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RESEARCH ARTICLE

"DISTRIBUTION OF AM FUNGI IN RHIZOSPHERE SOIL OF *MADHUCA INDICA* GMEL. IN DHARWAD DISTRICT OF KARNATAKA"

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Abstract

A Field survey was conducted on *Madhuca indica* Gmel. rhizosphere where plants growing in the tropical deciduous forest zone ecosystem of Dharwad district, Karnataka. Twelve plantation and nursery sites of *Madhuca indica* growing place in Dharwad district was studied. A total of 10 different AM fungal species belonging to five genera viz., *Acaulospora Glomus, Gigaspora Scutellospora and Sclerocystis.* was isolated and identified from the rhizosphere .Among the different species of the genus *Glomus, G. macrocapum* was found to be the most frequent fungus (100%) followed by *Sclerocystis dussii* (83%) and *G. mossae* (58%) , with respect to nursery sites *Glomus geosporum* was found to be the most frequent AM fungus (92%) followed by *Gigaspor candida* (75%) and *Scutellospora calospora* (56%), overall dominant AM fungal distribution in rhizospheric soil of different sites genus *Glomus* (38%) was most predominantly observed which is followed *Scutellospora* (30%) and *Sclerocystis* (22%) only limited species of *Gigaspora* (8%) ,*Acaulospora* (2%) was recorded from this study. The distributions AM fungal average frequencies have been discussed.

INTRODUCTION

Arbuscular mycorrhizal fungi are a ubiquitous group of soil fungi colonizing the roots of plants belonging to greater that 80% of plant families (Peterson and Farquhar, 1994). These zygomycetous fungi represent an important component by their ubiquity in the soil microbial biomass and their direct involvement in essential processes at the plant-soil interface (Harley and Smith, 1983; Bagyaraj, 1996). Interest in these associations is mainly because of the manifold benefits conferred on the host by the fungus. They are sown to improve the nutritional status of plants and growth and development, protect plants against root pathogens and confer resistance to drought and soil salinity conditions (Bagyaraj and Verma, 1995). The extent of root colonization varies with several soil and climatic factors apart from the host involved. However, these fungi show a preferential colonization to hosts, and thereby, the extent to which a host is benefited depends on the fungal species involved in the symbiosis (Abbott and Robson, 1985; Miller *et al*., 1987). The existence of inter and intraspecific variations among the plant species involved in relation to their phosphorus requirement and the ability of the host to translocate the native soil phosphorus further determines the efficacy of these fungi (Koide, 1991;Lakshman ,1996). Thus, it is essential to screen for an efficient AM fungus for a particular host in order to harness the maximum benefit from the fungus. Furthermore, since AM fungi cannot be grown on laboratory media, production of a large quantity of the inoculum is difficult as is the inoculation of the soil under field conditions. Nevertheless, since most of the commercially important crops are raised under nursery conditions before being transplanted to the main field.

Madhuca indica, is tall tree found in north Indian plains and in forest of Karnataka, Kerala, M.P and Rajasthan, its common name is Mahua tree. *Madhuca indica Gmel.* Is a moderately evergreen perennial tree, considered to be rare petro oil yielding tree grows upto 5-8 meter height ,with trunks and 3-10 lobed glandular leaves and its is clustered flowers tubular creamish white colour. This tree has many medicinal values its bark, heartwood, flowers fruits ,seeds are used to treat many aliments like astringent, scalds , dipreative , Bronchitis , laxative and neurotic disorders. Seed oil is used as ointment, in rheumatism and to prevent cracks in skin in winter. It is also used for edible purposes and culinary. *Madhuca* fat is satisfactory for production of washing soaps. *Madhuca indica* is a endangered hydrocarbon tree. It has great medicinal value. Its latex commonly used in skin diseases. Its flower buds used as vegetables by some tribal people. Seeds yield very good oil and used in crude oil preparation and adulteration of ghee. Stem bark shows antibiotic against *Staphylococcus aureus* (Lakshman and Inchal 2012). Leaves are very good fodder for herberous animals and it has astringent property used in embrocation. Arbascular Mycorrhiza fungal association was observed in all the examined plants. Vesicles, Arbascules and extrametrical spore's characteristic of AM fungi were observed.

MATERIALS METHOD:-

Field survey was conducted in the tropical deciduous forest zone ecosystem of Dharwad district, Karnataka. Dharwad district is situated in the Western sector of the northern half of Karnataka State. The District encompasses an area of 4263 km^2 lying between the latitudinal parallels of 15°02' and 15°51' North and longitudes of 73°43' and 75°35' East. The region The District lays approximately about 800 mts above the sea level, it has moderate and healthy climate. The District may be divided into 3 natural regions, viz., the Malnad, Semi-Malnad and Maidan. These regions, on an average, receive moderate to heavy rainfall and have dense vegetation. Nearly 12 plantation and nursery sites of *Madhuca indica* growing place in Dharwad district was selected **(**A- Khanapur , B –Garag ,C-– Kallapur , D-Yavad, E- -Shivalli ,F-Morab ,G-Kamaragop ,H-Basapur ,I,-Shiriuguppi , J-Kusagulli , K-Kamadoh , L- Harlapura ,)

Mycorrhizal Analysis.

AM Fungal propagules were isolated from the rhizosphere soils collected from nurseries and plantations site. Isolation, quantification and root colonization of AM Fungi was done by using wet sieving and decanting technique (Gerdmann & Nicolson, 1963). The quantitative estimation of AM spores was done by modified method of Adholeya and Gour (1994). To study the colonization of Abrascular Mycorrhizae, the rapid clearing and staining method by Philips and Hayman (1970) was employed .the am fungi were identified by using Trappe (1982), Walker (1983) and Schenk,Perex (1987).

RESULT AND DISCUSSION:-

The rhizospheric soil *Madhuca indica Gmel.* plants maintained in 12 Forest Nurseries and plantation sites ,Plants grown under forest plantation gives varied AM Fungal spores and per cent root colonization .The existence of varied range of root colonization might be attributed to soil factors which affect the number of vesicles Arbuscules and spore in the rhizospere soil. The frequency distribution of different AM fungi isolated from the rhizosphere of plants in nursery and plantation sites is shown in (Table 1 and 2). It was found that almost all the soil samples contained AM spores of different species of the genera viz. *Glomus, Gigaspora,* and *Sclerocystis* .*Scutellospora Acaulospora* was identified from the rhizosphere of nursery samples. Among the different species of the genus *Glomus, G. macrocapum* was found to be the most frequent fungus (100%) followed by *Sclerocystis dussii* (83%) and *G. mossae* (58%). A total of 10 different AM fungal species belonging to two genera viz., *Glomus, Scutellospora and Gigaspora w*ere isolated and identified from the rhizosphere of plantation samples. Among the species of the genus *Glomus, Glomus geosporum* was found to be the most frequent fungus (92%) followed by *Gigaspor candida* (75%) and *Scutellospora calospora* (56%), the distribution of AM fungi among 12 different places shown in (Fig 1, 2).A clear variation was observed in AM frequency with its Per cent root colonization and spore numbers in both nursery and plantation sites of Dharwad district shown in (Table-3, Fig -2).Similarly dominant AM fungal distribution in rhizospheric soil of 12 different sites of Dharwad district i,e Garag and Khanapur showed most AM distribution as shown in (Fig-3, 4) *Glomus* 38% was most predominantly observed in 12 nurseries and plantation rhizospheric soil which is followed *Scutellospora* 30% and *Sclerocystis* 22% only limited species of *Gigaspora* 8% ,*Acaulospora* 2% was recorded.

The association of AM Fungi with crop plants may improve soil health and increase crop production with reduced nutrient input (Haymen, 1987) .As the importance of sustainable cultivation practices increases, the role of AM- fungal symbiosis in contribution to sustainability has also been recognized (Giovannethi and Gianinazzi-pearson, 1994).The higer level of root colonization in 43 tree species indicated that its deep susceptibility towards

AM fungi as well as infectiveness of AM fungi. Variation in percent of colonization might be regulated at the species level .variation of spore population in rhizopsperic soil showed that the multiplication of spores depends on species to species level (Rahangdale and Gupta, 1999) The study corroborates with the earlier findings of AM association with tree species in different parts of the country by many researchers (Thapar and Khan 1988; Mohan, Verma, Singh 1995; Lakshman, 1996). Earlier studies by the authors have shown that variation in per cent colonization in roots and AM spores in the rhizosphere soils of various zone tree species under different site/soil conditions (Mohan and Verma 1995). The intensity of AM colonization in roots and spores in the rhizosphere of *Madhuca indica* Gmel in nursery and plantation sites varied according to the age of the plants and site factors including soil nutrients, moisture, and other environmental conditions. *G. macrocapum*, *G. mossae* and *Sclerocystis dussii* are widespread and consistent, both in nurseries and plantations, which make them the most favorable for mass multiplication as well as seedling inoculations of *Madhuca indica* Gmel in the tropical deciduous zone ecosystem of Dharwad district, Karnataka. Host preference among AM fungi has been reported by earlier workers (McGraw and Schenck, 1981; Vasanthakrishna *et al*., 1995). Hence the need for selecting efficient AM fungi that can be used for inoculating different mycotrophic plants has been stressed (Jaffries, 1987; Verma ,2013)High diversity of AM fungal species may or may not have more advantages than low diversity. It is observed that high fungal diversity at low agronomic input rates may result in more sustainable and safer agricultural production provided different AM fungal result can influence the crop under various potential conditions.

AM-fungal infection was favored better in this type of micro ecological niche. Heavy rain fall in the tropical deciduous forest zone ecosystem of Dharwad district, part of Karnataka may influence the selection process of AM fungi and regulate the incidence in the rhizosphere (Khan, 1975; Lakshman, 2007). Additional support that the mycorrhiza in the root zone may influence plant diversity comes from the huge shift in the mycorrhizal population over time. Ecologically distinct AM fungi respond differently to changes in the abiotic environment, and as the environment changes over time, so do the dominant AM fungal species. Such responses, plus changes in host phenology, are the implicit assumptions used previously to explain temporal variation, in mycorrhizal communities. Therefore, changes in the biotic environment may also influence the mycorrhizal population.

CONCLUSION:-

Although the composition of AM fungal in the various parts of mycorrhizosphere has been studied extensively in different ecosystems the underlying mechanisms behind the interactions on the mycorrhizosphere are poorly understood. As knowledge of the distinct ecologies of individual fungal species grows, simple assumptions about the influence of mycorrhizae on plant communities need to be reevaluated. It was found that almost all the soil samples from the 12 different rhizosphere of *Madhuca indica* Gmel nursery and plantation site samples contained AM spores of different species of the genera viz. *Glomus*, *Gigaspora*, and *Sclerocystis* .*Scutellospora Acaulospora* was identified. Among these genuses *Glomus* (38%) was most predominantly observed in all 12 sites and least *Acaulospora* (2%) was recorded. *G. macrocapum* was found to be the most frequent fungus nursery sites and in plantation site *Glomus geosporum* was more. Overall exploitation of these beneficial soil fungi as bio-inoculants for production of quality tree seedlings in nurseries and plantation sites in various parts of the country should be undertaken.

Table-1 Showing the frequency distribution of mycorrhizal fungi 12 Nursery rhizosphere samples of *Madhuca indica* Gmel.in Dharwad district during 2013-14

Sl.No	AM fungi	Nursery sites												Site Frequency	Average Site Frequency
		A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.		
1.	*Glomus macrocapum*	+	+	+	+	+	+	+	+	+	+	+	+	100	63.6
2.	*Glomus mossae*	+	+	_	_	_	+	+	+	_	+	+	_	58	
3.	*Glomus fasiculatum*	+	+	+	_	_	+	_	_	_	_	_	_	33	
4.	*Glomus geosporum*	_	_	+	_	_	+	+	+	_	_	_	_	35	
5.	*Glomus interadices*	_	+	_	_	_	_	+	+	_	_	+	+	42	
6.	*Glomus leptonicum*	+	+	_	+	+	_	_	+	_	+	_	_	50	
7.	*Sclerocystis dussi*	+	+	_	+	+	+	+	+	+	+	+	_	83	54.5
8.	*Sclerocystis indicus*	+	+	_	+	_	_	_	_	_	_	_	_	26	
9.	*Scutellospora calospora*	+	_	_	+	_	_	_	_	_	_	_	_	18	21.5
10.	*Scutellospora nigra*	+	_	_	+	_	_	_	_	_	_	+	_	25	
11.	*Gigaspora candida*	+	+	_	_	+	_	_	_	_	_	+	+	41	8.2
12.	*Acaulospora trappei*	+	_	_	_	_	_	_	_	_	_	_	+	17	3.4

PLACES – A- Khanapur , B –Garag ,C-–Kallapur , D-Yavad, E- -Shivalli ,F-Morab ,G-Kamaragop ,H-Basapur ,I,-Shiriuguppi , J-Kusagulli , K-Kamadoh , L- Harlapura ,

Table-2 Showing the frequency distribution of mycorrhizal fungi in 12 Plantation rhizosphere samples of *Madhuca indica* Gmel. in Dharwad district during 2013-14.

Sl.No	AM fungi	Plantation sites												Site Frequency In%	Average Site Frequency in %
		A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.		
1.	*Glomus macrocapum*	+	+	+	_	_		+	+	+	_	_	_	51	62.75
2.	*Glomus mossae*	+	+	+	+	+	+	_	_	+	_	_	_	58	
3.	*Glomus fasiculatum*	_	+	+	_	_	+	+	_	_	_	+	+	50	
4.	*Glomus geosporum*	+	+	+	+	+	+	+	+	+	+	+	_	92	
5.	*Scutellospora pellicuda*	+	_	_	_	_	_	+	+	_	_	_	_	25	44.66
6.	*Scutellospora calospora*	+	+	+	_	_	_	+	+	+	+	+	_	67	
7.	*Scutellospora nigra*	_	_	_	+	+	_	_	+	+	+	_	_	42	
8.	*Gigaspora candida*	-	+	+	+		+	+	+	_	_	+	+	75	50.1
9.	*Gigaspora margarita*	_	_	+	+	_	_	_	_	_	_	_	+	26	
10.	*Sclerocystis dussii*		+	_	+	_	_	_	_	_	+	+	+	44	17.2
11.	*Sclerocystis indicus*	+	+	_	_	_	_	_	_	+	_	_	_	25	
12.	*Acaulospora trappei*	_	+	+	_	_	_	_	_	_	_	_	_	17	4.2

PLACES – A- Khanapur , B –Garag ,C-–Kallapur , D-Yavad, E- -Shivalli ,F-Morab ,G-Kamaragop ,H-Basapur ,I,-Shiriuguppi , J-Kusagulli , K-Kamadoh , L-Harlapura ,

Tbale-3:-Showing the frequency distribution of AM Fungi its Root colonization and Spore No in 12 different sites of *Madhuca indica* Gmel of Dharwad District

Sl No	PLACES	AM Frequency in Nursery site	Root colonization (%)	Spore No/50 g of soil	AM Frequency in Plantation site	Root colonization (%)	Spore No/50 g of soil	AM Frequency in Dharwad	Average Root colonization (%)	Average Spore No/50 g of soil
1.	Khanapur	84	76.2	193	50	73.2	188	67	74.7	190.5
2.	Garag	67	81.3	171	77	83.2	157	72	82.25	164
3.	Kallapur	20	62.1	204	67	59.4	193	43.5	60.75	198.5
4.	Yavad	52	91.0	218	50	87.3	212	51	89.15	215
5.	Shivalli	36	72.1	184	25	68.5	173	30.5	70.3	178.5
6.	Morab	44	76.3	211	34	71.0	207	39	73.65	209
7.	Kamaragop	41	87.1	258	55	93.1	252	48	90.1	255
8.	Basapur	56	76.4	214	52	67.6	213	54	72	213.5
9.	Shiriuguppi	16	93.1	183	48	91.0	179	32	92.05	181
10.	Kusagulli	34	69.4	174	35	64.2	166	34.5	66.8	170
11.	Kamadoh	52	79.2	203	42	77.1	191	47	78.15	197
12.	Harlapura	35	66.3	201	33	62.4	184	34	64.35	192.5

Fig-1:-Showing the frequency distribution of AM Fungi in 12 different Plantation and Nursery sites of *Madhuca indica* Gmel in Dharwad District

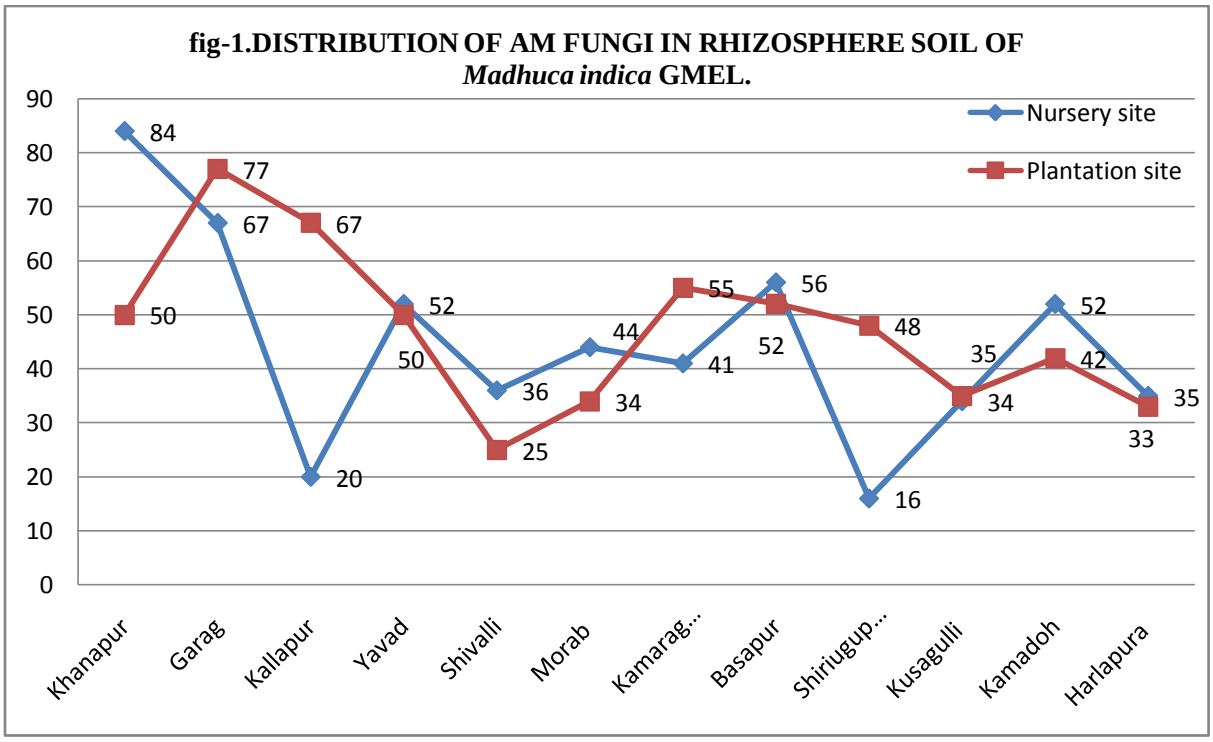


Fig-2:- Showing the frequency of AM Fungal distribution with its Root colonization and Spore No in 12 different sites of *Madhuca indica* Gmel in Dharwad District

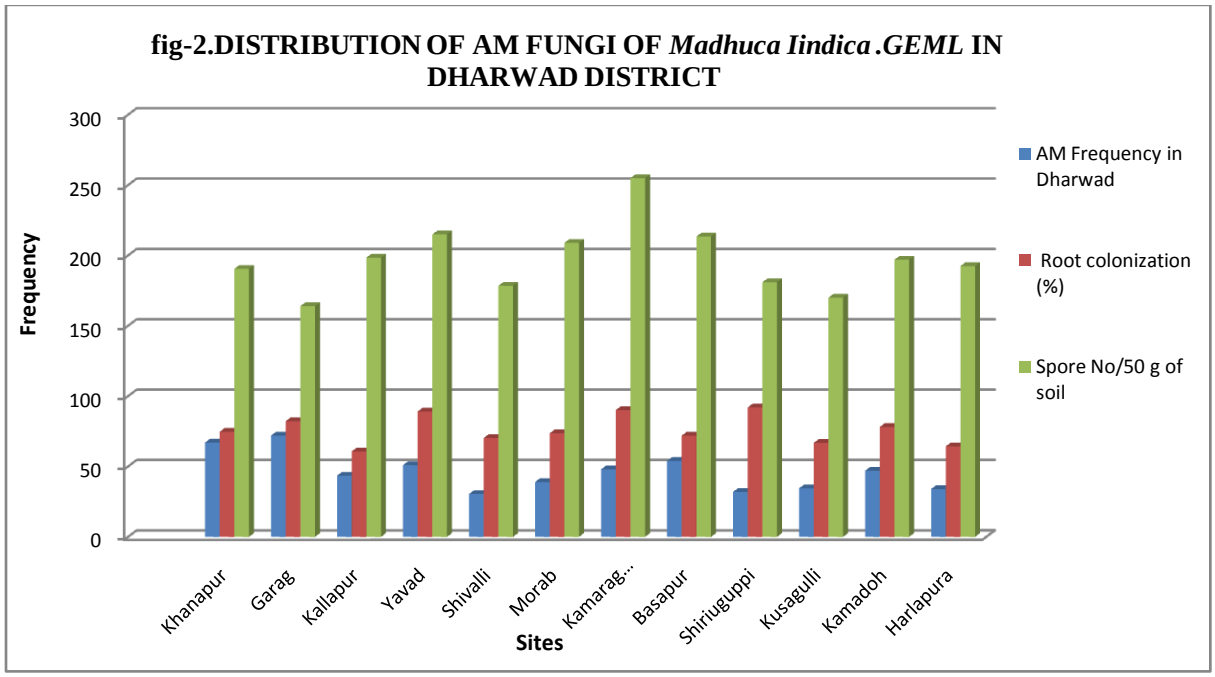


Fig 3:-Showing the frequency distribution of AM Fungi in rhizosphere soil of 12 different sites of *Madhuca indica* Gmel of Dharwad District

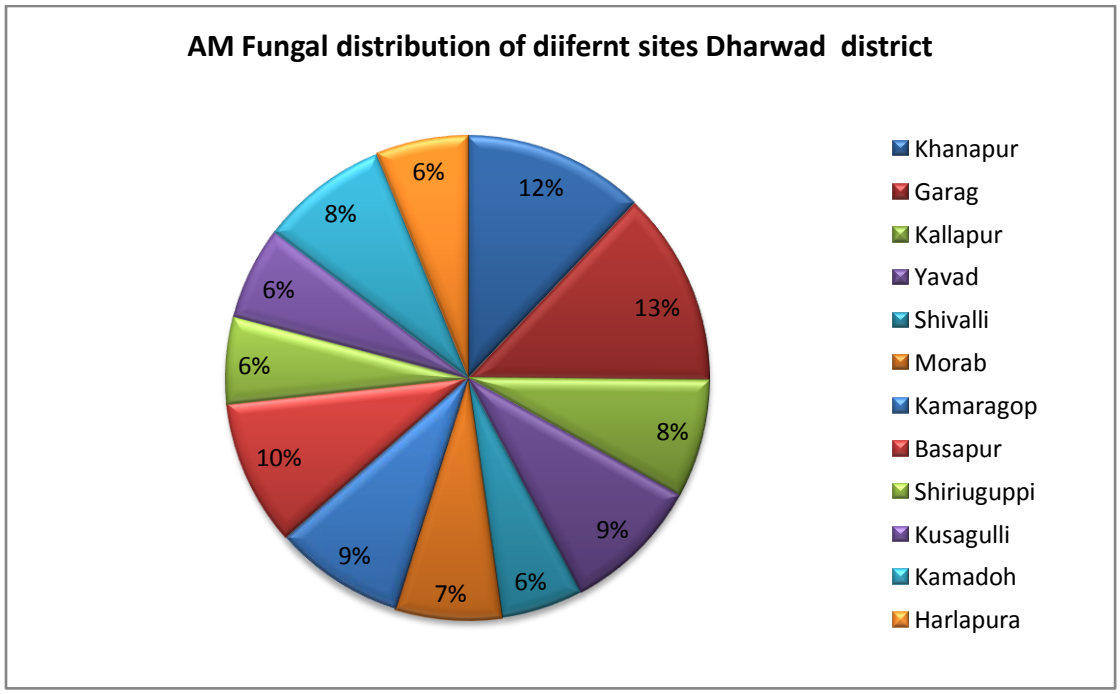
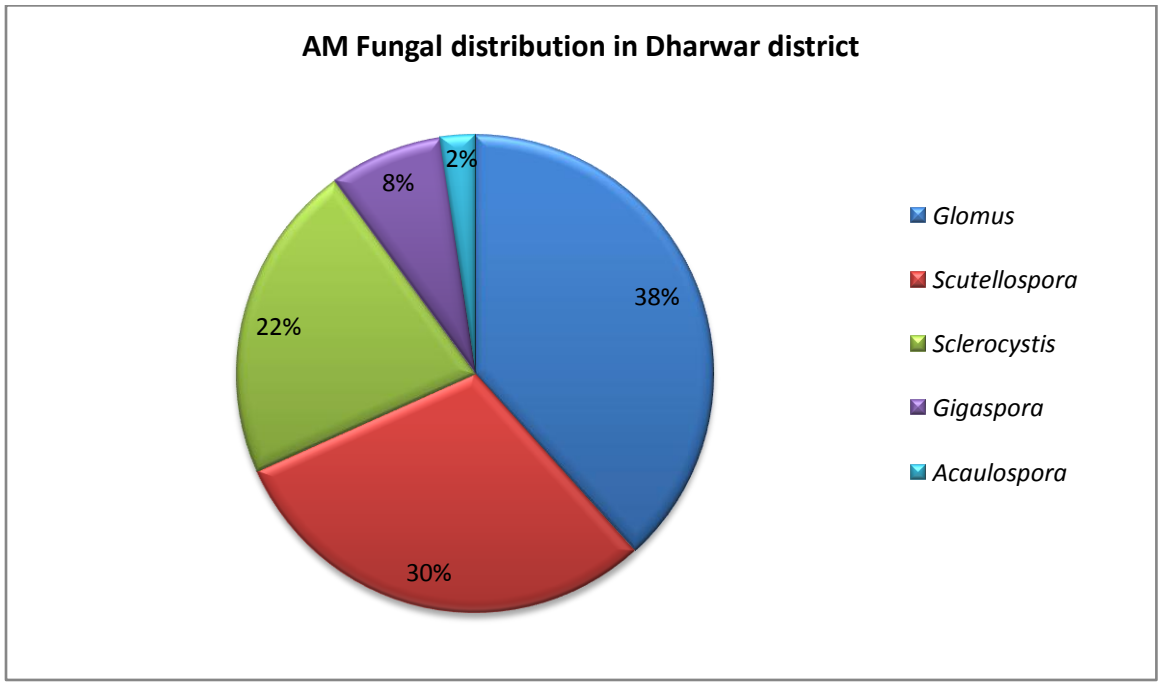


Fig 4:-Showing the frequency distribution of dominant AM Fungiin rhizosphere soil of *Madhuca indica* Gmel of Dharwad District.



REFERENCES:

Abbott, L. K., Robson, A.D., 1985. Formation of external hyphae in soil by four species of vesicular-arbuscular mycorrhizal fungi. New Phytol. 99, 245-255.

Bagyaraj D.J., 2006. Arbuscular mycorrhizal fungi in sustainable agriculture In: Techniques in mycorrhizae P.1-8 Eds. M.J.Bukhari and B.P. Rodrigues Department of Botany. Govt Arts, Science and Commerce collage Quepem Goa.

Bagyaraj, D. J., Byra Reddy, M.S., Nalini, P.A., 1989. Selection of an efficient inoculant VA mycorrhizal fungus for *Leucanena* for Ecol. Manage. 27, 791-801.

Gerdemann, J.W., Nicolson, T.H., 1963. Spores of mycorrhizal *Endogone* species extracted from soil by wet-sieving and decanting. Trans. Br. Mycol. Soc. 46, 235-244.

Gerdomann J W, Nicolson T H. 1963. Spores of nwot-rhizal Endogone species extracted horn sod by wet seving and decanting. Transactions of the *British Mycological Society* 46: 235-244

Giovanetti, M., Gianinnazzi-Pearson, V., 1994. Biodiversity in arbuscular mycorrhizal fungi. Mycol, Res. 98, 705-715.

Giovannetti, M., Mosse, B., 1980. An evaluation of techniques to measure vesciular-arbuscular infection in roots. New Phytol. 84, 489-500.

Harikumar V S. 1997 Endomycorrhizal studies in sweet potato Thiruvananthapuram: University of Kerala. [Doctoral thesis]

Harikumar V.S and Potty V.P .2002. Biodiversity of mycorrhizal fungi in *lpomoema batus* under field inoculated conditions in sweet potato *.B ulgarium .Agri.sci*., 8(5).11

Harley, J.L. and Smith S.E., 1983. Mycorrhizal Symbiosis, Academic Press, London, UK, 245 pp.

Jackson, M.L., 1973. Soil Chemical Analysis, Prentice Hall of India, New Delhi, India, 239 pp

Jeffries, P., 1987 Use of mycorrhizae in agriculture. Crit. Rev. Biotechnol. 5, 319-357.

Khan, A.G., 1975. Growth Effects of Vesicular-arbuscular Mycorrhiza on Crops in the Field. In: Sanders, F.E., Mosse, B., Tinker, P.B. (Eds.), Endomycorrhizas. Academic Press, New York, p.419-439.

Koide, R.T., 1991. Nutrient supply, nutrient demand and plant response to mycorrhizal infection. New Phytol. 117, 365-386.

Lakshman H.C. (1996). VA mycorrhizal studies in some important timber tree species. Ph.D. theses, Karnatak University, Dharwad, India, 255 pp.

Lakshman, H.C , Sabannavar, S.J and. Agron and Crop Sci, 2008. 197: 1931-2250.

Lakshman, H.C., Swetha S. Sabannavar, Santosh G. Hiremath and Mahesh M. Baytanal, 2008. Significance of medicinal plants and their utility plants growing in university botanical garden. The Current Science. 79 : 107-111.

Lakshman.H.C, In:Forest and Microbial diversity and its relevance. (eds .M.Jayashankara. Mangalore University), 2007, Pp20.

Miller, R.M., Jarstfer, A.G., Pillai, J. K., 1987. Biomass allocation in an *Agropyron smithi-Glomus* symbiosis. Am. J. Bot. 74, 114-122.

Miller, R.M., Jastrow, J.D., 1992. The role of mycorrhizal fungi in soil conservation. In: Bethlenfalvay, G.J., Linderman, R.C. (Eds.), Mycorrhizae in sustainable Agriculture, ASA Special Publication, WI, USA, pp 29-44.

Mohan V, Verma N. 1995. Studios on vesicular- arbuscular mycorrhizal association in seedling of forest tree species in arid zone of Rajasthan. Pp.52-55.In: Adholeya A, Singh S (eds). Mycorrhizae Biofertilizers for the future. Proceedings of the Third National COnflprookNo on Mycorrhiza, New Delhi, India, 13-15 Marsh 1995.New Delhi: TERI, 548 pp.

Pankow, W., Boller, T., and Wiemken, A. 1991. Structure function and eclology of mycorrhizal symbiosis expermentia. 47: 391-394.

Peterson, R.L. and Farguhar, M.L., 1994. Mycorrhizal-integrated development in between root and fungi. Mycologia. 86, 311-326.

Philips, J.H., Hayman, D.S., 1970. Improved procedures for clearing roots and staining parasitic and vesicular-arbuscular mycorrhizal fungi for rapid assessment of infection. Trans. Br. Mycol. Soc. 55, 158-161.

Porter, W.M., 1979. The 'Most probable number' method for enumerating propagules of VAM fungi in soil. Aust. J. Soil Res. 17, 515-519

Potty,V.P 1978 .Occurrence of Vesicular Arbascular mycorriza in certain tuber crops .4(1) ;49-50

R.F. Inchal and H.C. Lakshman. 2012. Diversity of AM fungi on *Madhuca indica* - A threatening medicinal plant. In: Proceedings of National Conference on Biodiversity and Biotechnology for Sustainable Development, 21st and 22nd March. (Eds.) H. C. Lakshman and G. R. Hegde, P. G. Dept. of Studies in Botany, Karnatak University, Dharwad. Pp: 55-61. **ISBN: 978-81-921165-0-1**

Reena, J., Bagyaraj, D.J., 1990. Response of *Acacia nilotica* and *Calliandra calothrysus* to different VA mycorrhizal fungi, Arid Soil Res. Rehabil. 4, 261-268

Saif, S. R. 1987. Growth responses of trophical forage plant species to vesicular-arbuscular mycorrhiza I. Growth, mineral uptake and mycorrhizal dependency. Plant and Soil. 97, 25-35.

Thapar, H. S. and Khan, S. N. 1988. Seasonal frequency of Endogone spores in New Forest soils. In: Trends in Tree sciences. (Eds. Khosla, P.K. and Sehgal, R. N). 161-162.

Vasanthakrishna, M., Bagyaraj, D. J., Nirmalnath, J.P., 1995. Selection of efficient VA mycorrhizal fungi for *Casuarina equisetifolia* – second screening. New. For. 9, 157-162.

Verma S.K. , Gond S.K., Mishra A., Sharma V.K., Kumar J, Singh D.K., Kumar A., Goutam J., and Kharwar R.N. (2013) Impact of environmental variables on the isolation, diversity and antibacterial activity of endophytic fungal communities from Madhuca indica Gmel. at different locations in India. Annals of Microbiology DOI 10.1007/s13213-013-0707-9