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Research Article

PHYSICAL CHEMICAL ANALYSIS OF THE RHIZOSPHERIC SOIL OF *PHOENIX DACTYLIFERA* L. IN SEMI-ARID REGIONS OF JAIPUR DISTRICT.

***Ameeta Sharma[1], Neha Gheek Batra[2] and Honey Sharma[3]**
[1,2,3]Department of Biotechnology, ICG - The IIS University, Jaipur, Rajasthan, India.

*Corresponding Author: Ameeta Sharma; Email: ameeta141@yahoo.com

Abstract: In order to study relationship between physical chemical properties of soil and occurrence of vesicular arbuscular mycorrhizal fungi (VAMF) in date palm (*Phoenix dactylifera* L.) rhizosphere, the present study was undertaken in semi-arid regions of Jaipur district at fifteen sites with naturally occurring abundant date palm trees. To study the physical chemical properties of soil, eight soil parameters having effect on VAM fungi occurrence were selected viz., pH, Organic matter, Organic Carbon, Phosphorus, Texture, Electrical Conductivity, Bulk Density and Pore space. The results showed quite variation in all parameters at different sites under study.

Key words: Physical chemical analysis, soil, date palm, VAM fungi.

INTRODUCTION:

In any study, analysis of soil parameters can provide important information for making the most use of available nutrients to enhance agricultural productivity. An available data on soil's physical chemical properties provided by long-term soil analysis is helpful for finding the effectiveness of bio-fertilizer management practices in maintaining soil fertility and productivity for sustainable agricultural. Soil analysis and testing is a useful method for studying, indentifying and solving the problems related to plant[1]. As the nutrient requirement of all plant and fungi differs so by physical chemical analysis one can determine whether the soil is suitable for the growth of specific fungi or plant. Physical chemical analysis is an important criterion as by this one can determine and analyze the content, composition and other feature like pH, acidity, bulk density and electrical conductivity. The methods and procedures used to analyze the soil parameters varies depending upon the chemical properties of soil.

A large number of studies have been conducted in the past on physical chemical parameters of the soil, keeping in mind its importance in research studies related to invasion of pathogen and nutrient status management to enhance crop productivity. In a study conducted on modifications associated with urban infrastructure, it was found that various soil properties like soil bulk density, microbial biomass and activity, and organic matter were impacted by anthropogenic activities. Time, of the soil forming factors, played the most important role in soil[2]. The physical properties such as bulk density and total porosity in soil were improved after the addition of vermin-compost as it had positive effects on the soil chemical, physical properties[3]. So one could easily understand the importance of analyzing soil properties as it harbors beneficial microorganism, harmful pathogens and essential nutrients. Soil chemical testing, on its own, is able to diagnose a specific activity. Better characterization of soil properties in coming years would improve the use of soil testing. Similarly an attempt was made earlier to analyze the correlation between the physical and chemical factors of soil with the distribution of VAM fungi under different Agroecological condition in Amravati district[4].

VAM Fungi has wide vital roles in several ecological and microbiological processes, effecting soil fertility, cycling and decomposition of organic matter, as well as plant nutrition status. Moreover, variation in the population of these fungi and their symbiosis with plant roots is related to host plant as well as soil properties. The occurrence of VAMF in different ecological regions and their relations to soil properties and local plants have been investigated earlier. There is restricted knowledge about soil parameters of palms rhizosphere in arid and semi-arid soils. Thus this study was carried out to study physical and chemical properties of soil with date palms rhizosphere in the arid and semi-arid regions of Jaipur district. Date palm trees are important component of the arid ecosystem as they guard the surrounding vegetation against desert effects and provide adequate microclimate to the under storey crops. Keeping this in mind, for analyzing correlation between VAM fungi occurrence and soil properties the present investigation of studying soil's physico-chemical properties was undertaken which can form basis for various studies related to VA mycorrhizal associations with date palms in arid and semi arid zones.

MATERIALS AND METHODS:

To know about the physico-chemical properties of rhizospheric soil, samples were collected from a particular Tordi region where Date palms naturally grew. Eight soil parameters were selected keeping in mind our crop of interest and research study. The methodologies which were used in present study for analyzing different parameters of soil are as follows:

(i) **Soil Sample analysis for studying pH parameter.**
pH is the measurement of hydrogen ions in soil and it indicates whether the soil is acidic, basic or neutral. It is defined as logarithm to the base 10 of the reciprocal of hydrogen ion concentration. The growth of plant is affected by both very low and very high pH of soil. For this experiment pH meter was used to identify the pH of the soil. The most acceptable pH range for plants is 5.2 to 7. This range of pH may vary according to the host plant.

(ii) **Soil sample analysis for studying Bulk Density parameter:**
Soil matter contained in a unit volume of the soil sample is called its Bulk density. Bulk density of soil is quite variable as it depends on the texture, structure, and organic matter status of the soil. High organic matter allows the bulk density, while compaction enhances the bulk density. In present study the bulk density of the soil sample the methodology was opted in which weight (after heating and drying at 105˚c for 24 hours) of a known volume of soil sample was determined and the mass per unit volume was calculated.

(iii) **Soil sample analysis for studying Electrical conductivity (EC) parameter.**
The measurements of EC can be directly related to soluble salts conc. of soil at any particular temperature. 20 gm of soil was shaken intermittently with 40 ml of distilled water in 150 ml conical flask for 1 hour and allowed to stand. The conductivity of the supernatant liquid was measured with the help of a conductivity meter.

(iv) Soil sample analysis for studying Organic Carbon (OC) parameter.
Organic carbon is present in the organic form in the cells of plants, animals and microorganisms which are present at various stages of decomposition. The humus gets oxidized by potassium dichromate with concentrated H_2SO^4. The un-reacted dichromate is determined by the back titration with ferrous sulfate. So by sufficient drying of soil Fe^{2+} will be oxidized to Fe^{3+} and organic carbon is estimated accurately.

(v) **Soil Sample analysis for studying Organic Carbon (OC) parameter.**
The organic matter content influences numerous soil properties like capacity of soil to supply S, N, P and trace elements, colour, infiltration, retention of water; degree of aggregation, structure, cation exchange capacity etc. The (OM) content of soil may be indirectly estimated through multiplication of organic carbon (OC) concentration by the ratio of OM to OC commonly found in the soil. The factor is 1.724. i.e., if OC is 1%, then OM= 1.724 %. The ignition of soil at high temperature gives quantitative value of OM, bur inorganic constituents of soil, chiefly the hydrated alumino-silicates, loose structural water, and carbonate minerals are decomposed, upon heating, thus resulting in weight losses and considerably in excess of actual organic matter content. However, if the soil id pretreated with a mixture of HCl and HF to remove the hydrated mineral water, loss on ignition gives a valid estimate of organic content of the soil.

(vi) Soil Sample analysis for studying Pore size parameter
The pore size of a soil is that portion of the soil volume which is occupied by air and water. % of pore space when added to % of solid space gives 100%. Hence % of pore space was calculated by subtracting % of solid space from 100%. Calculation for the individual soil samples were done by applying the suitable formulae.

(vii) Soil Sample Analysis for Studying Phosphorus content
Phosphorus is a second key nutrient found in the soil. The total-P in soil found between 0.02 to 0.10 % by weight. Extraction was done with suitable reagents according to specified soil to solution ratio and time of shaking. In the filtered extract, phosphorus was estimated colorimetric ally by adding ammonium molybdate and thereafter reducing the molybdenum phosphate complex in acidic medium. The Mo- blue method is most sensitive and, as a result is widely used for soil extract containing small amount of P. This method is based on the principle that in an acidic molybdate solution containing orthophosphate ions, a phosphorus-molybdate complex is formed that can be reduced by $SnCl_2$ and other reducing agents to a Mo- blue color. The intensity of blue color on reduction provides a measure of the concentration of P in the test solution. The procedure followed to calculate the phosphorus parameter was Olsen's Method[5].

(viii) Soil Sample analysis for studying Texture of soil:
The relative proportion of sand, silt and clay in a particular soil is determined by texture analysis. The sand fraction can also be broken into coarse, medium and fine sand. The analysis was done through Gyratory Sieve Shaker. This sieve shaker has 7 sieves of 6 or 8 inches in diameter and a motor immersed in oil to drive. The analysis of soil is done through the different gradation of sieves. Analysis of soil texture was done by using USDA textural classification chart.

RESULT AND DISCUSSION:
The analyses of soils' physical and chemical characteristics (Table.1) taken from rhizosphere of date palm trees grown at different sites have shown varied results.

Table 1: Analysis of Physical Chemical Properties of Soil from date palm rhizosphere.

S.no	Location	Bulk Density	Pore size	Organic Carbon	Organic Matter	Phosphorus	pH	Electrical Conductivity	Texture
1.	Tordi	0.147	94.41	0.34	2.00	25.00	5.69	5.9	Sandy loam
2.	Bhagwanpura	0.148	94.52	0.31	3.47	52.00	6.25	3.23	Sandy loam
3.	Chandsen	0.154	94.51	0.77	0.48	154.11	5.97	6.63	Sandy loam
4.	Diggi	0.146	94.51	1.74	0.54	59.13	5.71	0.39	Silt loam
5.	Chaprana	0.152	94.41	0.31	3.20	147.84	6.17	2.63	Silt loam
6.	Ambapura	0.143	94.4	1.74	1.85	120.64	6.55	0.58	Silt loam
7.	More	0.159	94.61	1.07	3.00	23.00	6.34	1.16	Silt loam
8.	Kukad	0.141	94.47	1.47	2.33	154.11	5.34	0.97	Silt loam
9.	Rupayali	0.145	94.5	1.74	2	112.44	7.36	3.43	Silt loam
10.	Pagdi	0.144	94.46	1.54	1.36	106.62	6.45	0.21	Silt loam
11.	Ganwar	0.148	94.5	0.78	0.54	109.32	7.17	0.83	Sandy loam
12.	Pachewar	0.145	94.41	0.12	1.57	88.64	6.63	0.86	Silt loam
13.	Parli	0.146	93.99	0.91	0.16	146.94	7.22	0.48	Silt loam
14.	Sewa	0.146	94.34	0.63	1.84	72.26	6.22	0.62	Sandy loam
15.	Avikanagar	0.144	94.35	0.04	2.21	166.65	5.55	0.39	Sandy loam

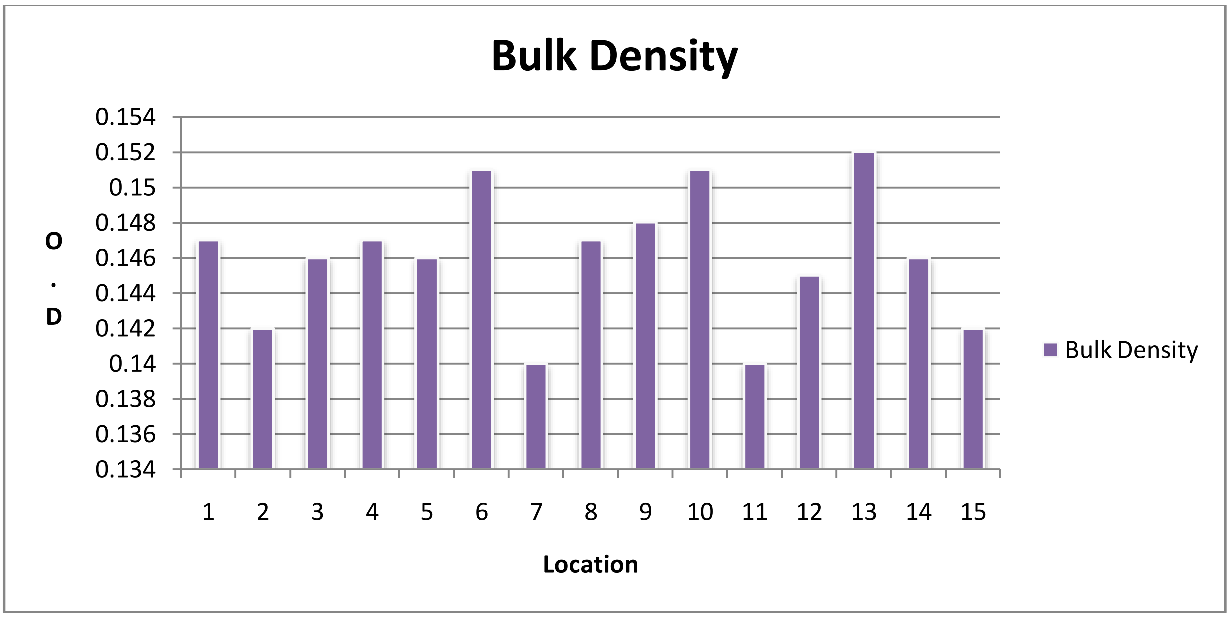

Figure 1. Graph for Bulk Density of soil samples

The results showed quite variation at different sites under study. The highest bulk density was found at the site No. 13 i.e. 0.16, followed by 10 and then 6. However the sites 1, 2, 3, 4, 5, 8, 9, 10, 12 and 13 did not show much variation among them and their value was between 0.145-0.150. The least bulk density was reported at site 7 and 11. After overall evaluation it was found that there was significant variation ranging from 0.135 to 0.152. (Figure 1)

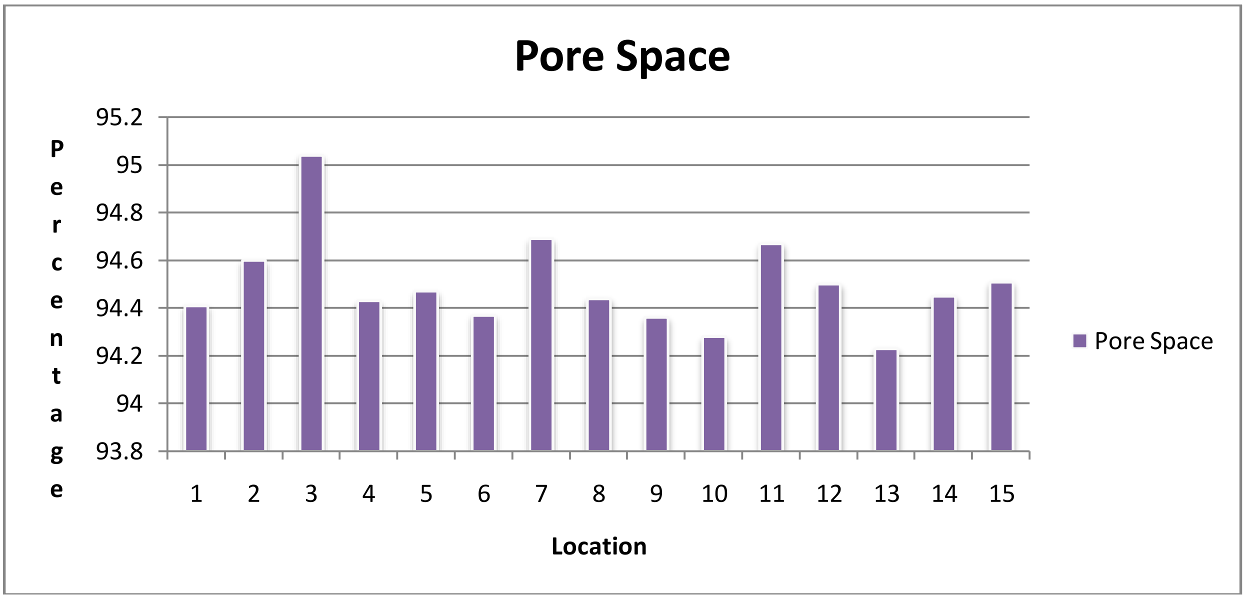

Figure 2. Graph for Pore size of soil samples

The results again showed variations at different sites under study .The highest Pore size was found at the site No. 2 i.e. 95%, followed by 12 and then 7. However the sites 1, 2, 3, 4, 5, 8, 9, 10, 12, 14 and 15 did not show much variation among them and their value was approximately 94.50%. The least Pore size was reported at site 10 and 13. After overall evaluation it was found that there was significant variation ranging from 94.00% -94.50%. (Figure 2)

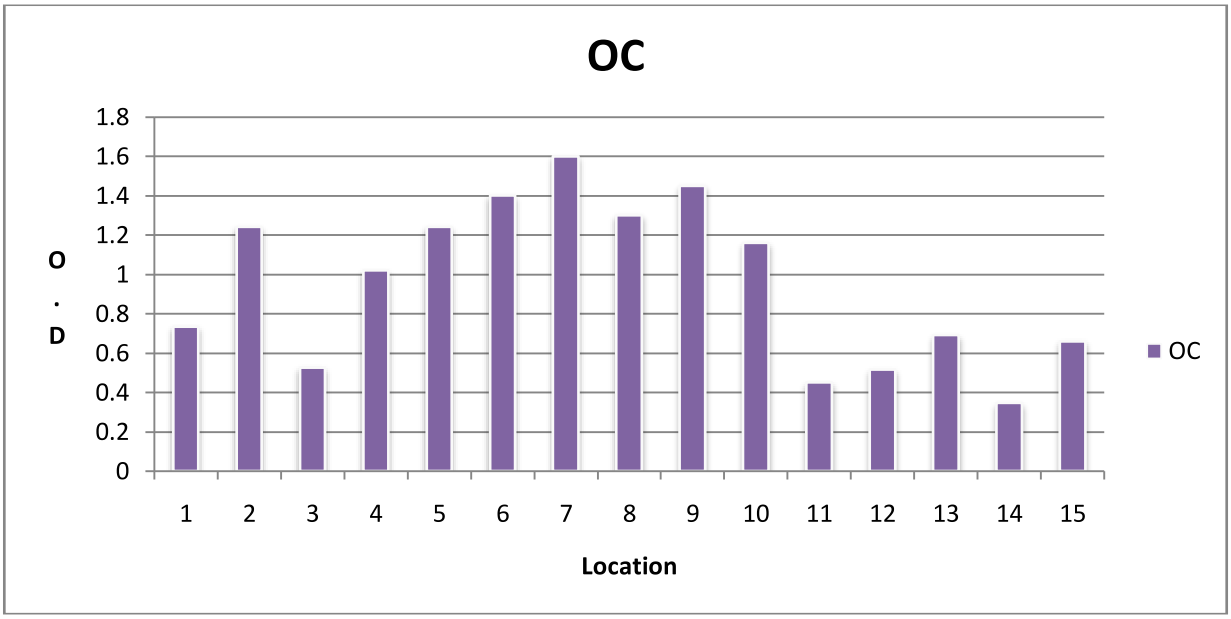

Figure 3. Graph for Organic Carbon of Soil samples

The highest Organic carbon content was found at the site no. 2 i.e. 0.16, followed by 4 and then 5. However the sites 1, 7, 12, 13 and 14 did not show much variation among them and their value lied between 1 -1.5%. The least bulk density was reported at site no. 15 followed by 12 which in turn followed by 1, 4 and 5. After overall evaluation it was found that there was high significant variation ranging from 0.04 to 2.00. (Figure 3)

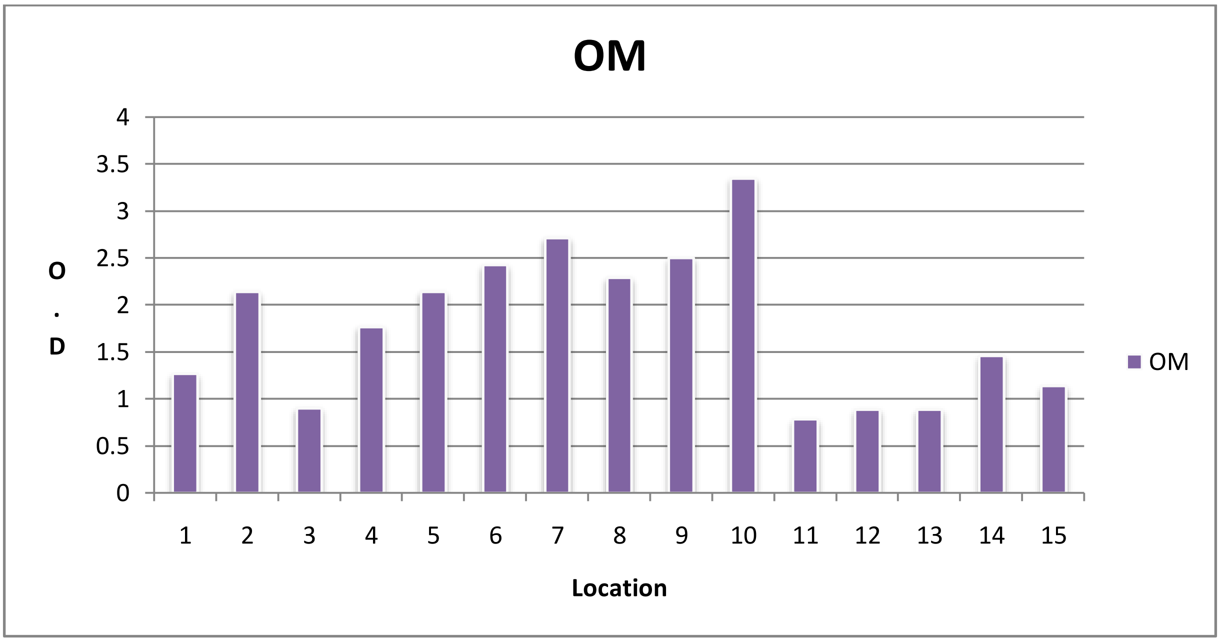

Figure 4. Graph for Organic Matter of soil samples

The highest Organic Matter content was found at the site No. 2 i.e. 3.50%, followed by 5 and then 4. However the sites 1, 2, 3, 10, 12, 13, 14 and 15 did not show much variation among them and their value lied between 1-1.50%. The least bulk density was reported at site 1, 3, 4, 15, 13, and 12. After overall evaluation we can say that there was significant variation ranging from 0.04 to 3.50% (Figure 4)

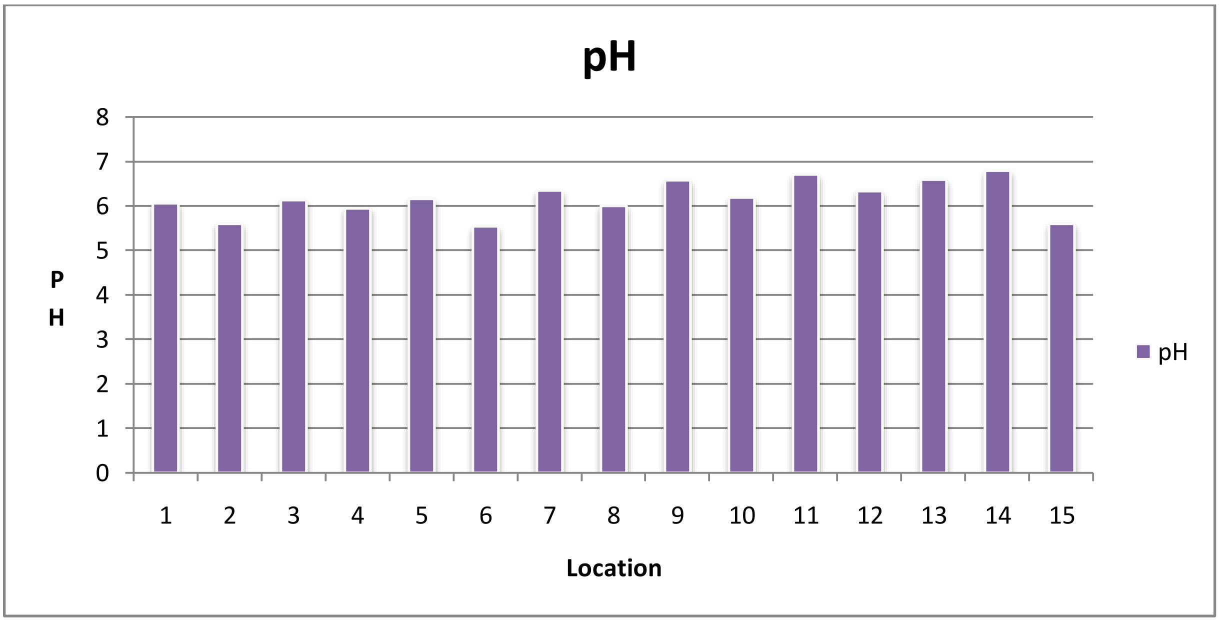

Figure 5. Graph for pH of soils samples

The highest pH was found at the site No. 9, 10, 13 and 14 i.e. approx 7. However the sites 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13 and 15 did not show much variation among them and their value laid approx at 6. The least pH was reported at site 6 i.e. 2.3. After evaluation it was found that there was significant variation ranging from 2.3 to 7 (Figure 5).

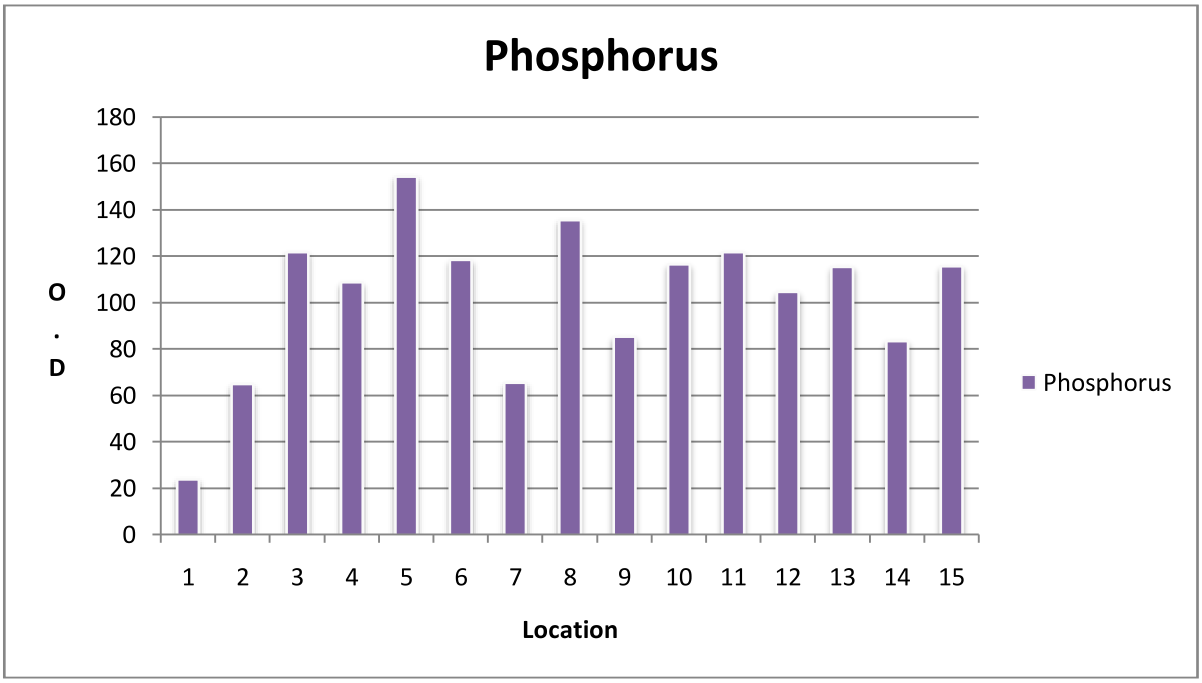

Figure 6. Graph for Phosphorus Content of Soil samples

The highest phosphorus content was found at the site No. 4, 6, 8 and 15. However the sites 6, 7, 8, 9 and 10 and 13 did not show much variation among them and their value lied between 100 to 20 gm. The least phosphorus content was reported at site 1 and 7. There was significant variation ranging from 20 to 163 (Figure 6)

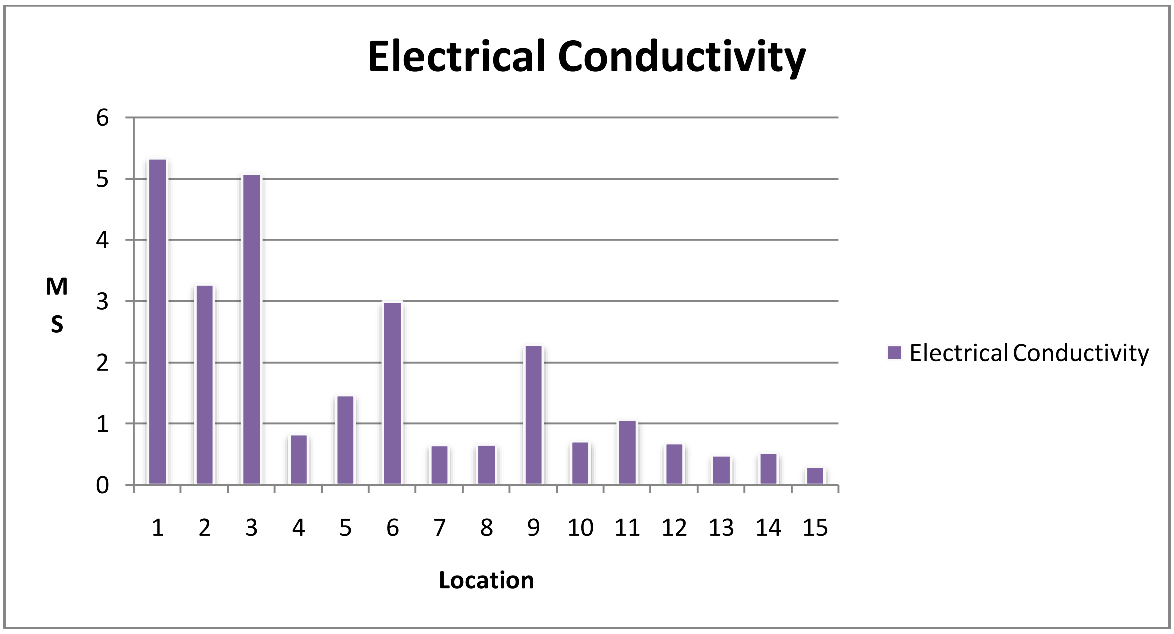

Figure 7. Graph of the electrical conductivity of the soil samples

The highest EC was found at the site No. 1, 3, 6 and 9. However the sites 1, 2, 3, 4, 5, 8, 9, 10, 12 and 13 did not show much variation among them and their value lied between 0.145-0.150. The least EC was reported at site 4, 5, 7, 8, 10 and 15. There was significant variation ranging from 0.8 to 6.8 (Figure 7). These are in accordance with findings on date palm in Morocco[6] and other researchers[7, 8.]

In present study one way ANOVA (Analysis of Variance) was applied and it expressed significant variation in three parameters of the soil. These parameters were Electrical conductivity, Organic Carbon and Organic Matter. Later Post Hoc was applied in order to know about the significant variations between these three parameters within a locality i.e. how much significant variation is shown by one parameter of a particular locality with the same parameter of 14 other localities. Results of Organic Carbon content of soil sample collected from different sites showed that Locality 1 was showing significant variation with locality 6, 8 and 9. Locality 2 was not showing significant variation with any other locality. Locality 3 was showing significant variation with locality 6 and 8. Locality 4 was showing significant variation with locality 6, 8 and 9. Locality 5 was showing significant variation with locality 6, 8, 9 and 10. Locality 6 was showing significant variation with locality 1, 3, 4 and 5. Locality 7 was showing significant variation with locality 3. Locality 8 was showing significant variation with locality 1, 3, 4 and 5. Locality 9 was showing significant variation with locality 1, 3, 4 and 5. Locality 10 was showing significant variation with locality 3 and 5. Locality 11, 12, 13, 14 and 15 were not showing significant variation with any other locality. Results of the Organic Matter of the soil sample collected from different sites showed that Locality 1 was showing significant variation with locality 6, 7 and 8. Locality 2 was not showing any significant variation with other localities. Locality 3 was showing significant variation with locality with 6, 7, 8, 9 and 10. Locality 4 was showing significant variation with locality 6 and 8. Locality 5 was showing significant variation with locality 6, 7, 8 and 9. Locality 6 was showing significant variation with locality 1, 3, 4 and 5. Locality 7 was showing significant variation with locality 3 and 5. Locality 8 was showing significant variation with locality1, 3, 4 and 5. Locality 9 was showing significant variation with locality 3 and 5. Locality 10 was showing significant variation with locality 3. Locality 11, 12, 13, 14 and 15 were not showing any significant variation with other localities. Results of the electrical Conductivity of the soil sample collected from the different sites showed No significant variations by any of the locality as reported earlier many times in different studies[9,10,11].

The result of Post Hoc analysis revealed Bulk Density was significantly inversely correlated to phosphorus. Phosphorus was significantly inversely correlated to Bulk density. Organic carbon was significantly positively correlated to Organic matter, but negatively significantly correlated with phosphorus. Organic matter was significantly positively correlated to Organic carbon, but negatively significantly correlated with phosphorus. The negative correlation was found between the available P and percentage of AMF root colonization, so adaptation of AM to low phosphorus soil was confirmed[12]. Phosphorus was negatively significantly correlated with Organic carbon, Organic matter and Electrical conductivity. pH was negatively significantly correlated with Electrical Conductivity. These results are in accordance with a study[13] which inferred that the differences between germination of spores of VAMF appeared to be negatively correlated with the differences in pH. Electrical conductivity was negatively significantly correlated with Phosphorus and pH. According to the previous study performed by various researchers[14,15]. It was concluded that the content of phosphorus in the soil is one of the determining factor for the development and presence of VAM fungi

The present study revealed physico-chemical characters of the soil having natural occurrence of VAM fungi in the rhizosphere of the date palms. One can utilize this data for deciding growth parameters for preparing VAM inoculums. Wide AM fungal diversity in the rhizosphere of date palms was also found and it could be a better inoculant for mass multiplication which could be used for commercial date palm production.

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