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Seasonal fluctuation of VAM fungi on six commonly cultivated crops of Dharwad district in Karnatka

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The establishment of arbuscular mycorrhiza (AM) fungi was recorded in six cultivated crops. There was a seasonal fluctuation of AM fungal colonization in root bit and in root length on Jowar, wheat, safflower, sugarcane, pigeon pea and cotton. The root colonization and AMF spore numbers in soil samples not correlated with each other. Results revealed that O.M. and E.C. higher or lower level have no influence on colonization / spore number, on contrary higher P and N concentration in soil reduced root colonization. It shows, the distribution of AM fungi varied with climate and edaphic environments as well as land use patterns among cultivated crops.

Key words : Arbuscular mycorrhizal fungi (AMF), Seasonal fluctuation, Per cent colonization

INTRODUCTION

Arbuscular mycorrhizal (AM) fungi are ubiquitous. in distribution and physiologically are unspecialized. In the soils they occur in the form of chlamydospores, zygospores and azygospores (Tisdall, 1991 and Coleman and Crossley, 1996). Root colonization with AM fungi has resulted in efficient uptake of immobile nutrients such as Phosphorus, Zinc and Copper. Mycorrhizal dependency is the degree to which a plant/crop is dependent on the mycorrhizal conditions to produce its maximum growth or yield (Bhagyaraj, 2006). Therefore, an attempt was made to study the fluctuation of AM fungi is commonly cultivated crops in Dharwad district in Karnataka, by determining the extent of root colonization, spore population and species composition.

MATERIALS AND METHODS

The present research was carried out at five different localities of Dharwad district. Soil samples from the root zone of each crop plant grown in different localities of the sites were randomly collected from zero cm up to a depth of 26cm. Physical and chemical properties of the soil were estimated by standard analytical methods (Piper, 1950; Jackson, 1973). Rhizospere soil samples with tender roots of plants were collected randomly. The soil sampling was done at three different seasons. Roots were separated, washed, cut in to 1cm segments, cleared in 10% KOH and stained with 0.05% tryphan blue (Phillips and Hayman, 1970). Arbuscular mycorrhization of each plant species was determined by estimating the per cent root colonization (Giovannetti and Mosse, 1980). For AM fungal spore enumeration, l00g of the substrate was dispersed in 1 lit. water. after 15 min. the suspension was decanted through 750m - 45m, sieves and the remaining five of the sieves were washed in to beakers. The Supernatant was filtered through Grided filter papers. Each filter paper was spread on a microslide and observed under a dissecting microscope at 45X magnification. The intact AMF spores were counted. The AM fungal spores were picked up with a wet needle and mounted in poly-vinyl alcohol lactophenol on a microslide for identification .

RESULTS AND DISCUSSION

A remarkable feature of the major crops examined was the extensive AM Fungal colonization which was frequently very high significantly highest level of AMF colonization was found in the survey in Jowar during monsoon and least root colonization was observed in pigeonpea during winter (Table 1). The sustainable crop line examined from all the localities reflects a well colonized AMF association. This suggests that nutrient or water stress determind the levels of colonization. Percentages of root colonization levels were low and atpar also in roots of safflower and cotton in winter season (Table 2). This is probably because of the dry eutrophic nature of the substrate (Harley and Smith, 1983;

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Table 1 : Seasonal fluctuation in growth of per cent root length (cm) colonization (%) in six cultivated crops

Plant	Monsoon		Winter		Summer	
	Root length (cm)	Root colonization %	Root length (cm)	Root colonization %	Root length (cm)	Root colonization %
Jawar	53.2	63.6	42.6	61.2	37.2	72.4
Wheat	49.1	57.1	34.1	46.8	25.2	82.3
Safflower	37.4	84.2	28.5	31.5	30.1	94.7
Sugarcane	31.5	81.4	23.3	63.6	21.1	77.6
Pigeonpea	28.6	89.6	19.4	48.7	22.1	69.2
Cotton	41.3	82.7	39.2	34.5	38.1	87.6
CD at 0.05s %	5.10	5.01	6.21	7.05	7.03	9.00

Table 2 : Seasonal fluctuation cultivated Jowar land in AFM Spores and O, C, N and P

content of Soil depth in cms	AMF spores per 25g soil	O.C (%)	N (%)	P (%)	AMF spores per 25g soil	O.C. (%)	N (%)	P (%)	AMF spores per 25g soil	O.C (%)	N (%)	P (%)
	Monsoon				Winter				Summer			
0-10	103.5	1.82	2.11	0.32	191.6	1.79	2.01	0.29	158.2	1.87	2.13	0.31
11-15	91.4	1.73	1.46	0.24	88.7	1.58	1.43	0.21	101.2	1.74	2.51	0.23
16-20	57.6	0.86	1.15	0.19	54.1	0.93	1.11	0.18	69.2	0.96	1.24	0.14
21-26	23.1	0.61	1.01	0.15	14.8	0.56	0.98	0.17	25.4	0.68	1.13	0.13
CD at 0.05%	9.0	0.03	0.02	NS	0.1	0.02	0.03	0.02	11.1	0.03	0.01	NS

Table 3 : Seasonal fluctuation of Wheat cultivated round in AMF spores and O, C, N and P content of Soil

Soil depth in cms	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%
	Monsoon				Winter				Summer			
0-10	99.8	1.73	1.88	0.26	192.5	1.68	1.18	0.24	126.2	1.91	2.14	0.32
11-15	81.3	1.66	1.37	0.23	82.6	1.49	1.10	0.21	104.1	1.82	1.16	0.27
16-20	62.7	0.84	1.10	0.18	59.4	0.87	0.91	0.18	78.6	0.97	1.10	0.21
21-26	19.4	0.57	0.84	0.14	16.3	0.58	0.54	0.13	24.4	0.70	0.89	0.16
CD at 0.05%	10.03	0.03	0.01	NS	8.00	0.02	0.01	NS	13.0	0.10	0.01	NS

Wangiyana *et al.*, 2006).

No reduction in mycorrhizal spores population in 0 to 10 cm. soil depth of all the six crops in all the seasons (Table 2 to 9). Highest spores number (158.4/25 g soil) during summer and least number of spores 14.8 / 25 gm soil during winter was observed in Jawar (Table 2). Greater number of spores were recorded during summer in all the examined crops. Significantly increased mycorrhizal spore population in 0-10 cm soil depth of all the six crops in all the seasons (Tables 2-7).

Spore population increased in mid-summer and declined mostly in the winter. Differences in time of

Table 4 : Seasonal fluctuation of Safflower cultivated land in AMF spores and O, C, N and P content of Soil

Soil depth in cms	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)
	Monsoon				Winter				Summer			
0-10	147.4	1.76	1.81	0.24	103.2	1.71	1.22	0.21	159.2	1.92	2.16	0.33
11-15	88.1	1.67	1.41	0.22	89.5	1.63	1.14	0.20	101.4	1.79	1.19	0.23
16-20	57.6	0.85	1.01	0.16	63.1	0.73	1.10	0.16	81.3	0.98	1.11	0.19
21-26	19.1	0.52	1.81	0.14	17.6	0.49	0.58	0.14	21.5	0.78	0.87	0.15
CD at 0.05%	9.01	0.02	0.01	NS	10.0	0.02	0.01	NS	11.0	0.01	0.01	NS

NS = Non significant

Table 5 : Seasonal fluctuation of Sugarcane cultivated land in AMF spores and O, C, N and P content of Soil

Soil depth in cms	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)
	Monsoon				Winter				Summer			
0-10	134.2	1.86	2.16	0.27	131.1	1.61	2.10	0.31	137.4	1.90	2.20	0.32
11-15	110.0	1.33	2.12	0.23	107.5	1.39	2.01	0.27	120.4	1.31	2.22	0.29
16-20	83.4	1.27	1.83	0.19	78.3	1.22	2.01	0.21	86.4	1.18	1.19	0.24
21-26	23.1	1.07	1.36	0.14	16.5	1.14	0.94	0.17	37.8	0.89	1.11	0.19
CD at 0.05%	9.04	0.05	0.03	NS	9.0	0.02	0.04	0.01	10.0	0.00	0.07	NS

Table 6 : Seasonal fluctuation of Pigeonpea cultivated land in AMF spores and O, C, N and P content of Soil

Soil depth in cms	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)
	Monsoon				Winter				Summer			
0-10	161.2	1.93	2.13	0.33	197.0	1.91	2.22	0.32	187.7	1.83	2.04	0.29
11-15	107.5	1.66	1.91	0.27	146.2	1.42	2.17	0.27	130.0	1.58	1.19	0.17
16-20	96.1	1.40	1.52	0.19	101.4	1.22	1.14	0.21	98.4	1.79	1.12	0.14
21-26	24.7	1.21	1.32	0.19	29.4	0.84	0.92	0.14	30.2	0.14	1.07	0.12
CD at 0.05%	8.50	0.02	0.03	NS	8.2	0.03	0.05	0.00	11.01	0.05	0.07	NS

increase and decrease in spore number are probably related to stage of post development and climatic conditions. In summer depression in P was attributed to uptake by vegetation, and decreases in microbial release due to lower soil moisture. The seasonal decline in spore population may be accounted by spontaneous germination or death, injection by soil fauna, destruction of germination in the presence of living host (Sieverding and Toro, 1988).

Many spores showed poor level of attachment with roots during monsoon and winter seasons. A similar trend

Table 7 : Seasonal fluctuation of Cotton cultivated land in AMF spores and O, C, N and P content of Soil

Soil depth in cms	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)	AMF spores per 25g soil	O.C. (%)	N(%)	P(%)
	Monsoon				Winter				Summer			
0-10	151.4	1.86	2.24	0.27	158.2	1.77	2.38	0.24	281.0	1.96	2.17	0.32
11-15	107.0	1.63	2.15	0.39	141.5	1.59	2.31	0.23	177.0	1.87	2.13	0.30
16-20	101.3	1.62	2.07	0.24	107.6	1.32	2.12	0.19	122.1	1.73	2.11	0.24
21-26	28.6	0.84	1.88	0.13	31.4	0.97	1.19	0.14	38.7	0.93	1.91	0.17
CD at 0.05%	10.02	0.04	0.07	NS	11.01	0.02	0.03	0.01	12.0	0.02	0.08	0.00

of variation in the AM fungal chlamydospore population with AM root colonization has been observed in roots of all the crops. Spores of *Glomus* were found in all the examined soils but there was no correlation between their number and mycorhhizal colonization (Miller *et al.*, 1995; Read, 1996).

The soil had a large indigenous population supporting the generally held view that there were more spores in cultivated than in uncultivated soils. Mycorrhizal fungi appear to ubiquitously associated with Jowar, Wheat, Safflower, Sugarcane, Pigeon pea and Cotton in Dharwad district. A wide variation was observed among and within different species of AM fungi in their ability to promote cultivated plant growth at different sites. The AMF spore population is reported from the field soils are 10 to 100 times greater the findings of, (Bowen, 1987; Allen, 1991). More conclusively demonstrated that AM mycorrhizal fungi grow saprophytically in soil. If the saprophytic existence of mycorrhizae with high levels of 0^0C is possible. There should be no reduction in mycorrhizal spore population in Jowar, wheat sugarcane, pigeonpea, cotton and safflower. This work believe that besides 0^0C other ecological features such as moisture, pH, soil aeration, temperature and trace elements are involved influencing mycorrhizal distribution and survival in agricultural crops. The intensity of AM association supporting general view that there are more spores in cultivated soils than in uncultivated.

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