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PHYSICO-CHEMICAL CHARACTERISTICS OF SOIL IN RELATION TO VAM *(GLOMUS FASCICULATUM)* COLONIZATION IN *SACCHARUM OFFICINARUM* L.

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The physico-chemical features of experimental soil exhibited sandy loam texture with 62.4 to 66.1% sand, 8.4 to 10.5% clay and 21.1 to 32.2% silt. This type of soil found to be quite suitable for Sugarcane cultivation. The temperature variations 20.5 to 35.5°C was recorded during different phases of plant grown round the year, with maximum infection at 30.5°C. Infection percentage and population density of VAM was highest at moderate level of soil moisture i.e. 19.2%. Generally alkaline pH(8.6) was found suitable for VAM infection and spore population. Among other chemical parameters EC presented direct correlation. Available phosphorus and potash contents of soil exhibited almost inverse relation with VAM infection and spore population. When P K Contents decline in soil, infection percentage and spore concentration increased. While available nitrogen presented no correlation.

Keywords: *Saccharum officinurum;* Soil; VAM.

Introduction

The VA Mycorrhizal fungi play a major role in soil and plant species diversity and survival.[1,2] It has been estimated that over 90% of all higher plants are mycorrhizae with 3 x 10^5 species forming vesicular-arbuscular mycorrhizae.[3] VAM fungi are indigenous to soil in all climatic zone. The concentration of such fungi depend on the physico-chemical nature of soil. According to Koske[4] nature of soil and environmental condition greatly affect the VAM distribution in soil and infection in roots. The density of VAM propagules varies from site to site, season to season and year to year.[5-7].The concentration of VAM spores in soil is affected by soil texture, soil pH, soil temperature, soil moisture and soil nutrients. The present paper deals with the distribution of VAM (*Glomus fasciculatum*) in soil and infection in root of sugarcane during different phase of plant growth has been examined. Impact of different physical and chemical factors of soil on the population of VAM spore in soil and on percentage infection in root have also been examined.

Material and Methods

The sugarcane sets were allowed to grow in soil having inoculum of *Glomus fasciculatum* provided in layers. They were allowed to grow for three months to develop infection of VAM in roots. VAM infected plants were uprooted and transferred to different experimental pots (60 x 50 x 50 cm size) containing (50kg/pot) sterilized soil. They were provided normal condition for growth in green house. Five replicates were taken for each set of experiments. The soil samples were collected in the first week of everey third month between 8.00 AM to 10.00 AM from different experimental pots of Sugarcane. All the samples were mixed thoroughly to get one uniform composite sample. It was dried in shade, powdered and

sieved through 40 number mesh size sieve. The dried soil samples were filled in different polythene bags for physico-chemical analysis. The method of composite sampling, described by Association of Official Analytical Chemists,[8] was adopted. The various parameters studied were spore density, root infection, soil texture, soil temperature, soil moisture, soil pH, EC, organic Carbon, organic matter, available nitrogen, available phosphorus and available potash. Spore density was determined by the wet sieving and decanting method of Gerdemann and Nicolson,[9] percentage infection in root was determined by Phillips and Hayman,[10] soil texture, soil temperature, soil moisture, organic carbon and organic matter was estimated by Jhingram et al.[11] and pH, EC and available nitrogen was also estimated.[12] Available phosphorus was estimated by the method of Olsen et al.[13] and Jackson[14] and available potassium were estimated by flame photometry method.[15]

Results and Discussion

(A) Physical characteristics of soil:

Texture: Analysis indicated sandy loam type texture of soil. The average percentage of sand range from 62.4 to 66.1%, clay range from 8.4 to 10.5 and silt 21.1 to 32.2%.

Temperature: The data presented in Table 1 shows that the soil temperature varied from 20.5 °C to 35.5°C. The range of temperature was quite variable. Maximum temperature was recorded in the month of April followed by July, October and January during different phase of plant growth i.e. 3,6,9 and 12 months. Maximum population of VAM spores was recorded in the month of July followed by October and April and minimum in January. Root infection followed the same pattern as intensityof infestation of VAM spores occurred in soil. It was also observed that VAM infestation in soil and infection in roots was greater between temperature range 25.5 to 30.5°C.

Moisture: The percentage of soil moisture varied from 9.4 to 22.5%. Maximum soil moisture was recorded in the month of October (22.5%) and minimum in the month of April (9.3%). The density of VAM spore in soil and the percentage of infection in roots was found to be high at moderate level of moisture in soil.

(B) *Chemical Characteristics of soil*: (refer to Table 2)

pH : It varied from 8.1 to 8.6. The soil showed moderately alkaline range of pH with slight flactuations in their values during different phase of plant growth. pH value and VAM concentration in soil or infection in roots run parallel to each other. When pH of soil was maximum the density of VAM spore in soil and the percentage of infection in roots was also found to be maximum.

Electrical conductivity: The amount of total dissolved salts fluctuated from 0.43 to 0.65 m mohs/cm in soils. E C was found to be almost directly correlated with the density of VAM spores in soil and the percentage infection in roots.

Organic Carbon: The percentage of organic carbon varied from 0.99 to 1.35% in soil. The value of organic carbon was inversely proportionate to the infestation in soil and the infection in root (except in April).

Organic matter: Its percentage fluctuated from 1.70 to 2.32 in soil during different

Table 1. Changes in physical characteristics of soil during different phases of *Saccharum officinarum* growth in relation to VAM infestation in soil and infection in roots.

Parameter	Control initial soil	Changes in soil characteristics after growth of 3 months (July)	6 months (October)	9 months (January)	12 months (April)
VAM spores/100 g soil	195	325	240	125	205
Root Infection (%)	64	88	68	44	65
Temperature (°C)	35.2	30.5	25.5	20.5	35.5
Soil moisture(%)	9.3	19.2	22.5	20.5	9.4

Value of correlation coefficient (r) of VAM spores with different parameter

Root infection	Temperature	Soil moisture
+ 0.987	+ 0.344	+ 0.160

phase of plant growth. The value of organic matter run paralled to the value of organic carbon. Its value was also found inversely proportionate to the density of spore in soil and the percentage infection in roots.

Available Nitrogen: The concentration of available nitrogen fluctuated from 167.0 to 195.0 kg/ha in soil during different phases of plant growth. Its value presented almost inverse relationship with VAM population in soil and infection in roots.

Available Phosphorus: The phosphorus contents fluctuated from 8.4 to 14.7 ppm in soil during different months of plant growth. Its value showed inverse correlation with the population of VAM spore in soil and the percentage infection in roots. The value of P was recorded lowest in the month of July (8.4 ppm) and highest in the month of January (14.7 ppm) when the population of spores in soil and the percentage of infection in roots was highest and lowest, respectively.

Available Potash: The potash contents fluctuated from 56.0 to 68.0 ppm in soil during different months of plant growth. Its value presented inverse relation with the population of VAM spore in soil and the percentage of infection in roots.

Analysis of soil texture of sugarcane cultivated pots revealed sandy loam type of texture. This type of soil is supposed to be best for sugarcane cultivation and VAM colonization.[16] In the present investigation 20.5 to 3.5°C temperature range was recorded during different months of plant growth round the year. The maximum temperature for VAM population and root infection in sugarcane was found to be 30.5°C confirming the earlier work.[17,18] Generally, the low moisture content of soil supported good response for VAM population and root infection.[19,20] Maximum VAM population in soil and infection in root were recorded at 19.2% moisture level of soil. Soil was found slightly alkaline with narrow variation in pH range i.e. from 8.1 to 8.6. The VAM population in soil and infection in roots increased with the increase of soil pH. The direct correlation was observed between EC and spore population and root infection. No correlation was recorded between organic carbon, organic matter and

Table 2. Changes in chemical characterstics of soil during different phases of *Saccharum officinarum* growth in relation to VAM infestation in soil and infection in roots.

Parameters	Control	Changes in soil characteristics after growth of			
	Initial soil	3 months (July)	6 months (October)	9 months (January)	12 months (April)
VAM Spores/100 g soil	195	325	240	125	205
Root Infection(%)	64	88	68	44	65
pH	8.2	8.6	8.5	8.1	8.2
E.C.(m moh/cm)	0.45	0.65	0.54	0.52	0.43
Organic Carbon(%)	1.08	1.18	1.22	1.35	0.99
Organic Matter(%)	1.85	2.02	2.10	2.32	1.70
Available Nitrogen(Kg/ha)	174.0	167.0	170.0	195.0	174.0
Available Phosphorus (ppm)	10.6	8.4	13.5	14.7	10.3
Available Potash (ppm)	65.0	56.0	63.0	68.0	64.5

Value of correlation coefficient(r) of VAM spores with different parameters.

pH	EC	Organic carbon	Organic matter	Avl N	Avl P	Avl K
+0.930	+0.625	-0.296	-0.350	+0.904	-0.720	-0.960

spore production and root colonization. Generally, moderate organic carbon and organic matter were found suitable for VAM colonization. Available N P K contents in soil did not exhibit well marked impact on VAM sporulation and root colonization. But available P and K showed direct correlation with spore production and root colonization. Several workers[21-24] also recorded negative effect of N P K in pot experiment.

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