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Use of AMF inoculation under different concentration of domestic sewage water to improve growth of *Impatieus balsamina* L.

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ABSTRACT

A comparative study was made to analyse the effect of vesicular mycorrhizal fungi and different dilution of domestic sewage water on growth parameters of vigor of Niger plants. Overall results revealed that the plant height, biomass production was significantly improved at 25% diluted municipal sewage water with VAM inoculation. The increased biomass production and NPK uptake in mycorrhizal plants was higher over the non-mycorrhizal plants or plants treated with water alone. However, plant height, mycorrhizal colonization was negatively responded when plants with undiluted domestic sewage water with mycorrhizal inoculation.

Key words : Niger, Vesicular arbuscular (VA) mycorrhizal fungi, Domestic sewage water, Per cent colonization, Spore population, Biomass production

INTRODUCTION

The problem of water pollution from domestic wastewater or municipal sewage is common both in developed and developing countries. With growing population, urbanization and industrialization, the quantity of sewage water is increasing alarmingly day by day. It is estimated that by the end of 2001. approximately 2200 million litre sewage will be released each day. Epidemic diseases like Brucellosis. Cholera, hepatitis and malaria are related with sewage. Besides heavy metals present in the sewage water pollute the environment.United Nations World health organization reports that more than 2.7 crores of people are affected by sewage related diseases every year (Pradhan *et al.,* 2000).

Biorediation a technology that has gained great popularity and is attracting attention as a remedial technology, in which arbuscular mycorrhizal fungi (AMF) are used to detoxify sewage water (Laksman, 1999). The problems of sewage water can be minimised only by effective use of this water with beneficial microorganisms. In India, municipalities use this sewage water for cultivation of vegetables in farm fields. However, there are some heavy metals such as manganese, zinc, copper, cobalt, nickel, lead and cad- mium etc. tend to accumulate in the environment and living systems. These metals directly affect the soil as well as accumulate in the vegetables. It affects directly human health. Therefore, crops like fibers, in yielding plants can currently be grown using sewage water and this may not affect directly human health. In recent days quite interesting work has been carried on the effect of different industrial effluents on germination and growth of pulses, cereals and millets (Jabeen and Abraham, 1997; Iqbal and Mehta, 1998).

However, a detailed perusal of the literature reveal that not much work has been done on the effect of domestic sewage water with inoculation of mycorrhiza *(G. fasiculatum)* on growth of Niger. It is an important drought tolerant oil yielding plant. Hence, the present investigation was carried out to elucidate the influence of domestic sewage water, with and without the use of AMF on growth and biomass production of Niger.

MATERIALS AND METHODS

Domestic sewage water samples were collected, from the main stream of Hubli - Dharwad at passage out skirt. NFES Labs (A division of National foundation for environmental service) Nehrunagar, was got analyzed domestic sewage at Karad (Maharashtra) India. Raw domestic sewage water was auto-claved 1-2 hrs and diluted with tap water in different concentrations. Similarly, other set of experiments were conducted by using *Glomus faslculatum* (VAMF) as an inoculation. The earthen pots measuring 30 × 25 were filled three parts of laterite loam and one part of pure sand. Chemical composition of the experimental soil consists of pH 6.8 organic carbon 0.29%, nitrogen 205 kg/ha, and phosphorus 12.3 kg/ha and Potash 119 kg/ha. Six replications were maintained for each treatment in a glass house with a temperature range of 25-28^0 C. Indigenous AMF spore strain *i.e., Glomus fasciulatum* was isolated and cultured in sterilized soil in earthen pots using host plant Sudan grass. 25 g mixed Inoculum consisted of chopped roots

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bits and soil from the pot culture of Sudan grass (*Sorghum bicolor* L. Moench. Var. Sudanese), which was infected with. Niger seedlings were harvested when they were 90 days old. Per cent of AMF coloniza- tion was estimated by microscopical examination at × 10 magnification, after staining in 0.05% trypan blue in lactophenol (Philip and Hayman, 1970). Chemical analysis of soil was determined following the, standard method (Jackson, 1973). Heavy metals of sewage water were detected by using 508 Itachi Model atomic spectrophotometer. The data has been statistically analyzed.

RESULTS AND DISCUSSION

Present data revealed the low concentration of nitrogen, phosphorus organic carbons and B.O.D. The results of analysis are presented in the Tables 1 and 2, with higher concentration of calcium, magnesium, zinc, iron, chlorides and copper. The increased plant height was four fold higher, compared to non mycorrhizal or control plants. 25% dilution of domestic sewage water with mycorrhizal inoculation brought six fold increased root length and shoot dry weight (Table 2). The per cent mycorrhizal colonization was significantly increased, when the mycorrhizal plants treated with 50% sewage water. In contrast to this, very low or no growth was observed in plants treated with undiluted sewage water. Spore number was reduced from (27 to 14/50 g. soil) with increased sewage concentration and without mycorrhizal inoculation. However, the increased spore number was observed in the plants treated with mycorrhizal inoculation in diluted sewage water. The harvest index was calculated and the data are presented in Tables 2. Total dry weight of shoot production was significantly increased in mycorrhizal plants over the control or non-mycorrhizal plants. Similar findings are evidenced by the early works (Joseph *et al.*, 1985) on different crop plants. The dilution of sewage water has very significant effect with mycorrhical inoculation on growth, per cent mycorrhizal colonization, spore population, plants biom- ass production and Phosphorus uptake. On contrary Pradhan *et al.* (2000) demonstrated that the concen- tration of sewage has no effect on germination of Niger (*Guzotia abyssinica*). It revealed that sewage water as good as tubewell water for germination of Niger seeds. This may be due to percentage of germination and seedling vigour index was not affected even when the sewage water was directly used in toto for raising seedling stock. It seems very likely that the effect of heavy metals in vesicular arbuscular mycor- rhizal fungi will vary between hosts, but not direct comparison has been made. The relationship between mycorrhizal colonization and the heavy metal concentration in shoots of Onion, suggests a much greater tolerance of the fungi when maximum colonization (Gilon and Tinker, 1983). In the investigation on Niger plants are in consistent with work of Brandly *et al.* (1981). They have shown that mycorrhizal colonization of *calluna* spp. Grown in sand culture with sewage treatment greatly increased its resistance to heavy metal toxicity, in an analogous, but much more striking way to that found here for cadmium. They attributed this protective action due to enhancing binding of heavy metals in roots, on the hyphal complexes in the mycorrhizal roots. The resistance to heavy metals intolerant cultivators of plants maybe based upon their ability to complex heavy metals on the cell wall, but the extension of this idea to the *calluna* spp. Mycor- rhizal association should be treated with caution. This binding mechanisms can only be benefit if

Table 1 : Effect of saline water and AMF on growth and biomass production of Balsam plants for 90 days

Treatment	Plant height (cm)	Root length (cm)	Shoot dry weight (g)
Tap water (N.M)	11.2±1.0	2.8±1.1	2.4±0.1
T.W.(S.W.)			
100:100	19.1±1.2	4.9±1.0	4.7±1.2
75:25	22.3±1.2	5.1±0.0	6.8±3.2
50:25	24.1±1.3	6.1±3.4	2.9±4.1
25:25	36.2±2.5	8.2±3.3	8.5±5.1
(S.W.) (M)	37.8±1.4	9.4±2.2	8.7±6.2
C.D. (P=0.05)	13.1±0.0	4.5±2.0	5.7±6.0

Table 2 : Effect of VAMF (G. *fasciculatum*) and saline water on per cent root colonization, spore number and P content in shoot of Balsam for 90 days

Treatment colonization	% AM soil	Spore number / 50g	% N, P, K content in shoot		
			N	P	K
Tap water (N.M) (T.W.) (S.W.)	0.0±0.0	0.0±0.0	1.29	0.05	0.41
100:100	13.5±5.2	16.2±0.0	1.61	0.07	0.42
25:75	28.3±7.2	19.2±4.2	1.63	0.1	0.44
25:50	29.5±3.3	23.2±7.0	1.59	0.1	0.47
25:25	43.2±7.3	27.6±5.0	1.59	0.12	0.48
C.D. at 0.05%	7.2±1.2	12.7±0.0	0.05	0.021	0.029

the supply rate of the heavy metal is limited (Allen, 1991, Lakshman, 2000), otherwise the binding sites will become saturated, after which the heavy metal will penetrate in to the cells. The mechanism is therefore unlikely to be very effective in sand culture.

From the detail perusal of data, it is considered that application of municipal sewage 25 % dilution with mycorrhizal inoculation is beneficial to be plants, and the increased level of pH, E.C. has not effect on the AMF spore population, spore germination and mycorrhizal effectiveness. The study further supports the occurrence of mycorrhiza (Draft and Nicolson 1974; Gildon and Tinker, 1983; Lakshman, 1999) most particularly, VAMF in any kind of environment stress.

An overview of the results indicated that 25% of dilution of domestic sewage water with mycorrhizal (VAM) Inoculum can be used for raising better Niger plants under semi arid conditions for their better establishment (WHO and UNICEF, 2000; Chandni *et al*., 2005). It also helps in reducing the PO fertilizer application. From the present findings, it is concluded that for higher biomasss yield and production of Niger plants treated with 25% diluted sewage water with mycorrhizal inoculation is the best treatment, which is followed by 50% dilution of domestic sewage water with mycorrhiza. Maximum plants height, root length, mycorrhizal colonization and nutrient uptake was determined. More emphasis should be given on param- eters like number of leaves per plant, chlorophyll content per leaflet and production of yield per plant.

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