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Research Article

Diversity and Distribution of VAM Fungi in soils of Kalaburagi District, Karnataka.

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Abstract

The present work deals with the diversity and distribution of VAM fungi in soil samples of Kalaburagi district, Karanataka. Kalaburagi is an important agriculture based district of Hyderabad Karnataka region in the state of Karnataka. The main crops of the district are *Cajanus cajan, Sorghum bicolar, Triticum aestivum, Saccharum officinalis* etc. The soil samples were collected from natural and artificial plantations, agricultural field and grassland during summer (March- June), monsoon (July-mid October) and winter (mid October.-February) seasons. In artificial plantation, the lowest frequency of the spores were recorded in all the three seasons. In natural plantation the maximum spore frequency was recorded in winter, while in agricultural fields and grassland, the spore frequency showed gradual increase from summer through monsoon to winter. The studies were conducted to record the diversity of VAM fungal spores in the different soil types at different seasons in agricultural soils of the district. The higher number of spores were recorded from all the soil samples, collected in the month of November. The spore number was found to be lowest in the month of August in all types of soil. Silt loam soil showed highest spore population, whereas the sandy loam soil showed lowest spore population compared to others. The spore population density decreased in a descending order from November to August in all types of agricultural soil of District. The Genus Glomus was well distributed in agricultural soils and occupied > 50% of total VAM spore population present in all types of soil.

Keywords: Glomus, Gigaspora, Acaulospora, Vesicular Arbuscular Mycorrhizae, Distribution, Diversity, Soil samples.

Introduction

Kalaburagi covers total of 8 taluks in Karnataka state and the district falls in the semi-arid region of Deccan platue. The total geographical area is 1,610,208 hectares; out of which 1,408,160 hectares is an arable land meant for cultivation of several types of crops. Generally, the soils in the district are black in colour and calcarious in nature.

Vesicular Arbuscular Mycorrhizae are associated with almost all plants in nature (Hayman, 1982). The host plants were being able to absorb phosphate and other minerals more efficiently due to VAM association and nutritionally gets benefited. VAM fungal association has been reported from time to time in different host plants growing in phosphorus deficient soil (Bagyaraj, 1986) and plays a major role in nutrient acquisition.

A large measure of ecological equivalence between endogonaceous species from a general spore survey of pastures in Ontago was reported (Hayman, 1978). General surveys are more useful for providing qualitative information of the ecological site (Sward *et al.,* 1978). Such works are necessary to understand the complex phenomenon of endophyte relations in time and space.

Diversity of VAM are affected by a number of factors such as soil type, fertility level, light, temperature, rainfall, humidity and the plant population of an area. In the present study, the occurrence and their

distribution (diversity) of VA mycorrhizal fungi were investigated. Besides analyzing the factors affecting the diversity of VAM, an attempt was made for a qualitative estimation of VAM associated with agricultural plants which would be useful for their exploitation in agriculture.

Materials and Methods

Study area

The study areas were selected from the Kalaburagi district. Agriculture land, natural plantation, artificial plantation and grasslands of Kalaburagi district were selected for the present work and the enumeration of VAM fungal spores have been estimated in different environmental conditions of the district.

Collection of soil sample

The soil samples were collected from selected sites Agriculture land, natural plantation, artificial plantation and grasslands in kalaburagi district. The sites were identified on the basis of use of land. 250 gms of rhizosphere soil samples were collected from each sites at different seasons using sterile techniques by following the standard procedure of Schenck and Perez (1999). Samples were collected at a depth of 5 cm, below the ground level. Collected soil samples were air dried and used for mycorrhizal spore collection

Physico chemical of soil samples

The physico chemical analysis of the collected soil samples were carried out as per the procedure of Mosse and Bowen, (1968). Physico chemical properties of soil such as pH, moisture and sand percentage were analysed. Soil samples were also analysed for important minerals like nitrogen, phosphorus and potassium.

Recording of environmental factors

The environmental factors (meterological data) such as maximum and minimum temperature, relative humidity and total rainfall were collected from meterological department, Kalaburagi District, Karnataka state.

Enumeration and identification of VAM spores

VAM spores were extracted using the wet sieving and decanting methods (Gerdemann and Nicolson, 1963). The extracted fungal spores were identified according to the keys mentioned by Schenck and Perez (1999). The isolated spores were counted by using stereoscopic binocular microscope.

Results and Discussion

Physico chemical of soil samples

Results of the physicochemical properties of the collected soil samples were as represented in table 1. The soil pH of agriculture land, natural plantation, artificial plantation and grassland were found to be 7.3, 8.5, 6.3 and 7.7 respectively. From this data, it is evident that the soil of agricultural land and grassland were neutral and near alkaline whereas soil of natural plantation site was alkaline. The acidic nature of the soil was observed in soil of artificial plantation site.

Table1. Physicochemical analysis of the soil samples

Site/Analysis	Agricultural land	Natural plantation	Artificial Plantations	Grassland
pH	7.3	8.5	6.3	7.7
Moisture (%)	15	16	17	14
Nitrogen(kg/ha)	120	134	124	121
Phosphorous(kg/ha)	8	10	9	7
Potassium (kg/ha)	7	12	11	15
Sand (%)	74	70	71	72

The moisture content of the soil was found to be 15, 16, 17 and 14 % in the respective soil of agriculture land, natural plantation, artificial plantation and grassland.

Recording of environmental factors

The results of the environmental factors recorded was presented in table 2 The minimum temperature recorded was in winter which was found to be 11.56 ^{0}C, while the maximum temperature was 44.30 ^{0}C in Summer season. The relative humidity was 35.8, 81.24 and 76.11 % in summer, Mansoon and winter season respectively. The highest rainfall recorded was 210.05 mm in the mansoon season and the least rainfall was recorded in the summer season which was 15.00 mm only.

Table 2. Metrological Data from September 2012 to October 2013 [Mean pooled data]

Season	Temperature (oC) Maximum	Minimum(%)	Relative humidity	Total Rainfall
Summer (March-June)	44.30	33.5	35.8	38.61
Mansoon (July-Mid October)	34.21	29.45	81.24	210.05
Winter (Mid October – February)	24.87	11.56	76.11	15.00

Enumeration and identification of VAM spores

The diversity in the Glomus spore frequency in natural and artificial plantations, agricultural fields and grasslands during three seasons has been observed. In case of artificial plantation the lowest frequency of the spores during all the three seasons was recorded. In case of natural plantation the maximum spore frequency was recorded in winter. The spore frequency in agricultural field also showed gradual increases from summer to monsoon to winter. Thus variability in the frequency of Glomus spore in different habitats has indicated the significance of edaphic, climatic and also the host factors in its occurrence.

The distribution of VAM spores varied according to the soil types and environmental conditions. The studies were conducted in 4 types of soil (clay loam, sandy loam, sandy clay loam and silt loam. The number of VAM spores obtained from different types of soil were counted and given in (Table 4). The study revealed that the number of VA Mycorrhizal spores observed from different types of soil ranges from 150-1850. Interestingly the higher number of spores was recorded from all the soil samples collected in the month of November while the spores number was found to be lowest in the month of August in all soil types. The population density of the spores in all the soil types decreases in the order of November, February, May & August 2012-13.

Table 3. VAM spores population in different types of Agricultural soils of Kalaburagi District

Type of soil	Feb. 15th	May 15th	Aug. 15th	Nov. 15th
Clay Loam	595	480	1550	1444
Sandy Loam	390	155	625	454
Sandy Clay Loam	315	230	774	600
Silt Loam	875	770	1865	1526

The generic level of distribution of VA mycorrhizal spores is also critically analysed according to Trappe (1982) on the basis of different morphological characters of vesicular-arbuscular mycorrhizal spores. The spore population of VAM spores (*Glomus* species, *Gigaspora* species *and Acaulspora* sp.) was studied. It was found that Glomus species was the most dominant genus. The results of the physico-chemical properties of four different types of soils were represented in the table.(2) The number and type of vesicular arbuscular mycorrhizal fungal spores were also analysed and represented as in table.(3) Maximum percentage of Glomus species was observed in sandy clay loam type. *Acaulspora* sp. was recorded next to Glomus species in distribution. There were some brown and yellow types of spores of confusing morphology were also recorded in the soil types. The physico-chemical properties of soil (Powell and Sithamparanathan, 1977; Sujan Singh, 1999) and environmental factors affect and influence the distribution of VA mycorrhizal spores.

Conclusion

As the VAM spores are important structures and vary greatly in size and species composition (Mosse and Hayman, 1971) in different habitats due to differences in edaphic, climatic and host factors that might determine or alter their nature and populations at a particular place (Hayman, 1975) and ecological studies are therefore, fundamental and have prompted numerous surveys all over the world aiming at enumerating the native VAM fungi prevalent at a particular region for the consideration of possibilities of increasing the efficiency of indigenous populations (Hayman, 1978). Many field soils all over the world have bee surveyed during last three decades for VAM fungi and population was found to be generally more and varied in cultivated soils (Gerdemann, 1968) than non-cultivated as in Australian and New Zealand soils (Mosse and Bowen, 1968).

References

Bagyaraj, D.J. 1986. Mycorrhizal association in crop plants and their utilization in agriculture. In: Beneficial fungi and their utilization. Nair, M.C. and Balakrishnan, S. (eds), Scientific Publ. Jodhpur, India, Pp. 59 72.

Gerdemann J. W., 1968. Vesicular arbuscular mycorrhiza and plant growth. *Annu. Rev.Phytopatho*l. **6:** 397-418

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: 235 246.

Hayman D. S., 1978. Mycorrhizal populations of Sown pastures and native vegetation in Otago. New Zealand. *N. Z. J. agric. Res*. **21:** 271.

Hayman D.S., 1975. The occurrence of mycorrhizas in crops as affected by soil fertility. In Endomycorrhizas. Academic Press, London, pp 495-509

Hayman, D.S. 1970. VA mycorrhiza in field crop system. In: Ecophysiology of VA mycorrhizal plants. Safir G.R. (Ed). CRC, Boca Raton, Pp. 171 192.

Hayman, D.S. 1970. VA mycorrhiza in field crop system. In: Ecophysiology of VA mycorrhizal plants. Safir G.R. (Ed). CRC, Boca Raton, Pp. 171 192.

Hayman, D.S. 1982. Practical aspects of VAM. In: Advances in agricultural microbiology. Subba Rao, N.S. (Ed). New Delhi Oxford, IBA, Pp. - 325 373. Powell, C.L.,

Hayman, D.S. 1982. Practical aspects of VAM. In: Advances in agricultural microbiology. Subba Rao, N.S. (Ed). New Delhi Oxford, IBA, Pp. 325 373. Powell, C.L.,

Mosse B. and Bowen G. D., 1968. The distribution of Endogone spores in some Australian and New Zealand soils and in an experimental field soil at Rothamsted. *Trans. Br. Mycol. Soc.* **51:** 485-492

Mosse B. and Hayman D. S., 1971. Plant growth response to vesicular- arbuscular mycorrhiza II. In utilized field soils, *New phytol*. **70:** 29-34

Schenck, N.C., Perez, Y. 1999. Manual for the identification of VAM fungi. Int.J.Curr.Microbiol.App.Sci (2015) 4(4): 27-31 Synergistic publ. Gainseville, Florida, USA.

Schenck, N.C., Perez, Y. 1999. Manual for the identification of VAM fungi.

Sithamparanathan, J. 1977. Mycorrhizae in hill country soils. IV Infection rate in grass and legume species by indigenous mycorrhizal fungi, under field condition. New Zealand. J. Agri. Res., 20: 489 494.

Sithamparanathan, J. 1977. Mycorrhizae in hill country soils. IV Infection rate in grass and legume species by indigenous mycorrhizal fungi, under field condition. New Zealand. J. Agri. Res., 20: 489 494.

Sujan Singh, 1999. Effect of edaphic and climatic factors on the development of mycorrhiza in tree nurseries (Part- I). Effect of soil moisture, soil texture and temperature. Mycorrhiza News, 11(3): 2 10.

Trappe, J.M. 1982. Synoptic key to the genera and species of Zygomyceteous mycorrhizal fungi. Phyto Patholo., 72: 1102 1108