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Analysis of Physico chemical properties of soil from Groundnut crop fields in Central Dry Zone of Davanagere District, Karnataka

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Abstract

Assessment of physico-chemical parameters in soil samples are collected from three Groundnut (*Arachis hypogaea* L.) crop fields in central dry zone (Jagaluru, Davanagere & Harihara) of Davanagere district was studied. The soil characterization was carried out for physical parameters like soil colour was determined by visual observation and particle size distribution of soil samples were analysed by International pipette method and the chemical parameters were analysed by using standard procedures. The results obtained showed that concentration of physico-chemical parameters varied in different soil samples. Statistical test of significance using Pearson correlation revealed that there are significant differences at ($r > 0.05$ and < 0.01) between the values of physico-chemical parameters in soil samples obtained from all the sampling sites of Ground nut field. This soil study is considered as a good source of soil nutrient management and this information will help farmers to solve the problems related to soil nutrients and amount of which fertilizer to be used for the increasing the effective growth of the groundnut crop.

Soil is a thin layer on the surface of earth and it constitutes the minerals, organic matter gases, decaying plant and animal matter etc. Soil play a crucial role in delivering a variety of ecosystem it also act as a medium that can supports plant growth and it modulates water, nutrients and pollutant transport[15]. At microscopic level it performs the ecological important function is that help in sustaining a diverse and dynamic microbial activity. Soil characterization is to evaluate the fertility status of the soils of an area or region is an important aspect in context of sustainable agricultural production. The Productivity of agricultural soil depends largely on its physicochemical properties. The soil condition is important because it is a universal medium for plant growth, which supplies essential nutrients to the plants. The several elements known to be essential for plant growth, macronutrients (N, P, and K) and micronutrients (Zn, Fe, Cu, and Mn) are an important soil element that controls the soil fertility[16]. Oil seed crops generally are one of the most

important crops in the world. The oil seeds are energy rich crops, grown generally under the energy-starved conditions. Oil seeds show good response to both major nutrients and micronutrients. Groundnuts (*Arachis hypogaea* L.) are known as Peanuts and are related to the Leguminosae family. Groundnuts arc considered an important source of oil, folate, antioxidants, protein, and essential fatty acids (linoleic)[8]. Peanut seeds contain about 44 to 56% oil, 22 to 30% protein, and 9.5 to 19.0% carbohydrate as dry weight[10]. In addition, it is a good source of minerals (phosphorus, calcium, magnesium, and potassium) and vitamins (E, K, and B group).

The study of soil physicochemical parameters is an important for plant growth and soil management. The Physicochemical properties such as p^H, Moisture content, Electrical conductivity, and Micro and macro nutrients in the soil were analysed. The investigation is undertaken because Davanagere is comprises different agro climatic zone and it is the most agreeable and healthy climatic condition for growing the crops. In Davanagere district now a day, large number of fertilizers are used instead of manures due to this the crop productivity increases speedily but the quality of the soil decreases. So it is essential to analyse the physicochemical characteristics of soil because as with the increasing use of chemical fertilizer to the soil. Therefore, the present study was under taken to know the physicochemical parameters of soils used for cultivation of Ground nut in Davanagere district and an attempt was also made to correlate nutrient contents of the soils with other soil properties.

The Study Area :

Davanagere district is an agricultural and food treasury of Karnataka state located in central part of Northern Karnataka. It is the heart of Karnataka. Total area of district is 54, 98,397 sq.km. It lies in 13° 45(00" N and 14° 5600"14 latitude and 75° 3000" E and 76° 3000" E longitude. The district occupies the total geographical area 5913.4 sq.km. Davanagere district which consist of 2 different agro climatic zones three taluks are **Central dry Zone** (Davangere, Harihara and Jagaluru) and the two taluks are **Southern Transition Zone** (Honnali and Chennagiri). It consists of hot humid monsoon type of climate; the annual rainfall is 637mm and the temperatures ranges from 43°C, depending upon the climatic season. We have chosen **Central dry Zone (Zone no. 4)** of three taluks for the Physico-chemical parameter analysis of soil samples are collected from the Groundnut crop fields.

Sample Collection :

Groundnut crop field soil samples were randomly collected in the region of Jagaluru, Harihara and Davangere, Central dry Zone (Zone no. 4) Soil samples were collected by using spade and then dig a “V” shaped furrow to a depth of (6 inches) and then cut a uniform slice and collected the bottom in the depth of 22 cm of the soil place in a bucket. Similarly, collected soil samples at all 4-5 spots in groundnut field. The collected soil samples by following quartering technique reduce the bulk of soil samples. Spread the sample on clean polythene sheet in circular manner after thoroughly mixing. Break the clods and remove the roots pebbles and then divide the soil into four quarters, reject the two opposite quarters

and mix the remaining two quarters and spread in a circular manner again. Repeat this procedure until desired sample size of 500g of soil is left. Then the soil put in to a clean zip locked polythene bags with proper labelling and transported through the laboratory[15,16]. The collected soils samples along with locations showed in table-1.

Sample preparation :

The collected soil samples were taken to the laboratory and air dried by placing soil on filter paper on a steel mesh. Stones and debris were removed from the soil samples. The samples were ground, passed through 2-mm sieve and stored in new clean polythene bags until further analysed in the laboratory for various physico-chemical parameters[12].

Analysis of Physicochemical parameter :

The physical parameters such as soil colour was analysed by visual method and particle size distribution of soil samples were determined by International pipette method. The processed soil samples were analysed for basic soil chemical parameters pH was measured in 1:2:5 soil water suspension using p^H meter[2] and EC (dS/m^{-1}) was measured in the supernatant solution of 1:2.5 soil water extract using Conductivity Bridge. Organic Carbon was estimated by Walkley and Black's wet oxidation method. Macronutrients are analysed (N, P and K) by using standard procedures. The available nitrogen content of the soil was estimated by alkaline potassium permanganate method (Subbaiah and Asija, 1956). Available phosphorus was estimated by Olsen's method (Olsen, *et al*., 1954). The Potassium was analysed by using flame photometric method[7]. The available micro-nutrients (Fe, Mn, Cu and Zn) in soil samples were extracted with a DTPA solution (0.005M DTPA + 0.01 M CaCl2 + 0.1 Mtriethano-lamine, pH 7.3) as outlined by Lindsay and Norvell[3,16]. The concentration of micronutrients in the extract was determined by atomic absorption spectrophotometer.

Table -1

Sl. no	Sample No.	Taluk	Location
1	Sample-1	Jagaluru	Akanuru
2	Sample-2	Davangere	Aluru
3	Sample-3	Harihara	Ekkegondi

Collection of soil samples from groundnut crop fields at Central dry Zone of Davangere District.

Physicochemical Parameter Analysis :

The data on particle site distribution is presented in Table 2. It was observed that sand was the dominant fraction in soils of Jagaluru taluk, which varied from 80, 84 & 86 (Table 2) per cent in groundnut crop field soils, respectively. The silt content is higher in the soils of Harihara taluk ranged from 2, 4 & 14 per cent of soils respectively. Clay content was higher in the soils of Davanagere Taluk varied from 6, 10 & 14 per cent respectively (Fig. 1). The groundnut growing soils are energy starved conditions, the soil texture varied from sandy clay loam, loamy sand & sandy loam with sand as the dominant mineral fraction. These wide variations in soil texture may be due to differences in parent material, physiography, in-situ weathering and translocation of clay[3].

The increase in clay content with depth might be attributed to the intensive tillage operations, which make finer particles to move down leaving behind the coarser particles on the surface[4].

Data Analysis: Pearson Correlation was used for the significance determination of results and the level was adjusted at 0.05, results were said to be significant as their.

Soil p^H :

p^H is a measure of hydrogen ion activity in the soil solution. It expresses the acidity and alkalinity of the soil and is a primary factor in plant growth. p^H is very important property of soil it determines the availability of nutrients, microbial activity and physical condition of the soil. Soil pH values in the three areas ranges from 6.8, 7.0 and 7.3. The lower pH was observed in Harihara taluk and higher p^H in Jagaluru taluk. The soils studied from the ground nut crop fields were neutral and moderately alkaline. Statistical test of significance using Pearson correlation revealed Correlation is significant at the 0.01 level (2-tailed) between the values of pH in the soil samples obtained from the three areas. The neutral to alkaline may be attributed to the reaction of applied fertilizer material with soil colloids, which resulted in the reaction of basic cation on the exchangeable complex of the soil[18].

Electrical conductivity Electrical Conductivity (EC) :

Electrical Conductivity expresses the ion contents of solution which determine the current carrying capacity thus giving a clear idea of the soluble salts present in the soil. Electrical conductivity values ranges from 0.37, 0.47 & 0.38 (dS/m^{-1}). The electrical conductivity of Davangere taluk soil is high as compared to the other two taluks which may due to excess use of fertilizer like P and K. According to Wagh *et al* 2013 Soil with EC below 0.4 (dS/m^{-1}) are considered marginally or non-saline soils while above 0.8 (dS/m^{-1}) are considered severely saline. The soils under analysis were non-saline. Statistical test of significance using Pearson correlation revealed that the Correlation is significant at the 0.01 level (2-tailed) between the values of EC in the soil samples obtained from the three areas. The difference in the EC values could be attributed to differences in the soluble salt content of the soils[12].

Organic Carbon :

The organic carbon content is medium to high in all three soil samples, this might be due to continuous cultivation, different management practices adopted by the farmers because these groundnut crop fields are started yielding at higher quantity. Higher organic content (0.24%) was recorded in Jagaluru taluk and low organic content (0.06) in Harihara taluk. According to Patil and Ananthacharayan (1990) the medium to high organic carbon status in the soil attributed to good vegetative growth and consequent addition of organic matter to soil. Low organic carbon in the soil was due to low input of FYM and residues[9,10].

Relationship between pH, EC, OC and Macronutrients (N, P & K) status of soil :

Nitrogen :

The nitrogen requirement of groundnut

is much higher than cereals because of its high protein content. The groundnut is capable of meeting its nitrogen requirements both from symbiotic nitrogen fixation (60-80%) by root nodules and soil nitrogen (20-40%). Low nitrogen status in the soils could be due to low amount of organic carbon in the soil. Since most of the soil present in organic form, this relationship was observed. Available nitrogen was positive correlation in sample 2 and sample 3 (r = 0.982) and negative correlation in sample 1 (r = -0.914) with (Fig, 2, 3& 4). In sample 1 is negative correlation (r = -0.225) with EC & OC. In sample 2 which shows the very significant positive correlation (r = 1.000**) with EC & OC (r = 1.000). In sample 3 positive correlation with EC (r = 0.982) & less positive correlation with OC (r =189). According to Kvien during reproductive stage of Groundnut plant N is mobilized continuously from leaves to the developing pods. Application of 10-20 kg N/ha has been found optimum to get better response. Application of higher dose of nitrogen may reduce nodule number and nodule growth and thus adversely affects the nitrogen fixation capacity[21].

Phosphorus :

Phosphorus is most indispensable mineral nutrient for legume crop as it helps in better root growth and development and thereby making them more efficient in biological nitrogen fixation. The available phosphorus is less positively correlated in sample 2 (r = 0.143) and sample 3 (r = -0.945) and sample 1 negatively correlated (r= -0.189) with p^H. In sample 1 which shows the significant positive correlation (r = - 1.000**) with EC & OC. In sample 2 (r 0.327) positive correlation with EC & negative correlation with OC (r= -0.945). In sample 3 positive correlation with EC (r = 0.945) & OC (r = 0.327) (Fig, 2, 3& 4). According to Singh Indian soils where groundnut is grown are either deficient in P or having medium P due to its fixation and low availability in the soil. Phosphorus is very critical at flowering and pod formation stages of groundnut crop and its application increased the modulation, N2-fixation and N contents of the kernel and foliage[4].

Potassium :

Potassium (K) is an essential nutrient and plays an important role in the growth of plants, synthesis of amino acids and proteins. The available potassium is very significant positive correlation in sample 3, (r = 1.000**) positive correlation in sample 2(r = 0.945) and less negatively correlated in sample 1 (r = -0.500) with p^H. In Sample 1 (Fig: 2) shows the positive correlation with EC & OC (r = 0.945). Sample 2 indicates the less positive correlation with EC (r = 0.866) and OC is (r = 0.500). Sample 3 shows the very positive significant correlation with EC & OC (r = 1.000**). Lombin and Singh reported that K application caused increase in K content of haulm and N content of kernels of groundnut[11].

Relationship between pH, EC, OC and Micronutrients (Cu, Zn, Fe and Mn) status of soil :

Copper and Zinc :

Copper plays an important role in protein and carbohydrate metabolism and nitrogen fixation. Zinc is also involved in many

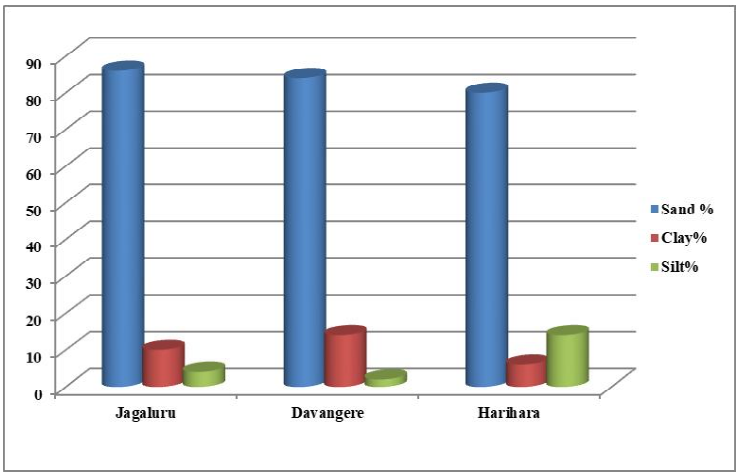
enzyme systems. The available Copper is less negatively correlated in sample 2 and sample 3 (r = -0.189) and sample 1 is(r = -0.500) with p^H. The Electrical conductivity is very positively significant correlation in sample 1 and sample 3 (r = 1.000**). The OC is very positive significant correlation in sample 1 (r = 1.000**) negative correlation in sample 2 (r = -1.000**) and the available Zinc is very less positive correlation in sample 1 (r = 0.189), Sample 2 & 3 Very less negative correlation in sample 2 & 3 (r = -0.189 and r = -0.500) with p^H. The EC is very negative significant correlation in sample 1 (r = -1.000**) & less negative correlation in sample 3 (r = -0.500) there is no correlation in the sample 2 with EC. The OC is very negative significant correlation in sample l&2 (r -1.000.) and positive correlation in sample 3 (r - 0.866) (Tables, 2, 3 & 4).

Iron and Manganese :

Iron is the fourth most abundant clement in the earth crust and soil, still its deficiency is most widespread in the world mainly due to its availability in root zone rather than abundance. The available Fe is positive correlation of in Sample 1 (r = 0.929), Sample 2 (r = 0.327) & Sample 3 (r = 0.500). The EC & OC is less positive correlation in sample 1 (r = 0.189). The EC is positive correlation in sample 2 & 3 (r = 0.500). The OC is negative correlation in sample 2 & 3 (r = -0.866). According to Vose in groundnut, the Fe-deficiency is most severe when grown on calcareous and alkaline soils. The Fe deficiency also limits nodule development in groundnut grown in calcareous soil. In plant system the oxidation reduction process, photosynthesis and oxygen evolution are governed mainly by manganese. Several enzymes activated by Mn and Mg. The photosynthesis and regulation of IAA are the highly Mn specific. The available Mn is varied from region to region (Fig-1, 2 &3). In sample 1 & 2 (r = -0.655) Mn is negative correlation with the In In sample 3 (r = 0.500) shows the less positive correlation with p^H. EC & OC positive correlation in sample 1 (r = 0.866). EC & OC is less negative correlation in sample 2 (EC, r = -0.500 & OC, r = -0.866) and sample 3 shows the less positive correlation (r = 0.500) with EC & OC (r = 0.866). The Mn deficiency is a problem of high p^H soil and the Mn content are inversely related to Ca and Mg levels, but in groundnut the Mn deficiency is also reported on soil p^H as low as 5.8. The calcareous soils are Mn deficient owing to immobilization as insoluble Mn02 at high p^H.

Table – 2. Physico-Chemical Parameter Analysis of Soil Sample

Taluk	Soil Type	Soil Colour	Particle size Distribution		
			Sand %	Clay%	Silt %
Jagaluru	Sandy Clay Loam	Blackish Brown	86	10	4
Davangere	Loamy Sand	Light Brown	84	14	2
Harihara	Sandy Loam	Red	80	6	14



(Fig. 1)

Jagaluru (Sample-1) (Table-2)

	p^H	EC	OC	N	P	K	Cu	Zn	Fe	Mn
p^H	1									
EC	-0.189	1								
OC	-0.189	1.000**	1							
N	-0.914	-0.225	-0.225	1						
P	-0.189	1.000**	1.000**	-0.225	1					
K	-0.500	0.945	0.945	0.106	0.945	1				
Cu	-0.189	1.000**	1.000**	-0.225	1.000**	0.945	1			
Zn	0.189	-1.000**	-1.000**	0.225	-1.000**	-0.945	-1.000**	1		
Fe	0.929	0.189	0.189	-0.999*	0.189	-0.143	0.189	-0.189	1	
Mn	-0.655	0.866	0.866	0.292	0.866	0.982	0.866	-0.866	-0.327	1

**.Correlation is significant at the 0.05 level (2-tailed)

Davangere (Sample-2) (Table-3)

	p^H	EC	OC	N	P	K	Cu	Zn	Fe	Mn
p^H	1									
EC	0.982	1								
OC	0.189	0.000	1							
N	0.982	1.000**	0.000	1						
P	0.143	0.327	-0.945	0.327	1					
K	0.945	0.866	0.500	0.866	-0.189	1				
Cu	-0.189	0.000	-1.000**	0.000	0.945	-0.500	1			
Zn	-0.189	0.000	-1.000**	0.000	0.945	-0.500	1.000**	1		
Fe	0.327	0.500	-0.866	0.500	0.982	0.000	0.866	0.866	1	
Mn	-0.655	-0.500	-0.866	-0.500	0.655	-0.866	0.866	0.866	0.500	1

**.Correlation is significant at the 0.01 level (2-tailed)

Harihara (Sample-3) (Table-4)

	p^H	EC	OC	N	P	K	Cu	Zn	Fe	Mn
p^H	1									
EC	1.000**	1								
OC	0.000	0.000	1							
N	0.982	0.982	0.189	1						
P	0.945	0.945	0.327	0.990	1					
K	1.000**	1.000**	0.000	0.982	0.945	1				
Cu	1.000**	1.000**	0.000	0.982	0.945	1.000**	1			
Zn	-0.500	-0.500	0.866	-0.327	-0.189	-0.500	-0.500	1		
Fe	0.500	0.500	-0.866	0.327	0.189	0.500	0.500	-1.000**	1	
Mn	0.500	0.500	0.866	0.655	0.756	0.500	0.500	0.500	-0.500	1

**.Correlation is significant at the 0.01 level (2-tailed)

The physicochemical characteristics of groundnut crop field soil in central dry zone of Davanagere district were analysed. In the present study, the three soil samples are belonging to Silt clay loam, Loamy sand & Sandy loam of textural class. The results indicate that the soil p" is neutral to slightly alkaline and it is one of the major factors affecting mobility/solubility of metals in soil. Electrical conductivity of the soils was non-saline, while the soils have an appreciable organic carbon level. The physicochemical study of parameters is important for plant growth and management. These studies give information about nature of soil, nutrient status of soil. This information will also help in farmers arrange the amount of which fertilizers and nutrients needed to soil fertility increases the percentage yield of the groundnut crop. It is concluded that the physicochemical analysis of soil samples under study shows different concentration of various parameters at different sites of Davangere district. Statistical test of significance using Pearson correlation revealed that there are significant differences at ($r > 0.05$ and < 0.01) between the values of physic-chemical parameters in soil samples obtained from all the sampling sites of Ground nut field.

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