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ARBUSCULAR MYCORRHIZAL (AM) FUNGAL DIVERSITY ON *RICINUS COMMUNIS* L. GROWING IN DIFFERENT PLACES OF DHARWAD DISTRICT IN KARNATAKA – SOUTH WESTERN INDIA

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Abstract: AM spore number of *Ricinus communis* L. and percent root colonization do not correlated with each other. Except in sulikatti, Khannur and Dundur places. 97 per cent of plants showed AM fungal dependency. Organic matter of the collected soil do not cause varied distribution of spores. Altogether thirty six AM fungal spores were recovered from 879 soil samples in twenty locations. Soil samples comprised with ten indigenous AM fungal species, *Acaulospora spinosa*, *Gigaspora scrubiculata*, *Glomus geosporum*, *Glomus macrocarpum*, *Glomus mosseae*, *Glomus multicole*, *Glomus leptonicum*, *Sclerocystis dussi*, *Glomus geosporum* and *Scutellospora nigra*. Highest spore count was noticed from (306-334) in 50g soils, of Ajjapur, Garag Byalhal and Basapur (2). The lowest number of spores (127-188/50g soil) was recorded in the soil samples of Navalagund Takadhonalli, kusagol, Khanapur and Kamdoli. It was observed that *Glomus* is dominant among the recovered AMF spores.

Key Words: Arbuscular mycorrhizal (AM) fungi, *Ricinus communis* L, Percent root colonization, spore number, dependency.

INTRODUCTION

Arbuscular mycorrhizal (AM) fungi are most beneficial soil fungi that have a close association with the roots of variety of plants, ranging from corn to redwoods. They have shown to increase field crops and nutrient uptake, enhance resistance to plant pathogen and to stabilize soil structure. Arbuscular mycorrhizal (AM) fungi, belongs to be division Glomeromycota, are obligate symbionts and form associations with about 90% of plant species. These mycorrhizal Fungi colonize the plants indifferent soil environment, plant physiological conditions and mycorrhizae can be greatly changed through different tillage or fertilization systems. Sieverding (1991), have found that in agro ecosystems with monocultures in conventional tillage. Kunwar *et al.,* (1999), have studied the occurrence and distribution of AM fungi associated with garlic rhizosphere soil. Beena *et al.,* (2000), have studied the diversity of AM fungi on costal sand dunes of the West Coast of India. AM fungal association of mangroves in saline and non-saline soil has been studied by Gupta *et al.,* (2000). Screening of AM fungi for the re-vegetation of eroded red soil in sub-tropical china was reported by Wu *et al.,* (2002), Harinikumar and Potty (2002) and recorded AM spores from cultivated soil and uncultivated soil. Prasad *et al.,* (2006), have studied the distribution of AM fungi in Soyabean rhizosphere.

Ricinus communis L. castor is probably indigenous to North Africa and is now extensively grown in tropical and sub-tropical regions, usually it is an annual crop, Castor oil is extracted from its matured seeds, oil is nearly colour less or very pale greenish yellow viscous liquid, the typical fatty acid composition of castor oil is ricinoleic acid, 95% linoleic acid, 5% palmitic and stearic acid and 1-2% of negligible amount of oleic acid. Castor oil is employed in the manufacture of transparent soaps, printing ink, linoleum and oilcloth. Owing to their strong bacterial action, sodium ricinoleate and sulphoricinoleate are important ingredients of tooth paste formulations. Hydrogenated castor oil is used in the manufacture of ointment bases, waxes, polishes, carbon paper and candles. Ricinolic acid is used as one of the ingredients of chemical contraceptives to lower the surface tension which finally results in the disruption of sperms. The oil is used in pharmacy as a strong laxative (Kochhar, 1998).

Ricinus communis L. are commonly grown in agricultural fields of Dharwad district, in Karnataka south western India as this plant being a good source of hydrocarbon. No reports on diversity of AM fungi studied on this plants Therefore, this study was under taken to evaluate the AM fungal diversity and its dependency.

MATERIALS AND METHODS

Roots and rhizosperic soil sample were collected from twenty different places, where *Ricinus communis* L. was growing regions of Dharwad district. Geographical location of the studied site is lying in between 14°15¹ to 15°5¹ North longitude and 74°49¹ and 76° 21¹ east latitude. There is a marked diurnal temperature difference. That can be below as 20.2°C in June and high as 34.42°C in March. The annual rain fall is 600-850 mm. The climate is semi humid to humid. Soil is covered with a hard, compact crust having dark brown colour. Roots and soil samples collected and they were packed in clean polyethylene bags with labeling. The physic-chemical properties of soil such as nature, soil type, pH, organic carbon and available phosphorous of the soil have been determined following the procedure of Jackson (1973). Recovery of

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AM fungal spores from the rhizosphere soil sample, in the present study was used by adopting wet sieving and decanting technique according to (Gerdemann and Nicolson, 1963). Different AM fungal species were identified based on the manuals and synoptic keys proposed by (Morton and Benny, 1990; Scheck and Perez, 1990; Walker and Trappe, 1993). The cleaned roots were transferred in to 10% KOH solution and heated at 90°C degree for one hour and the time period was adjusted according to root bit delicacy. 10% of KOH was poured off and roots were rinsed with tap water. Root bits were taken out and acidified by placing in 2% HCL solution and washed with distilled water, stained in 0.05 tryphan blue in lactophenol, the method proposed by (Phillips and Hayman, 1970). The percent of root colonization was calculated by the formula as proposed by (Giovannetti and Mosse, 1980).

$$\% \text{ of root colonization} = \frac{\text{Total number of infected roots}}{\text{Total Number of roots}} \times 100$$

Table 1: Sandy loam soil characteristics

Places of soil collection	pH	Soil moisture	O.H	E.C	N	P	K	Zn	Cu	Mg	Pb
Khanapur	7.1	27.2	0.79	0.91	1.47	0.23	2.41	2.14	1.83	1.37	0.51
Garage	7.0	28.4	0.76	0.97	1.48	0.24	2.39	2.13	2.16	1.32	0.49
Venkatapur	7.2	29.1	0.74	0.96	1.46	0.27	2.37	2.16	2.19	1.34	0.49
Benchali	6.9	27.3	0.75	0.95	1.49	0.28	2.41	2.17	2.19	1.32	0.46
Sulikatti	6.8	28.4	0.79	0.98	1.45	0.24	2.38	2.14	2.11	1.40	0.47

Elemental concentration in mg/kg soil. Each value is the mean of 12 samples

RESULTS AND DISCUSSION

Maceration and anatomical studies followed by Tryphan blue staining revealed different stages with district components of AM fungi. Microscopic measurements provided an assessment of the relative abundance of mycelia in roots, the density and wall thickness, etc. The coarse aseptate hyphal coils were often seen from initial penetration points. Mycorrhizal colonization and spreading of hyphae was seen more in the young terminal roots. The external hyphae showed thick irregular wall and aseptic condition in the diameter range of the hyphal filaments. The mycorrhizal hyphae spread in the cortical cells and formed arbuscules look like haustoria as little trees with finger like projections. In present study vesicles were more in number and were seen intra-cellularly within the infected roots. Vesicles contain lipid and are reserve organs of the fungus. Vesicle size, sub globose and large. The granular cytoplasm with full of globules observed in mature vesicles. The intercellular vesicles and host walls have district contact, whereas the intracellular vesicles usually enclosed in a layer of cytoplasm. The outer wall of the vesicles appeared smooth without ornamentation. Arbuscules in various stages of growth were observed in the various portions of the mycorrhizal roots as compared to the young mycorrhizal roots. They are regenerated and are digested by the host cell. The process of arbuscules formation and degeneration occurs simultaneously in the root.

Rhizospere soil sample from twenty locations were subjected for recovery of AM fungal spores. The physicochemical characteristic have varied in collected rhizosphere samples. Table 1 showed any for five places depicting different pH's with alkalinity and acidic nature soil with lower P and organic matter was determined. AM fungal spore population and percent root colonization do not correlated with each other. The lowest percent root colonization in *Ricinus communis* (41–49%) at khanapur, Garag, Hairlapur and Navalagund. Moderately root colonization was recorded from (51-63%) in the locations of venkatapur, benchali; Basapur (1) Basapur (2) Kamadoli, Talval, Selkannal, Kusugall, Dundur and Byalhal. Whereas, the highest percent root colonization from (64-78%) was determined in the places of Khannur, Shivalli, Sulkatti, Takad Honalli and Ajjapur. Similarly, highest spore count was noticed from (306-334) in 50g soils, of Ajjapur, Garag Byalhal and Basapur (2). The lowest number of spores (127-188/50g soil) was recorded in the soil samples of Navalagund Takadhonalli, kusagol, Khanapur and Kamdoli shown in (Table 2). Infact, *Ricinus communis* L. have 97% AM fungal dependency that have been documented in all the sampled places in the present study, except the plants growing places such as Garga, Salakannal and kamadoli respectively. The soil samples of different location showed varied spores. All the recovered spores represented five genera *Acaulospora, Gigaspora, Glomus, Sclerocystis,* and *Scutellospora* in each soil sample. The genus *Glomus* was most dominant spore species in most of the soil samples. (Table 3) (Variation of spore population in rhizospheric soil showed that the multiplication of spores depends on species to species level (Lakshman *et al.,* 2008). In the present investigation optimum number of AM fungal spores was isolated in rhizospere soil samples of *Riccinus communis* L. altogether thirty six AM fungal spores were recovered from 879 soil samples in twenty locations. In all the soil samples, out of thirty six AMF spores, only mine prominent spore species have mentioned in (Table 3). There are *Acanlospora spinosa*

(59%), *Gigaspora, Scrubiculata* (76%), *Glomus geosporum* (98%), *Glomus macrocarpum* (99%) *Glomus mosseae* (92%), *Glomus leptonicum* (89%), *Sclerocystis dussi* (6%) and *Scutellospora nigra* (83%) have been documented. (The high level of root colonization may be the prime determinant of the efficiency of symbiosis (Lakshman and Geeta patil., 2004) and the fungus *Glomus fasciculantum* was found to be the efficient fungus for colonization on *Glomus mossae*. Difference in the response of AM fungi with in host suggested that under some conditions selection should occur to favor certain host- fungus combinations).

Table 2: Showing the percent root colonization and spore number screened at *Ricinus communis* L. growing sited of University botanical garden.

S. No.	Places	% of root colonization	Spore/ 50g soil	AM fungal dependency (%)
1.	Khanapur	41. 7	134	56.6
2.	Garag	43.7	319	47.3
3.	Venkatapur	51.3	218	54.7
4.	Benchli	54.2	241	59.4
5.	Sulikatti	69.1	212	69.3
6.	Ajjapur	78.4	314	66.2
7.	Kamdali	69.8	188	48.1
8.	Basapur	57.4	208	50.5
9.	Hairalpur	46.3	217	61.4
10.	Byalhal	63.5	330	74.5
11.	Talval	58.6	221	61.6
12.	Shivahalli	70.4	226	73.2
13.	Kamagopu	55.3	213	63.1
14.	Navalagund	49.2	109	59.3
15.	Selakannal	58.5	196	47.5
16.	Khannur	64.4	208	66.4
17.	Basapur	57.3	306	71.3
18.	Dundur	63.1	211	73.1
19.	Kusagal	61.2	132	53.9
20.	Tabkadhonalli	71.8	127	55.7

Table 3: The distribution of different AM fungal spore genera of rhizospheric soil of *Ricinus communis* L. at different location in Dharwad district in karnataka.

Locations	*Acaulospora spinosa*	*Gigaspora scrubiculata*	*Glomus geosporum*	*Glomus macrocarpum*	*Glomus mosseae*	*Glomus multicole*	*Glomus leptonicum*	*Sclerocystis dussi*	*Glomus geosporum*	*Scutellospora nigra*
A	+	+	+	+	+	+	+	-	+	+
B	-	+	+	+	+	+	-	-	+	-
C	-	+	+	-	+	+	+	-	+	+
D	+	+	-	+	+	-	+	-	+	+
E	+	-	+	+	-	+	-	-	-	-
F	+	-	+	+	-	+	-	-	-	-
G	-	-	+	+	-	+	-	+	+	-
H	-	-	+	+	+	+	+	-	+	-
I	-	-	+	-	+	_	-	-	+	-
J	-	-	+	+	+	+	+	-	+	-
K	+	+	+	+	+	+	+	+	+	-
L	+	+	+	+	+	+	+	-	+	-
M	+	+	+	+	-	+	+	-	+	+
N	+	+	+	+	-	+	-	-	+	-
O	-	-	+	+	-	-	+	+	+	+
P	-	-	+	-	+	-	-	-	+	+
Q	+	-	+	-	+	-	-	-	-	-
R	+	-	+	+	+	-	-	-	-	-
S	+	+	+	+	+	-	+	+	+	-
T	+	+	+	-	+	+	+	-	+	-

Note: + : Present; -: Absent. A-Khanapur; B- Garag; C-Venkatapur; D- Benchi; E- sulikatti; F-Ajjapur; G-Kamdali; H-Basapur; I-Hairlapur; J-Byalhal; K-Talval; L- Shivahalli; K-Kamagopa; L-Navalgund; M-Selakanhal; N-Khannur; O- Basapur; P- Dundur; Q-Dundur; R-Kusugall; S-Tabkad Honnalli; T-Arlihond.

Ricinus communis L. plants with moderate to higher percent of root colonization of AM fungi clearly promotes re-establishment of below ground. And the AM fungi provided host tree for re-establishment with neighbouring plants with rhizospheric link and enhance in nutrient absorption and transportation through the fungal hyphae (Fitter, 1985; Abbott and Gazey, 1994; Brundrett *et al.*, 1996). Spore densities of AM fungi vary but relatively higher. The results of the current work showed that spore density was not related to colonization levels and species richness when all the site were considered together. And all the *Ricinus communis* L. with AM fungal dependency. Several earlier workers (Lekha *et al.*, 1995; Trimurthula and Johri 1998; Lakshman, 2004) in different plants. Wide occurrence and distribution of *Glomus* species in the rhizosphere soil may be attributed to its early evolution and can be considered one of the few plant fungus associations with fissile recorded (Taylar *et al.*, 1998; Lakshman *et al.*, 2001). The present work was carried out in agricultural fields, farmers use manure during cultivation of crop. And there will be rich organic matter in the soil. However, organic matter do not affect the percent root colonization and acquires N directly from organic matter, further their wide ecological amplitude our observation in the present study is consistent with the early workers. (Hodge *et*

al., 2001; Cavagnaro *et al.,* 2006; chaurasia *et al.,* 2007; Pushpa *et al.,* 2013).

The results of the present *Ricinus communis* plants roots revealed the AM fungal association significantly. This reflects the mycotrophic nature of the plant species and ability of AM fungi in the soil in colonizing in agriculture field and the plant dependent on AM fungi. (Jain, 1997; Chaurasia and Khare, 2011) have reported on forage crops weeds, and ornamental plants.

In conclusion: *Ricinus communis* L. had a significantly dependent on AM fungal association, but no correlation between per cent root colonization, spore number and species diversity. Although *R. communis* is oil yielding plant has maximum root colonization affecting competition composition and succession.

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