Journal of Phytology 2010, 2(1): 91-95
Microbiology
ISSN: 2075-6240
Available Online: www.journal-phytology.com

REGULAR ARTICLE

STUDIES ON THE OCCURRENCE AND DISTRIBUTION OF AM FUNGI IN SUGAR MILL EFFLUENT POLLUTED SOILS IN NELLIKUPPAM REGION OF CUDDALORE DISTRICT

M. Ezhil Bama[1*] and K. Ramakrishnan[2]
[1]*Reseach and Development, Bharathiyar Univeristy, Coimbatore-641 046*
[2]*Department of Botany, Annamalai University, Annamalainagar – 608 002*

SUMMARY

The occurrence and distribution of Arbuscular Mycorrhiza (AM) fungi on the sugar mill effluent polluted soil was examined. Twenty three species of AM fungi belonging to five genera *viz., Acaulospora, Gigaspora, Glomus, Sclerocystis* and *Scutellospora* were identified from the soil taken around ten plant species. Among ten plant species studied, only eight species were colonized and also the percentage root colonization was less in polluted soil. The number of AM spores were also less in polluted soil when compared to non-polluted soil. The increased levels of micronutrients and heavy metals were noticed in polluted soil, which caused reduction in the AM propagules.

Key words: Sugar mill effluent, AM fungi, Polluted soil

M. Ezhil Bama and K. Ramakrishnan. Studies on the Occurrence and Distribution of AM Fungi in Sugar Mill Effluent Polluted Soils in Nellikuppam Region of Cuddalore District. J Phytol 2/1 (2010) 91-95.
*Corresponding Author, Email: leninreegan@gmail.com

1. Introduction

Among soil microorganisms, mycorrhizal fungi have a direct link between soil and roots. Occurrence of Arbuscular mycorrhizal (AM) fungi has been reported from an exceptionally wide range of plant and different ecosystems and play a major role in better nutrition, species diversity and survival (Lakshman, 1996; Tanushree Chatterjee, 1999; Ramakrishnan *et al.,* 2001; Tripathi *et al.,* 2005). Alexander (1974) has reported imbalances and disturbance of microbial ecosystem in polluted soils. Baseline studies are still needed for many polluted habitats in question on the AM fungi status of native species. There are few reports of AM fungi in polluted habitats (Srinivasan *et al.,* 1995; 1996; Ramapulla Reddy and Manoharachary, 1990; Ramakrishnan *et al.,* 2001). In this investigation, the rhizosphere soils polluted with sugar mill effluents were tested for the occurrence and distribution of AM fungi and to determine the impact of physico-chemical factors in relation to the quantitative assessment of AM fungi in polluted soils.

2. Materials and Methods

The EID-Parry Sugar factory is situated in Nellikuppam, Cuddalore district, Tamil Nadu. The effluent from the sugar factory passes through a small channel and travels for (8 km from the place of origin and eventually), confluences in the river Gadilam at Tiruvendipuram. Ten plant species belonging to nine families of angiosperms were selected based on their relative abundance in each study site. Plants were surveyed for colonization by AM fungi at four sites of polluted and non-polluted soils of Nellikuppam, Cuddalore district *viz.,* Eydanur, Karamanikuppam, Varkalpattu and Tiruvendipuram. At each site, an area of 3 m^2 was chosen for sampling. Both the study sites that root samples and rhizosphere soils were collected. Sucrose centrifugation method of Smith and Skipper (1979) was followed for spore isolation. The root samples were cleared with 10% KOH and stained with 0.05% tryphan blue in lactophenol (Phillips and Hayman, 1970). Percentage root colonization was calculated

gridline intersect method of Giovannetti and Mosse (1980). Altogether twenty then species of AM were isolated and brought into pot culture studies with plants of *Allium cepa* L. After the plants were 90 days old, the spores and sporocarps were their reisolated for determining the physiochemical properties of soil.

3. Results and discussion

Physico-chemical properties of soil samples of both the study sites (Sugar mill effluent polluted and non-polluted soil) were presented in Table 1. Both the non-polluted soils were of sandy clay loam and pH of the non-polluted soil ranged from 6.4 to 7.1 while that of the polluted soils ranged from 6.7 to 7.8 study sites were deficient in phosphorus and-nitrogen.

Table 1. Physico-chemical characteristics of polluted and non-polluted soils of 4 different sites at EID-Parry-Nellikuppam area

Study sites*	pH	EC	Macronutrients (kg/acre)			Micronutrients (ppm)				Heavy metals (ppm)	
			N	P	K	Zn	Cu	Fe	Mn	Hg	Pb
Polluted sites											
Site I	6.12	1.9	48	34	156	1.4	0.34	1.1	2.1	1.49	0.862
Site II	7.6	1.4	50	25	232	2.1	0.80	1.8	2.0	1.80	0.536
Site III	7.2	1.8	36	20	175	1.7	0.56	1.6	2.8	1.22	0.442
Site IV	6.7	1.9	43	26	178	1.6	0.82	2.0	1.8	1.20	0.623
Non-polluted sites											
Site I	6.6	1.8	92	24	122	2.7	1.8	1.8	3.1	0.31	0.2
Site II	6.8	1.9	81	28	138	2.7	1.8	2.1	2.8	0.28	0.1
Site III	7.1	1.6	76	35	140	2.1	2.1	2.1	2.1	0.26	0.1
Site IV	6.4	1.8	85	34	160	1.8	1.9	1.7	2.6	0.22	0.3

*Study sites: Site I – Eydanuar; Site II – Karamanikuappam; Site III – Varkalpattu; Site IV – Tiruvendipuram

Table 2. Per cent root colonization, spore count and AM species associated in the root-zone soil of plant in polluted and non-polluted sites at Nellikuppam

Family and plant species	Study sites**	Percent root colonization		AM spore number 100 g soil		AM spore associated***	
		PS*	NPS*	PS*	NPS*	PS*	NPS*
Malvaceae *Abutilon indicum*	Site I	49	54	102	168	LMSS, LAGR, GABD, LFSC, LMSS, LFSC	ALVS, ABRT, ATRP, LAGR
	Site II	45	65	180	410	LMCC, LMSS	LHOI, ABRT, ALVS, LMSS, LMCC

	Site III	46	57	212	460	LFSC, LMSS	LFSC, ALVS, SSNS, LMSS
	Site IV	63	68	220	570	SSNS, LMSS, LFLV	AELG, LMSS, ASCB
	Site I	38	60	260	610	SCVS, GABD, LMCC	ABRT, ALVS, LMSS, LFSC
	Site II	40	76	212	630	LAGR, LMSS	AELG, ASCB, GABD, ALVS, CVRL
Mimosaceae *Prosopis julifora*	Site III	56	92	275	560	LMSS, SSNS	LGSP, GABD, ALVS, CVRL, LCLR
	Site IV	48	90	260	545	LMSS, LMCC	ATRP, GDCP, LMSS, CVRL
	Site I	25	40	75	130	ABRT, LMSS	LCLR, LHOI, LMSS, GABD
Solanaceae	Site II	25	38	85	90	LFSC	GMRG, LMSS
Solanum nigrum	Site III	20	45	80	120	ABRT, LMSS, LFSC	ABRT, ATRP, LMCC, GMRG
	Site IV	24	38	52	95	LMCC, GABD	SSNS, GABD
	Site I	30	40	99	120	LFLV, LGSP, SCVS	GMRG, LAGR, LCLR
Nyctaginaceae	Site II	12	25	22	40	LMSS, LMNS	LMSS, GMRG, CBRN
Boerhavia diffusa	Site III	20	42	62	85	LMSS, LFSC, GABD	SRBF, ATRP
	Site IV	24	38	54	80	LHOI, LMSS	ABRT, LFLV, GMRG
	Site I	–	–	–	–	–	–
Euphorbiaceae	Site II	–	15	–	–	–	LMSS
Croton sparciflorus	Site III	–	–	–	30	–	LMSS
	Site IV	–	–	–	–	–	–
	Site I	32	40	140	160	ABRT, LMSS	CBRN, SRBF, ATAR, LMSS
Lamiaceae *Ocimum canum*	Site II	30	38	162	183	SSNS	CBRN, LVRL, ALVS, LMSS
	Site III	38	48	148	88	SRBF	ABRT, LFSC
	Site IV	45	54	112	169	SSNS, GMRG	AELG, ALVS
	Site I	–	12	–	28	–	LMCC
Commelinaceae	Site II	–	–	–	–	–	–
Commelina bengalensis	Site III	–	–	–	–	–	–
	Site IV	–	–	–	–	–	–
	Site I	45	65	220	430	GABD	ALVS, AELG, ABRT, LMCC
Poaceae	Site II	58	69	312	428	LMSS	ALVS, ABRT, LMSS, GDCP
Cynodon dactylon	Site III	42	64	120	330	LFSC	ATRP, CBRN, CVRL
	Site IV	49	82	241	328	LMNS	ABRT, ALVS, GMRG, GABD
Eleusine indica	Site I	55	76	250	530	LMSS, SCVS, LFLV	ABRT, LGSP, GABD, LCLR

	Site II	50	62	240	624	LFSC, LMSS, SSNS	ASCB, ATRP, LMSS, CBRN
	Site III	80	94	330	690	CVRL, LGSP	ABRT, SCVS, GMRG, LMSS
	Site IV	82	88	228	610	LCLR	ATRP, GMRG, LMSS
	Site I	14	22	41	93	LFSC, SRBF	LMNS, LMSS
Cyperaceae	Site II	10	20	43	85	SSNS	LMCC, GMRG
Cyperus rotundus	Site III	13	24	38	80	SSNS	LMCC, LMSS
	Site IV	21	40	60	112	LGSP	GMRG, GDCP

Note: PS* - Polluted site; NPS* -Non-polluted site; **Site I – Eydanuar; Site II – Karamanikuppam; Site III – Varkalpattu; Site IV – Tiruvendipuram

***ABRT – *Acaulospora bireticulata;* AELG – *A. elegans*; ALVS – *A. levis*; ASCB – *A. scrobiculata*; ATRP – *A. trappei*; GABD – *Gigaspora albida*; GDCP – *Gig. decipiens*; GMRG – *Gig. marganita*; LARG – *Glomus aggregatum*; LCLR –*Gl. clarum*; LFSC –*Gl. fasciculatum*; LFLV – *Gl. fulvum*; LGSP – *Gl. geosporum*; LHOI – *Gl. hoi*; LMCC – *Gl. macrocarpum*; LMNS – *Gl. monosporum*; LMSS – *Gl. mosseae*; SCVS – *Sclerocystis clavispora*; SRBF – *Scl. rubiformis*; SSNS – *Scl. sinuosa*; CBRN – *Scutellospora biornata*; CVRL – *Scu. verrucosa*.

In all twenty three AM fungal species were observed in the rhizosphere soils of both non-polluted and polluted sites. The AM fungal species isolated from the study sites belonged to the five genera *viz., Acaulospora, Gigaspora, Glomus, Sclerocystis* and *Scutellospora* (Table 2). The number of AM spores in the root zone soils ranged from 28-690. The non-polluted soils was rich both in AM spore number and species abundance where as in polluted soils were less. There was a certain degree of specificity among the different species in both non-polluted and polluted sites. There are previous reports of such specificity in root zone soils (Moose, 1981) and the occurrence of ten species of AM fungi in polluted habitats in the present study. Gildon and Tinker (1981) have isolated only one species of effluent tolerant AM fungi. In the present study *Glomus mossea* was noticed the most dominant effluent tolerant strain of AM fungi in polluted sites.

All the test plant species in non-polluted soil sites examined exhibited AM colonization whereas in polluted soil sites, eight plant species were positive for AM colonization and two plant species (*Croton sparasiflorus* and *Commelina bengalensis*) were non-mycorhizal, results indicated that mycorrhizal condition is the rule and non-mycorrhizal condition in exception and agrees with the wide spread association of AM reported in natural ecosystem (St. John and Coleman, 1983). The present root colonization was comparatively more in non-polluted soil plant species than polluted soil plants (Table 2).

Glomus mossea was the dominant colonizing species of most of the plant species. The number of AM spores were more in non-polluted soil and less in polluted soil may be due to dilution of nutrients and water stress and increased levels of zinc, iron and heavy metals were noticed in polluted soil may be caused reduction in the number of AM propagules, as supported by Ramapulla Reddy and Manoharachary (1990).

References

Alexander, Y.M. Introduction to soil microbiology. *John Wiley and Sons Inc.,* New York, pp. 1-472 (1971).

Gildon, A ad P.B. Tinker. A heavy metal tolerant strains of VAM fungus. *Trans Brit. Mycol. Soc.,* **77:** 648-649 (1981).

Giovannetti, M. and B. Mosse. An evaluation of technqiues for measurng VAM infection in roots. *New Phytol.,* **84:** 489-500 (1980).

Lakshman, H.C. Possible role of weeds on maintaining VA-mycorrhizal colonization of rice soil. *World Weeds,* **2:** 53-56 (1996).

Mosse, B. VAM research for tropical agriculture. The research bulletin No. 194.

College of Tropical Agriculture and Human Resource, University of Hawai, p. 82 (1981).

Phillips, J.M. and D.S. Hayman. Improved procedures for clearing roots and staining parasitic and VAM fungi for the rapid assessment of infection. *Trans. Brit. Mycol. Soc.,* **55:** 158-161 (1970).

Ramakrishnan, K., P. Thamizhiniyan, P. Sundaramoorthy and M.V. Sriramachandrasekaran. Effect of sugar mill effluent polluted soil on VAM fungi. *J. Ecobiol.,* **13(3):** 187-192 (2001).

Ramapulla Reddy, P and C. Monoharachary. Occurrence and distribution of VAM fungi in soil polluted with sewage and industrial effluents. pp. 51-52.. *In* : mycorrhizal symbiosis and plant growth ed. D.J. Bagyaraj and A. Manjunath. *University of Agricultural, GKVK Campus, Bangalore* (1990).

Smith, W. and H.D. Skipper. Comparison of methods to extract spores of VAM fungi. *Soil Soc. Am. J.,* **43:** 722-725 (1979).

Srinivasan, D., T. Muthukumar and R. Udayan. Occurrence of VAM in a waste water irrigated field in Bharathiar University, Coimbatore. *Poll. Res.,* **14(2):** 157-164 (1995).

Srinivasan, D., T. Muthukumar and R. Udayan. Influence of effluent irrigation on VAM. *Ind. J. Microbiol.,* **36(1):** 37-40 (1996).

St. John, T.V. and D.C. Coleman. The role of mycorrhizal in plant ecology. *Can. J. Bot.,* **61:** 1005-1014 (1983).

Tanushree Chatterjee. Vesicular Arbuscular mycorrhiza in Ambaji Multi Metal Mines Area. *Ecol. Env. Cons.,* **5(4):** 353-356 (1999).

Tripathi, A., C. Rashmi Srivastava, C. Chaturvedi, B.K. Srivastava and H.B. Singh. Response of bitter gourd to mycorrhizal diversity for growth, yield and nutrient uptake. *Indian J. Hort.,* **62(3):** 306-307(2005).