA mycorrhizal fungi has a synergistic effect on the plant-Rhizobium symbiosis[15]. This effect is also primarily attributed to increased P- supply to the nodules through mycorrhiza, leading to the increased nodulation, bigger nodules

Table 1 : Effect of VAM fungus, *Glomus macrocarpum* on growth response and mycorrhizal dependency of *Sesbania grandiflora* seedlings in saline soil.

DAG	Treatment	Root Length (cm)	Root Fresh Weight(g)	Root dry Weight(g)	Shoot Length (cm)	Shoot Fresh Weight(g)	Shoot Dry Weight(g)	Number of Nodules	Mycorrhizal Dependency
30	SS-GM	9.98±1.24	0.016±0.08	0.04±0.01	15.52±2.08	1.68±0.52	0.27±0.11	13.40±1.44	71.86
	SS+GM	15.62±1.31b	1.26±0.62	0.19±0.06b	22.12±3.30a	4.25±2.30a	1.43±0.48b	17.40±3.26a	
45	SS-GM	15.10±2.05	2.80±1.77	0.59±0.47	50.58±2.28	18.64±4.99	5.74±3.80	20.80±3.96	62.90
	SS+GM	25.40±2.51b	15.23±2.84b	1.23±0.83	80.20±2.75c	40.00±3.84a	14.40±4.29a	31.60±4.55a	
60	SS-GM	27.2±3.17	7.77±2.48	1.83±0.66	76.44±3.72	56.03±6.41	15.41±4.26	40.40±5.13	43.01
	SS+GM	39.66±3.65b	20.58±4.26b	3.13±1.44	140.7±3.95c	86.35±6.55b	27.15±5.11	82.01±6.25c	

SS-GM - Uninoculated saline soil
SS+GM - Inoculated saline soil
DAG - Days After Germination

Data is expressed as Mean±S.D., where n=5
'a' significant at ≤ 0.05
'b' significant at ≤ 0.01
'c' significant at ≤ 0.001

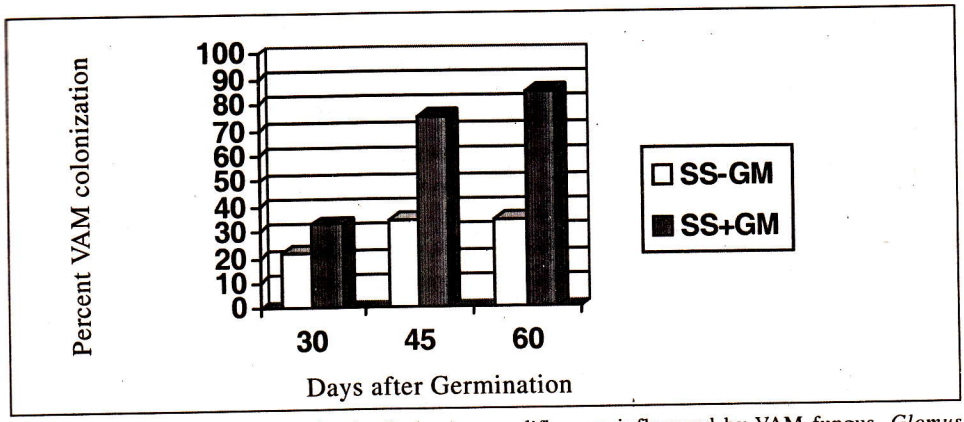

Fig. 1 Percent Root colonization in *Sesbania grandiflora* as influenced by VAM fungus, *Glomus macrocarpum*

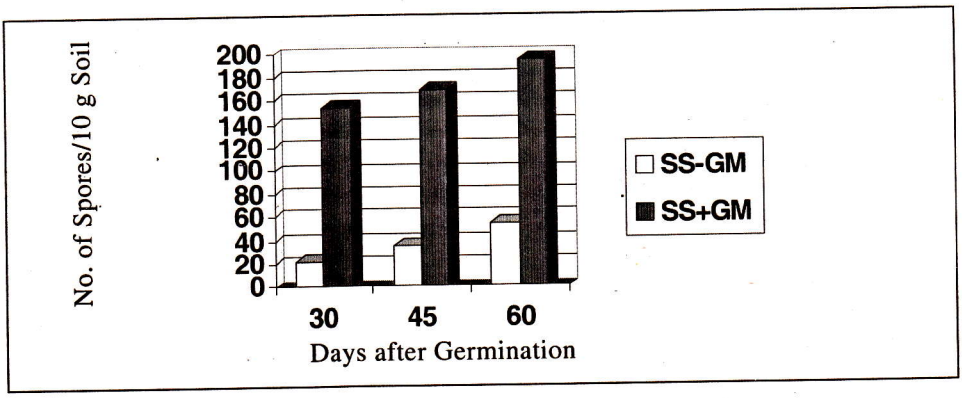

Fig. 2 Number of spores/10g of soil in *Sesbania grandiflora* as influenced by VAM fungus, *Glomus macrocarpum*

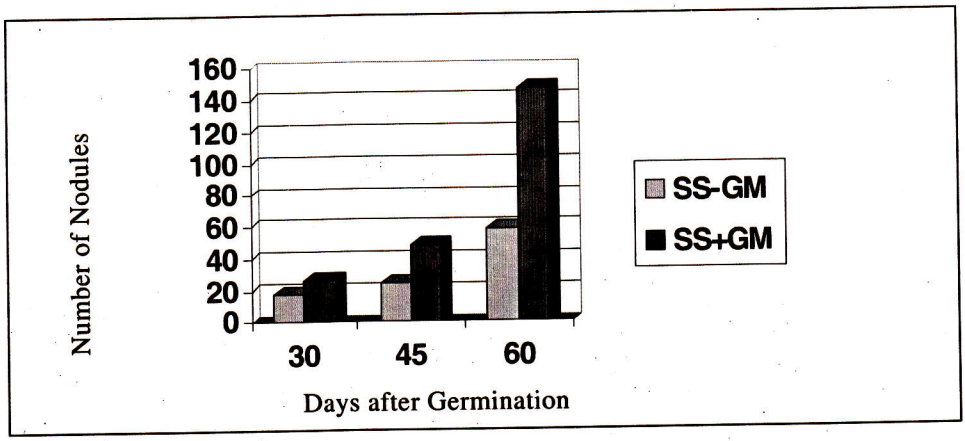

Fig. 3 Effect of VAM fungus, *Glomus macrocarpum* on number of nodules of *Sesbania grandiflora* in saline soil

SS-Gm- Uninoculated saline soil; SS+Gm-Inoculated saline soil

and greater efficiency of nitrogen fixation[16].

The dependency of *S.grandiflora* on VAM fungal inoculum for growth and establishment has been highlighted[17]. In our study higher dependency of *S.grandiflora* during early stages of plant growth further proves that plants growing under salinity stress are more dependent on mycorrhiza especially during seedling establishment and early stages of vegetative growth. If the results of this study can be extended to the field, inoculating seedlings of *S.grandiflora* with selective strains of VAM fungi may be a feasible strategy for improving growth, productivity, establishment and survival of this legume in saline soils.

References

1. Charest C, Dalpe Y and Brown A 1993, *Mycorrhiza* **4** 89
2. Giri B and Chamola BP 1999, In : *Advances in Microbial Biotechnology* J P Tewari, J Singh, TN Lakhanpal, R Gupta, and BP Chamola (eds). p.421
3. Giri B, Kaur M and Mukerji KG 1999, *Ann. agri. Res.* **20**(1) (in press)
4. Gupta R and Krishanamurthy KV1996, *Mycorrhiza* **6** 145
5. Kothari SK, Marshner H and George E 1990, *New phytol.* **116** 303
6. Ojala JC, Jarrell WM, Menge JA and Johanson ELV 1983, *Agronomy J.* **75** 255
7. Rosendahl CN and Rosendahl S 1991, *Environ. Exp. Bot.* **31** 313
8. Jain RK, Paliwal K, Dixon RK and Gijerstad DH 1989, *Journal of Forestry* **87** 38
9. Chavan PD and Karadge BA 1986, *Plant and Soil* **93** 395
10. Phillips JM and Hayman DS 1970, *Trans. Br. Mycol. Soc.* **55** 185
11. Giovannetti M and Mosse B 1980, *New Phytol.* **84** 489
12. Gerdemann JW and Nicholson TH 1963, *Trans. Br. Mycol. Soc.* **46** 235
13. Plenchette C, Fortin JA and Furlan V 1983, *Plant and Soil* **70** 191
14. Safir GR, Boyer JS and Gerdemann JW 1971, *Science* **172** 191
15. Azimi S, Gianinazzi PV and Gianinazzi S 1980, *Can. J. Bot.* **58** 2200
16. Mosse B, Powell CL and Hayman DS 1976, *New Phytol.* **76** 331
17. Habte M and Aziz T 1985, *Appl. Environ. Microbiol.* **50**(3) 701