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RESEARCH ARTICLE .....!!!

EVALUATION OF SOIL PARAMETERS FOR SOILS FROM JAYAMANGALAM, PERIYAKULAM AND AUNDIPATTY – A CASE STUDY

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KEYWORDS:

Salinity, fertilizers, Osmotic pressure, pH.

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ABSTRACT

Soil, water and air are integral parts of our natural environment. Soil is used in agriculture, where it serves as the primary nutrient base for plants. Man made threats to soil quality by means of improper cultivation, inadequate recycling of nutrients, and accumulation of salinity, acidic deposition and addition of toxic materials in all manners. In our country we have a large amount of agriculture land and the yield of the crops depend on the nature of the soil, its available nutrients, the type of fertilizers used and the pollutants, which are in the soil or which come from external sources. In this context, the present study takes up three different samples from three different villages from Theni District namely Jayamangalam, Periyakulam and Aundipatty, their contents are analyzed for the presence of various parameters such as soil pH, moisture content, salinity of soil, calcium, total salt concentration, osmotic pressure are carried out using the available methods which are already published and from the values, the suggestion are to be made for better yield of crops. The nutrient contents of these three samples are also compared in this study to get more insight on the nature of the soil, which will have the right type of parameters conducive for plant growth.

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INTRODUCTION:

Soil is the natural covering on most of the earth's land surface. Soil, in its traditional meaning, is the natural medium for the growth of land plants, whether or not it has developed discernible soil horizons. In this sense soil has a thickness that is determined by the depth of rooting of plants [1].The mineral constituents and the organic matter of soils are known major sources of plant nutrients. These nutrients in the soil are usually present in various degree of availability of plants. Available nutrients are those, which plants can readily take up. Their amounts are not closely related to the total nutrients of the soil [2]. For example, the total nutrients of a soil may be high whereas the amount of available nutrients is low for another [3]. Nutrient availability may vary seasonally with soil temperature and moisture conditions. Cool season crops may not get sufficient phosphorus or nitrogen, even where warm-season crops can [4].

Soil characteristics play major role in distribution of species. The types of plants present in an area have a great impact on the quality of the soil of that area as the plants and soil are strongly influenced by each other [5].The effective factors on establishment and growth of plant species were classified into two categories. The first group consisted of soil moisture and the second group belonged to soil fertility characteristics [6]. As the roots inhabit chiefly the upper soil layer and because all materials derived from plant shoots are deposited upon the surface, soil generally show a rapid decrease is organic matter from the surface downwards and away from the canopy cover [7]. Many soils do not have high degree of natural fertility for plant crops. The parent materials from which the soul was formed may have short of one or more essential elements. Soils of humid regions lose some of their nutrients by leaching [8]. Long period of cropping without the addition of nutrients can impoverish a soil. Soils of desert regions, when brought under irrigation, are frequently low in available nitrogen and phosphorous because of their low organic content [9]. Some of the productive soils of the world have been made so by the use of plant nutrients provided that soil texture allowed good root development and water storage capacity was adequate [10]. For more than a century, soil and plant scientists have been developing methods for determining the levels of plant scientists have been developing method for determining the levels of plant-available nutrients in soils. One of the first quick soil tests for 'active' (available) nutrients was that of Daubery in 1845. It involved extracting the soil with carbonated water [11].

The first known fertilizer recommendations based on a soil test were made by Dr.Bernard Duyer in 1894. He recommended that phosphate fertilizer be applied to soils releasing less than 0.01 % P_2O_5 (0.0044 % P) when extract with 1% citric acid. Since 1845 many extracting test solution have been suggested and tried. Some of the tests have been proved to be very successful inspite of the fact that

many different chemical forms of each nutrient occur in the soil, each having a different level of availability to plants. Research efforts in developing soil testing as useful guide to soil management have been extensive in soils and agronomy departments. In many places the soil is polluted and the soil pollution arises due to the leaching of wastes from landfills and the most common pollutant involved are the metals like copper, lead, cadmium, and mercury. The contamination of ground water and soil is the major environment risk related to unsanitary land filling of solid waste. Most of the atmospheric pollutants also comedown and settle on the ground surface causing soil pollution. Pollutants also settle on soil when polluted water is used for irrigation. Many pollutants are directly deposited on the soil namely sewage, industrial effluents and chemical fertilizer [12]. All soils contain some water-soluble salts, which include essential nutrients for plant growth. When the level of water-soluble salts exceeds a certain level, harmful effects on plant growth occur. Saline soil is the most common type of salt-affected soil and usually the easiest type of reclaim. Salt affected soils often result from the lateral or artesian flow of salty water on to an area. In other cases it is caused by an impermeable layer in the soil resulting in a high water table or side-hill seeps. In well-drained, irrigated soils the application of poor quality water in amounts insufficient to leach soluble salts from the surface horizons will result in salt accumulation.

As majority of agricultural species prefer approximately neutral pH levels, soils that are excessively acid or excessively alkaline cause reduced productivity. Lower or higher pH values can cause plant nutrient deficiencies (phosphorus, manganese, zinc, copper, iron, molybdenum) or elemental toxicities (aluminium, manganese), which have adverse effect on crop yield.

Considering the above-mentioned parameters, if the characteristics of the soil are conducive to the growth of the plants and crops, naturally the yield will be as expected. On the other hand, if the soil contains rocky area or unwanted chemicals, which are detrimental to the crops, it leads to heavy loss to the farmers and this will in turn affect the economy of the society.

Materials and Methods:

Sampling area:

Three sampling areas were selected in Theni District as given in Table (i).

Table (i) : Selection of monitoring areas in Theni District

Monitoring areas	Characteristics of sampling areas
Periyakulam	No cultivation is done so far
Jayamangalam	Periodically cultivated soil
Aundipatty	Periodically cultivated soil

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Soils from the Jayamangalam, Periyakulam and Aundipatty were selected for the present study. Periyakulam comprised of uncultivated soil whereas Jayamangalam and Aundipatty consisted of periodically cultivated soil.

SAMPLE COLLECTION

Preparation of soil extract

The soil sample was dried in air and 25gm of it was weighed and 50ml of 40% ethanol was added. It was shaken well and kept undistributed for ten minutes. It was filtered through filter paper and the soil suspension was washed with 40% ethanol and finally with absolute ethanol. The residue was taken in a beaker and 50ml of ammonium acetate was added. It was stirred and kept overnight. The supernant solution was filtered using filter paper. The filtrate was used for testing calcium.

Determination of soil pH

Principle

The pH value is a measure of hydrogen (or hydroxyl) ion activity of the soil-water system and indicates whether the soil is acidic, neutral or alkaline in reaction.

Procedure

pH was measured using a standardized pH meter. The pH was recorded as soil pH in water in accordance with R.G.Bates (1957) [13].

Electrical conductivity

Principle

Electrical conductivity of soil-water system arises due to the content of soluble salts in the soil giving rise to more of ion pairs on dissociation. Thus the measurement of electrical conductivity can be directly related to the soluble salts concentration of the soil at any particular temperature [14].

Procedure

20ml of soil saturation extract was taken in a beaker and the temperature was noted. Conductance was measured using conductivity cell of known cell constant as reported by J.H. Dane and G.C. TOPP (2002)[15].

Calculation

Electrical conductivity (EC) (mmhos/cm at 25°C) = EC of soil suspension (mmhos at 25°C) X Cell constant (K) at 25°C

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Soil moisture content

Principle

Soil moisture influences crop growth not only by affecting nutrient availability but also nutrient transformations and soil biological behavior. The moisture content in a soil sample is determined by drying a known quantity of sample in hot air oven at 105°C ± 2°C estimating the loss of weight.

Procedure

An empty weighing bottle with lid was dried in a hot air oven at 105°C for 15 minutes, cooled in a desiccators and weighed. The weighing bottle was filled about two third of its capacity with fresh sample. The lid was removed and kept in oven at 105°C for about eight hours. The weighing bottle was removed and cooled in desiccator. The weight was noted immediately as reported by V.O.Wasonga et al (2003) [16].

Calculation

$$\text{Moisture (\%)} = \frac{(c-a)x100}{(b-a)}$$

where,

a=weight of empty moisture bottle in gm

b=weight of moisture bottle + sample in gm

c=weight of moisture bottle + sample after drying in gm

Calcium

Principle

The calcium was present in the soil in an exchangeable form (nitrates, chlorides and bicarbonates). The calcium content in the soil was determined by EDTA titration.

Reagents

1) sodium hydroxide solution

It was prepared by dissolving 4 gm of NaOH in distilled water and made upto 50ml.

2) Murexide indicator

It was prepared by mixing 0.2 gm of ammonium purpurate and 100gm of sodium chloride and grounded thoroughly.

3) 0.01M of EDTA solution

It was prepared by dissolving 1.8615 gm of disodium salt of EDTA in distilled water and made up to 500ml.

Procedure

25 ml of soil extract was taken in a conical flask.0.5 ml of NaOH solution was added along with a pinch of murexide indicator. This solution was titrated against EDTA solution until the pink color was changed to purple as reported by M.I.Onwuka et al (2007) [17].

Calculation

$$\text{Calcium(mg/g)} = \frac{V_3 \times 400.4 \times V_1}{V_2 \times X \times 10000}$$

V_3=volume of EDTA titrate used (ml)

V_2=volume of soil extract titrated (ml)

V_1=total volume of soil extract titrated (ml)

x=Weight of air-dry soil which is taken for extraction (gm)

Total Cation, Total salt concentration and osmotic pressure

These parameters can be calculated using electrical conductivity value determined previously as reported by David Mouat, Amos Banin and Brunce jones[18].

Total cation (or anion) concentration(meq/L) =10xEC(ds/m25°C)

Total salt concentration (mg/L) = 640xEC (ds/m25°C)

Osmotic pressure bars at 25°C = 0.39x EC (ds/m25°C)

RESULT AND DISCUSSION

Soils from the lands of Periyakulam, Jayamangalam and Aundipatty were analyzed, as discussed in the materials and methods section, for the various parameters such as soil pH, salinity of soil, soil moisture content, total calcium, total cation, total salt concentration and Osmotic pressure, and the results are tabulated in Table ii. The pH for soil from Jayamangalam is 7.02 whereas for Periyakulam soil it is 8.06 and for Aundipatty soil the pH is 7.40. It indicates that the soil from Periyakulam is sodic in nature and other two soils are near neutral. Conductance measurements shows that the salinity of the soil from periyakulam is greater than the other two.

Calcium and total cation for periyakulam soil is greater than that for the soil from Jayamangalam and Aundipatty.

Total salt concentration and osmotic pressure of Periyakulam soil is greater than the other two.

All the parameters whatever we measured are greater for Periyakulam soil than soils from Jayamangalam and Aundipatty.

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Table: (ii) Variation of parameters of soils from Jayamangalam, Periyakulam and Aundipatty

Parameters	Periyakulam	Aundipatty	Jayamangalam
pH	8.06	7.40	7.02
Salinity of the soil	0.795 mmhos	0.75 mmhos	0.724 mmhos
Soil moisture content	96.69%	97.04%	98.52%
Calcium	0.06438 mg/g	0.0176 mg/g	0.0168 mg/g
Total cation	7.9500 ds/m	7.5400 ds/m	7.2400 ds/m
Total salt concentration	508.8000 ds/m	482.5600 ds/m	463.3600 ds/m
Osmotic pressure	0.3105 ds/m	0.2940 ds/m	0.2823 ds/m

CONCLUSION:

Optimum pH for most crops is 6.5-7.5, less than or higher than this value leads to problematic situation for crops. Since Jayamangalam soil has a pH of 6.75 which lies in optimum range and it is ideal for crop. The pH of Periyakulam, Aundipatty are 8.06, 7.40 respectively. It indicates that soil is alkaline or sodic in nature. It may be due to repeated gardening in this area. It may also be due to less infiltration and percolation of soil water.

Sodic soils are usually barren but potentially productive soils. The soil does not support plant growth primarily because of excessive salts in the soil solution that is due to high osmotic pressure preventing the absorption of moisture nutrients in adequate amounts.

Under alkaline soil condition the damage is not due to salt concentration since the conductivity of the soil solution is low. The sodium adsorbed by clay and organic colloids cause dispersion of clay, which results in a loss of desirable structure and the development of a puddle effect. Such effects on physical properties reduce drainage aeration and microbial activity. The high pH in alkali soils causes a reduction in the solubility and availability of

iron, copper, manganese and zinc to plants [19]. As the optimum range of pH for better yield of crop is 6.5-7.5, while comparing the soils, Jayamangalam soil is ideal for crop growth.

The consequences of salinity are depicted in the Table iii.

Table(iii):Scale of Conductivity in mmhos/cm at 25°C

0-2	No effect on crops
2-4	Sensitive crops Restricted
4-8	Many crops restricted
8-16	Most crops restricted
16-32	Few crops tolerant

Since the salinity for samples from three villages soil lies in the range of 0-2, it has no effect on crops. It provides suitable condition for the cultivation of crops.

Jayamangalam soil has the high moisture content compared to other two cultivation of crops in Periyakulam, Aundipatty soil reduces the moisture content due to absorption of soil water by plants. Rate of absorption of water is low in Jayamangalam land and water holding capacity is increased as reported by V.O. Wasonga et al (2003).

The availability of calcium is invariably higher in acidic soils as compared to neutral or alkaline soils. In strongly alkaline soils, calcium is precipitated as carbonate. The calcium therefore has a buffering effect upon pH.

It is found that soil with pH value 9 or above is often somewhat deficient in calcium and for similar reason for magnesium. Calcium and magnesium are regarded as secondary nutrients and required by plants in moderate amounts. Calcium plays an important role in cell elongation and cell division of plants [20]. The calcium content of Jayamangalam soil is 0.0168mg/g and that of Periyakulam and Aundipatty soils are 0.06438mg/g, 0.0176mg/g respectively. Low levels of calcium are accounted for those soils. It can be improved by applying calcium carbonate. It will pave way for better yield.

On the basis of this present study it is concluded that the Jayamangalam soil is more conductive for cultivation of plants.

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