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Arbuscular mycorrhizal fungi association with paddy (cv. KAPPA) rhizosphere soil : occurence and distribution

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ABSTRACT

Arbuscular mycorrhizal fungi (AMF) form obligate symbiotic association with the roots and other underground parts of the plant and enhance plant growth and biomass. Studies were conducted on the AMF associated with the paddy rhizosphere soil, and the relation of various physico-chemical characteristics of soils with the number of AMF propagules. Twenty two species of AMF belonging to all the six genera of Glomales were recorded. *Acaulospora* and *Glomus* were the predominant genera. *A. rehmii* and *G. fasciculatum* were the most frequently occurring species. The number of AMF propagules/100 g soil ranged from 107-305. Increasing moisture content had a positive effect on the number of AMF propagules. Nutritionally deficient soils and phosphorous deficient soils in particular harboured more AMF.

Key words : Arbuscular mycorrhizal fungi, Paddy, Rhizosphere soil, Phosphorous.

INTRODUCTION

Oryza sativa L. cv. KAPPA cultivated under dry or upland semi-dry conditions. It has a considerably high nutrient content with about 90% carbohydrates, 8-10% proteins, 1% fats and 1.5% mineral status. Phosphorus and potash accounts 0.5-0.7%, it is a staple form of food to our sub continent.

Arbuscular mycorrhizal fungi (AMF) are ubiquitous in phosphorus deficient soil and form obligate symbiotic association with roots and other underground parts of most plants (Smith and Read, 1997). Their potential to enhance plant growth and biomass is well known. Because of this ability AMF are called as biofertilizers. AMF are capable of scavenging phosphorus from the soil into the root system mainly through the exploration of the soil by the extraradical hyphae beyond the root hairs and phosphorus depletion zone. There are reports on the natural colonization in many cereals (Schreiner and Bethlenfalvay, 1995; Patil and Lakshman, 2005; Sudheta and Jha, 2007). There are no reports on the AMF associated with the rhizosphere soil of *Oryza sativa* L. cv. KAPPA hence, an attempt was made to investigate the qualitative and quantitative composition of AMF associated with paddy cv. KAPPA rhizosphere soil and various physico-chemical characteristics of the soil in relation to the number of propagules of AM fungi.

MATERIALS AND METHODS

Oryza sativa L. cv. KAPPA rhizosphere soil samples were collected from paddy fields of Karwar South Canara district in Karnataka from each paddy plant triplicate rhizosphere soil and root samples were collected and brought to the laboratory. A part of soil was used for physico chemical properties and major part of the soil sample were used for isolation of AMF spores following wet sieving and decanting method (Gerdemann and Nicolson, 1963) and counted. Mycorrhizal roots were stained and per cent root colonization was established according to (Phillips and Hayman, 1970). The AMF were identified with the help of relevant literature (Schenck and Perez, 1990). Physico-chemical characteristics of the soils *viz.* pH, moisture content, soil texture, nitrogen, phosphorus and potassium contents were determined according (Jackson, 1973).

RESULTS AND DISCUSSION

Twenty two species of AMF were isolated and identified from the rhizosphere soils paddy Var. Kappa (Table 3). The number of AMF propagules/100 g soil ranged from 107-305 (Table 2). Species belonging to all the six genera of AMF were isolated from the soils. Species of *Acaulospora* dominated the rhizosphere soil supporting ginger cultivation. Nine species of the genus *Acaulospora,* one species of *Entrophospora,* two species of *Gigaspora,* eight species of *Glomus,* one species each of *Sclerocystis* and *Scutellospora* were isolated and identified. *A. rehmii* and *Glomus fasciculatum* were the most frequently occurring species isolated from one sample each. Tisdall (1991) isolated six species of AMF from agriculture land Koske and Gemma (1997) isolated 35 species of AMF from grasses rhizosphere soil.

The physico-chemical characteristics of ginger

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Table 1 : Arbuscular mycorrhizal fungi (AMF) isolated from the rhizosphere soil of paddy cv. KAPPA in Karwar district Karntaka

Factors	Soil Samples								
	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9
AMF propagules / 100 g soil	206	107	180	210	260	136	148	305	271
pH	7.8	8.0	7.6	7.3	7.6	7.2	7.5	7.4	8.1
Moisture%	12.0	9.5	10.0	9.8	12.5	9.5	10.2	12.9	10.7
Sand%	60.0	15.0	35.0	50.0	55.0	25.0	55.0	50.0	60.0
Silt%	40.0	50.0	60.0	35.0	45.0	35.0	35.0	40.0	35.0
Clay%	0.0	35.0	5.0	15.0	0.0	15.0	10.0	10.0	5.0
Nitrogen mg kg^{-1}	650	350	570	700	950	1100	1050	400	550
Phosphorous mg kg^{-1}	5.0	11.0	9.5	4.9	6.0	10.5	9.0	3.0	5.5
Potassium mg kg^{-1}	400	270	300	350	450	580	600	380	350

S1-S9 Rhizosphere soil of ginger paddy cv. KAPPA grown in different places in Karntaka.
S_1= Arga S_2= Lande S_3 = Mallapur S_4 = Majali S_5 = Kerwadi
S_6= Ulga S_7=Devalmuki S_8=Shriwada S_9 = Beragal

Table 2 : Per cent AM fungal colonization and spore/100g soil in paddy cv. KAPPA in Karwar district of Karntaka at 40 days (Mean average of 12 plants)

Plant	Place / % of AMF colonization								
	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9
Paddy cv. KAPPA	52.2	70.0	61.3	49.2	55.7	66.4	48.1	76.8	81.3
	198.5	105	216	291	217	181	241	305	281

Table 3 : Arbuscular mycorrhizal fungi (AMF) isolated from the rhizosphere soil of paddy cv. KAPPA in Karwar district Karntaka

Sr. No.	AMF	Soil Samples								
		S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9
1.	*Acaluospora appendicula* (Spain, Sierverding and Schenck)	-	+	-	-	-	-	-	-	-
2.	*A. delicate* (Walker, Pfeirffer and Bioss)	-	-	+	-	+	-	-	-	-
3.	*A. elegans* (Trappe and Gerdemann)	-	+	-	-	-	-	-	-	-
4.	*A. foveata* (Trappe and Janos)	-	-	-	-	+	-	-	-	-
5.	*A. lacunose* (Mortion)	-	-	+	-	-	-	-	-	-
6.	*A. laevis* (Gerd and Trappe)	-	-	+	-	-	-	-	-	-
7.	*A. mellea* (Spain and Schenck)	-	-	+	-	-	-	-	-	-
8.	*A. rehmii* (Sieverding and Toro)	+	-	-	+	-	-	-	+	-
9.	*A scrobiculata* (Trappe)	-	-	-	-	-	+	-	+	-
10.	*Entrphospora schenckii* (Sieverding and Toro)	-	-	-	-	-	-	-	-	+
11.	*Gigaspora margarita* (Becker and Hall)	+	-	-	-	-	-	-	-	-
12.	*G. rosea* (Nicolson and Schenck)	+	-	-	-	-	-	-	-	-
13.	*Glomus ambisporum* (Smith and Schenck)	-	-	-	-	-	-	-	-	+
14.	*G. citricolum* (Tang and Zang)	-	-	-	-	-	-	-	-	+
15.	*G. diaphanum* (Morton and Walker)	-	-	-	-	-	-	-	-	+
16.	*G. fasciculatum* (Thaxter sensu Gerd.)	-	-	+	-	-	-	+	+	+
17.	*G. fueaianum* (spegazzini) Trappe and Gerdemann	-	-	-	+	-	-	-	-	-
18.	*G. geosporum* (Nicol. and Gerd.) Walker	-	-	+	-	-	-	-	+	-
19.	*G. hoi* (Berch and Trappe)	-	-	-	-	-	-	-	+	-
20.	*G. pustulatum* (Bhattacharjee and Mukerji)	-	-	-	-	-	-	-	+	-
21.	*Sclerocystis rubiformis*	-	-	+	-	-	-	-	-	-
22.	*Scutellospora* sp.	-	-	-	-	-	-	-	-	+

S_1-S_9 Rhizosphere soil of paddy cv. KAPPA grown in different places of Karwar in Karnataka.

rhizosphere soils are presented in Table 1. The population of AMF in different soils was determined in terms of resting spores and sporocarps in the soil. The AMF were of widespread occurrence in all the soils investigated but with variation both in number and type of spores and sporocarps. No relationship was found between pH and spore numbers. Similar was the observation of Abbot and Robson (1985) and Koske and Gemma (1997). Increasing moisture content had a positive effect on the number of AMF propagules. There are contradictory reports on the effect of moisture content on VAM fungal propagules. A negative effect of increasing moisture content on spore numbers was observed by Morton and Bentivenga (1994). Significant positive correlation between moisture content and vesicular-arbuscular mycorrhizal fungal spores in *Terminalia* rhizosphere soil indicated a positive influence. Similar was the observation of Patil and Lakshman (2005) in garlic rhizosphere soil.

It is a well known fact that the nutritionally deficient soils and phosphorous deficient soils in particular harbour more AMF. Present findings also supported this. This corroborated -by the findings of Berch (1986); Lakshman (2005) and Hiremath *et al*. (2006).

Though there are reports on the colonization of underground parts of ginger by AMF (Bagyaraj, 2007), this is the first detailed taxonoic study on the association of various arbuscular mycorrhizal fungi and the physico-chemical characteristics of agriculture field rhizosphere soil. It is a clear indication of their diversity mycorrizal dependence of the plant.

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