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Full Length Research Paper

Influence of five industrial pollutants on mycorrhizal colonization, nodulation and growth of *Acacia nilotica* and *Leucaena leucocephala*

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An attempt was made to investigate the effect of different polluted soils on the mycorrhizal association, nodulation and subsequent growth of *Acacia melanoxylon* and *Leucaena leucocephala* tree species. Five industrial pollutant affected soils viz., Organic chemicals, pesticide, detergent, paper and neem seed oil cake were employed in this study and Palamuru University Campus soil used as a control. Among the five types of effluents, Adarsha Paper Industries and Vidyadhari neem extract effluents exerted less negative effect. Corey organics and Rhyme organics factory effluents have shown maximum inhibitory effect, K. K. Detergent factory effluents exerted moderate inhibitory effect. Both agro forestry tree species were shown similar response towards AM colonization, nodulation and growth against five industrial effluents.

Key words: Mycorrhizae, pollutants, *Acacia* and *Leucaena*.

INTRODUCTION

Soil fertility, vegetation, and soil stability drastically affected by industrial pollutants (Rajannan and Oblisami, 1979; Young et al., 1981). Mycorrhizal fungi are known to improve plant growth and development under nutrient deficient conditions. AM fungi are present in most of the soils and generally not considered to be host specific (Bowen, 1987). Industrial effluents or natural soil pollutants may interfere with the possible benefits of mycorrhizal association on plant nutrition and its health (Pavan et al., 2005). Very less information is available on the effect of effluents on indigenous AM fungi (Laxminarayan et al., 2006; Kehri and Chandra, 1990; Raman et al., 1995; Reddy et al., 1995; Srinivas et al., 1996). Therefore, the present investigations, an effect of five industrial effluents on the AM colonization, nodulation and growth of two legume plants were investigated.

MATERIALS AND METHODS

In the present investigations five industrial effluents namely phenol and methyl chloro acetate (Corey organics), Pesticides formulation (Rhyme organics), detergent cake (K.K. detergents), paper industry (Adarsha Paper Industries) and neem seed oil cake (Vidyadhari neem extracts) from Kothur, Mahabubnagar District were selected for these studies. Physico-chemical characteristics of the effluents were analyzed (APHA, AWWA and WPCF, 1975). Two Agro-forestry legume plants namely *Acacia melanoxylon* and *Leucaena leucocephala*, seeds were shown in polythene bags containing different polluted soils. Sterile water used for the experiments. AM colonization, number of resting spores, nodulation and biomass of the nodules and plant were estimated after 180 days of growth. To assess the mycorrhizal colonization, the procedure of clearing and staining of roots was carried out by the method suggested by Phillips and Hayman (1970). The percentage of infection was calculated by the formula given by Giovannetti and Mosse (1980). The resting spores of AMF were extracted by wet sieving and decanting methods of Gerdemann and Nicolson (1963) and Pacioni (1992) and later they were identified by following the key provided by Hall and Fish (1979) and Schenck and Perez (1987). Plant biomass, nitrogen (AOAC: Official method of analysis, 1950), phosphorus (Jackson, 1973) were estimated.

RESULTS AND DISCUSSION

An effect of five polluted soils on the mycorrhizal colonization, nodulation and subsequent growth of *A. melanoxylon* tree species was studied. The results are

Table 1. Effect of different polluted soils on AM colonization nodulation and growth of A. *melanoxylon.*

S/No.	Pollutant	Mycorrhizal colonization (%)	No. of spores/ 100 g soil	Nodulation			Height of the plant (cm)		Plant dry weight (g)		N content (%)	P content mg/g
				No.	Size (cm)	Dry weight (g)	Shoot	Root	Shoot	Root		
1	P.U. Campus	41.7	123	20	0.2	0.12	78.3	41.6	2.31	0.91	1.4	2.19
2	Adarsha paper Industries	27.4	73	22	0.3	0.14	59.6	31.2	1.85	0.88	1.0	1.55
3	K.K. detergents	21.3	64	13	0.2	0.09	44.2	25.8	1.43	0.78	0.9	1.10
4	Rhyme organics	14.9	39	8	0.3	0.04	37.2	24.2	1.38	0.74	0.8	0.69
5	Corey organics	11.9	28	5	0.2	0.03	25.2	18.2	1.04	0.65	0.5	0.51
6	Vidyadhari neam extracts	31.4	91	18	0.3	0.11	61.4	35.4	2.11	0.91	1.4	1.81

Table 2. Influence of different polluted soils on AM colonization nodulation and growth of L. *leucocephala.*

S/No.	Pollutant	Mycorrhizal colonization (%)	No. of spores/ 100 g soil	Nodulation			Height of the plant (cm)		Plant dry weight (g)		N content (%)	P content mg/g
				No.	Size (cm)	Dry weight (g)	Shoot	Root	Shoot	Root		
1	P.U. Campus	57.1	139	31	0.3	0.18	44.1	27.8	3.11	1.02	1.6	2.27
2	Adarsha paper Industries	36.5	101	23	0.3	0.16	40.8	25.9	2.38	0.96	1.2	1.59
3	K.K. detergents	23.8	92	14	0.2	0.12	36.8	25.1	2.30	0.74	1.1	1.43
4	Rhyme organics	17.7	67	12	0.3	0.10	31.4	22.6	1.95	0.71	1.0	1.14
5	Corey organics	14.3	49	9	0.3	0.08	28.9	18.9	1.71	0.62	0.7	0.87
6	Vidyadhari neam extracts	41.3	105	18	0.3	0.15	41.6	26.4	2.96	0.98	1.4	1.97

presented in Table 1. Results presented in table reveal that Corey organics effluents exerted maximum negative effect on mycorrhizal colonization. It was followed by Rhyme organics factory effluents. Least negative influence was observed with Vidyadhari neem extracts effluents. The present effluents exhibited a similar type of influence on the resting spore population of mycorrhizal fungi. Corey organics and Rhyme organics factory effluents have shown drastic inhibitory effect on the nodulation of this plant. Nodulation was not affected by the effluents of Adarsha paper Industries. Nitrogen content of the plants decreased when grown under the influence of different effluents. A positive correlation was observed between the extent of nodulation and nitrogen content of the plants. Phosphorus content of the plants grown in different polluted soils decreased when compared to the normal control soil. Maximum phosphorus inhibition was observed in the Corey organics and Rhyme organics factory effluent polluted soils.

Influence of different polluted soils on AM colonization, nodulation and growth of *L. leucocephala*. Results pertaining to this aspect are presented in Table 2. Based on these results the following observations could be made. In all the effluent affected soils mycorrhizal colonization was inhibited. However, the extent of inhibition differed according to the effluent. Corey organics effluents followed by Rhyme organics factory and K.K. Detergent factory exerted more inhibitory effect. Vidyadhari neem extracts effluent exerted least effect. In accordance with the mycorrhizal colonization, spore population was also reduced in different effluent affected soils.

Similar to mycorrhizal colonization nodulation was also adversely affected by the effluents, and the same tendency was observed. Nitrogen and phosphorus contents of the plants grown in soils polluted by different effluents decreased over the control plants. Uptake of these two nutrients to a large extent can be correlated with mycorrhizal colonization and nodulation. Seedling growth was also drastically effected by different effluents. Maximum inhibitory effect was recorded in Corey organics effluent polluted soils. Adarsha paper and Vidyadhari neem extracts effluents have shown least inhibitory effect on the seedling growth.

A positive correlation was observed between AM colonization, nodulation and uptake of phosphorus and nitrogen respectively. This variation may be attributed to the physico-chemical characteristics of the effluents. The drastic negative effect of Corey organics effluents may be due to high pH, presence of amino phenols and methyl chloro acetate. Similarly, inhibitory effect of Rhyme organics factory effluents may be due to pesticide formulation. These factors may influence the AM fungi directly and hamper the AM mediated beneficial effects or indirectly through the host plant growth. Results of these investigations are in contrary to the observations of Raman et al. (1994). From these investigations, two conclusions can be made. Firstly, Adarsha Paper Industries and Vidyadhari neem extract effluents could be used safely to raise the nurseries. Secondly, it is desirable that AM and *Rhizobium* strains adapted to these polluted soils should be isolated propagated and used for artificial inoculations in order to reclaim the pollution affected soils.

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