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Studies on the analysis of physico - chemical properties of soil samples collected from different locations in Cauvery delta zone of Tamil Nadu

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Abstract

Soil is a complex mixture of minerals, organic matter, liquids, gases and microorganisms that all works together to support life. Soil fertility is one of the important factor that determines yield of the crops. The present study focuses on analysis of physico - chemical properties of soils that were collected from five districts of Cauvery delta zone of Tamil Nadu, India. The physical and chemical parameters of soil samples such as pH, Electrical conductivity, Organic carbon and nutrient status of available Nitrogen, Phosphorus and Potassium were analyzed. The soil samples comprising four different textural types *viz*., Clay soil**,** Clay loam, Loamy soil and Sandy clay loam from ten different locations were noticed. Soil pH of the collected samples was alkaline and neutral, ranging from 7.0 to 8.10 and soil EC ranged from 0.14 to 1.20 dSm^{-1}. The available Nitrogen content of the collected soil samples ranged from 125 to 295.05 kg ha^{-1}. The available Phosphorus content of the collected soil sample ranged from 7.86 to 37.50 kg ha^{-1} and the available Potassium content of the collected soil sample ranged from 232 to 390 kg ha^{-1}. This knowledge on soil nutrient status could help the researchers, farmers and planners for a better crop production.

Key words : Cauvery delta zone, physico - chemical properties and Available soil nutrients NPK.

All agricultural production depends upon physico - chemical parameters of the soil used for the cultivation of crop plants. Soil is a key component of the terrestrial ecosystem that fulfills many functions including those that are essential for sustaining plant growth[12].

The importance of soil as reservoir of nutrient and moisture for the production of plant species has been recognized since the beginning of the crop management. The modern concept of soil quality is the ability to sustain plant and animal productivity to increase water and air

quality and to contribute plant and animal health[4]. The soil health and quality has consistently evolved with an increase in the understanding of soil and soil quality attributes[3]. It is controlled by physical, chemical and biological component of soil and their interaction[16]. Soil fertility is an important factor which determines the growth of plant. The pH is a most important physical properties of soil. It is having great effect on solute concentration and absorption in soil[2]. Soil pH is an important consideration for farmers and gardeners for several reasons; including the fact that many plants and soil life forms prefer either alkaline or acidic conditions[14]. It is the good indicator of balance of available nutrients in the soil[11]. Further, electrical conductivity (EC) is a very quick, simple and inexpensive method to check health of soils. It is a measure of ions present in solution. The electrical conductivity of a soil solution increases with the increased concentration of ions[5]. It depends on the concentration of N, P, K, organic and inorganic materials, micron-utrients and water. In general soil chemical fertility and in particular lack of nutrient inputs is a major factor in soil degradation[7].

The properties of soil along with its type have a great importance in agriculture[1]. Soil physico - chemical properties deteriorate to the change in land use especially from agriculture and forest[18]. Nitrogen, Phosphorus and Potassium are crucial macronutrients for plants, playing a vital role in their development and being needed in significant quantities. These elements, along with carbon, hydrogen, oxygen, and calcium, are essential for the complete life cycle of plants. Nitrogen is a major component of chlorophyll, amino acids and an important factor in the growth of plants. Similarly, phosphorus is an important constituent of plant deoxyribonucleic acid (DNA) and ribonucleic acid (RNA), it plays an important role in the development of roots and production of seeds, whereas potassium play an indirect role in the plant development like activating over 80 enzymes throughout the plant. Thus, these elements are very important and must be present at optimum level in the soil for proper plant growth and if required, their quantity must be replenished by the applications of NPK fertilizers.

Collection of soil sample from Cauvery delta zone of Tamil Nadu :

The soil samples were collected from five districts of Cauvery delta zone of Tamil Nadu, such as Nagapattinam, Thiruvarur, Thanjavur, Mayiladuthurai and Cuddalore, and 2 sample were collected from each districts. Samples were aseptically kept in sterile poly bags from targeted sites and transferred to laboratory.

Estimation the pH of the soil samples :

The pH of the soil samples were estimated by pH meter method[9]. Twenty gram of soil is taken in a beaker and 40ml of distilled water mixed thoroughly and wait for 30 minutes. The pH meter was switched on and the buffer solutions were calibrated (4,7 and 9.2) half an hour before taking the reading. The reading of the sample was observed by dipping the glass electrode of the pH meter.

Estimation the EC of soil samples :

Electrical conductivity of soil was

determined by EC meter. Twenty gram of soil was taken and mixed with 40ml of distilled water with the help of glass rod. The suspension was allowed to stand still until clear liquid is obtained. The cell EC meter was dipped in the water suspension to estimate the EC value and expressed in terms of d Sm^{-1}. The EC value was calculated by using the formula.

EC (ds m^{-1}) = EC meter reading x Cell content x Temperature factor.

Organic carbon of soil :

Organic carbon was estimated by Walkley and Black wet oxidation method[9]. One g of soil sample was weighed and transferred into 500ml conical flask. 10ml of 1N $K_2Cr_2O_7$ was added to 20ml of Con. H_2SO_4 and keep aside for 30 minutes. 100 ml of distilled water was added to 10 ml of 85 per cent Pure Ortho-Phosporic acid (H_3PO_4). 2-3 drops of 0.5 per cent di-phenyl amine indicator was added. 0.5N ferrous ammonium sulphate (Note down initial value), was titrated and the Color changes from violet blue to dark green the the titration was stopped. Similarly, the blank was also run. The organic carbon was calculated using the formula

$$\% \text{ of Organic Carbon} = \frac{(B\text{-}S) \times \text{Normality of ferrous ammonium sulphate} \times \text{meq.Wt. of carbon}}{\text{Weight of soil}} \times 100$$

Soil Nitrogen :

Available soil nitrogen was estimated by the method suggested by Subbiah and Asija[17] and expressed in kg ha^{-1}. 20g of the soil sample was weighed and transferred to the distillation flask, and the sample was moistened with distilled water and the distillation assembly was fixed.

About 0.32 per cent $KMNO_4$ solution was added to 100 ml of 2.5 per cent NaOH solution. To prevent frothing and bumping during boiling 1 ml of liquid paraffin and few glass beads were added respectively. The contents were distilled in a distillation assembly at a steady rate and the librated ammonia was collected in a conical flask containing 20 ml of boric acid solution with mixed indicator. The end of the delivery tube was dipped into solution with the absorption of ammonia then the pinkish colour turns to green. The available Nitrogen was calculated by using the formula

$$\text{Available Nitrogen (kg ha}^{-1}) = \frac{Z \times 0.0014 \times 100}{W - 20 \text{ g}}$$

Soil Phosphorus :

Available soil phosphorus was determined by the procedure formulated by Olsen *et al.*[13] and expressed in kg ha^{-1}. Extraction was prepared and out 5 ml of olsen reagent was pippeted out and 2 to 3 drops of p-nitrophenol indicator was added. Yellow colour was developed. A drop of 2.5M H_2SO_4 was added to acidify the olsen's reagent to make the pH 5 at which the yellow colour disappeared. 5 ml of ammonium molybdate solution was added and gently shaked then 4 ml ascorbic acid solution was added to make the volume to 25 ml rest for 10 minutes. The absorbance at 730 – 840 nm using UV-VIS spectrophotometer was measured. The readings was recorded and run a blank with extracting solution (without soil) and it is used to set zero absorbance of spectro-

photometer. The available Phosphorous was evaluated by the formula

$$\text{Available Phosphorous (kg ha}^{-1}\text{)} = \frac{Z \times V \times 2.24}{A \times W}$$

Soil Potassium :

The soil available potassium was estimated by the Flame photometric method, the method suggested by Piper and expressed in kg ha^{-1}. 5g of air dried soil was shaken with 25ml of neutral normal ammonium acetate solution for 5 minutes and filtered immediately through a dry filter paper (Whatman No. 1). Potassium concentration in the extract was determined by flame photometer. A series of K standards were prepared ranging from 0 to 1000 ppm and feed into flame photometer through the atomizer. Plot the reading of the galvanometer as a function of K concentration (in ppm). A small quantity of the triacid extract was transferred after neutralizing with dilute ammonia, into a vial. The solution was fed into the flame photometer and the readings were noted. The concentration of K in the solution is calibrated by referring to the standard curve. The available potassium was calculated by the formula

$$\text{Available Potassium (kg ha}^{-1}\text{)} = R \times \frac{\text{Volume of the extract (25)}}{\text{Weight of soil taken (5 g)}} \times \frac{2.24 \times 10^6}{10^6} \times 1.2$$

Physico – chemical characteristics of soil samples from Cauvery delta zone of Tamil Nadu :

The physico - chemical characteristics of the soils samples collected from ten locations of Cauvery delta zone Tamil Nadu were analyzed and presented in Table-1. The soil samples collected from different locations belonged to four different textural type's *viz*., Clay soil**,** Clay loam, Loamy soil and Sandy clay loam. Soil pH of the collected samples was alkaline and neutral, ranged from 7.0 to 8.10 and soil EC ranged from 0.14 to 1.20 dSm^{-1}. Similar results were reported previously by Ghosh *et al.,*[6] and Karmakar *et al.,*[10]. Soil organic carbon content ranged from 0.19 per cent to 0.73 per cent from the soils collected from the Cauvery delta zone of Tamil Nadu.

Nutrition status of soil samples collected from Cauvery delta zone of Tamil Nadu Available Nitrogen :

The available Nitrogen content of the collected soil sample ranged from 125 to 295.05 kg ha^{-1}. The maximum available Nitrogen recorded was 295.05 kg ha^{-1} in papanasam block of Tanjavur district, which was followed by 283.75 kg ha^{-1} in kilvelur block of Nagapattinam district, 280 kg ha^{-1} available Nitrogen in Thiruthuraipoondi block of Thiruvarur district and 273kg ha^{-1} in Nannilam block in Thiruvarur district. The minimum available Nitrogen content was recorded with 125 kg ha^{-1} in Sirkazhi block of Mayiladuthurai district of Tamil Nadu. As available Nitrogen is directly correlated with soil organic carbon, sufficient nitrogen content shows the adequate availability of organic matter (Table-2). Similar

results were reported previously by Panwar *et al.*[15] and Karmakar *et al*.,[10].

Available Phosphorus :

The available Phosphorus content of the collected soil sample ranged from 7.86 to 37.50 kg ha^{-1}. The maximum available Phosphorus content was recorded as 37.50 kg ha^{-1} in Sirkazhi block of Mayiladuthurai district, which was followed by 20 kg ha^{-1} in South poigai Nallur block of Nagapattinam district, 19.20 kg ha^{-1} in Nannilam block of Thiruvarur district, 18.75 kg ha^{-1} in Papanasam block of Thanjavur district, 17.50 in Pandhanallur block of Mayiladuthurai district, 17.00 kg ha^{-1} in Kilvelur block of Nagapattinam district, 16.70 kg ha^{-1} in Thiruthuraipoondi block of Thiruvarur district, 10.63 kg ha^{-1} in Orathanadu block of Thanjavur district and 8.79 kg ha^{-1} in Kumaratchi block of Cuddalore district and the least was recorded in Kattumannar koil block of cuddalore district was 7.86 kg ha^{-1}. Available Phosphorus was medium to higher with respect to standards and sets up for good crop production. Similar results were reported previously by Panwar *et al.,*[15].

Available Potassium :

Available Potassium content of collected soil sample ranged from 232 to 390 kg ha^{-1}. The highest available Potassium content was recorded as 390 kg ha^{-1} in Pandhanallur block of Mayiladuthurai district, which was followed by 350 kg ha^{-1} in Orathanadu block of Thanjavur district, 312.50 kg ha^{-1} in Papanasam block of Thanjavur district, 292 kg ha^{-1} in South poigai nallur block of Nagapattinam district, 285 kg ha^{-1} in Nannilam block of Thiruvarur district, 284 kg ha^{-1} in Kilvelur block in Nagapattinam district, 282 kg ha^{-1} in Thiruthuraipoondi block of Thiruvarur district and 257 kg ha^{-1} in Kumaratchi block and the least was recorded in 232 kg ha^{-1} in Kattumannar koil block of Cuddalore district. Potassium content was in medium range than standards due to less K loss from organic residues during weathering process. Similar results were reported previously by Karnakkar *et al*.,[10] and Ghosh *et al.,*[6].

Table-1. Physico – chemical characteristics of soil samples collected from Cauvery delta zone of Tamil Nadu

Cauvery delta zone	Name of the location	Soil type	pH	EC (dsm^{-1})	Soil organic carbon
Nagapattinam	South Poigai Nallur	Clay	7.30	0.14	0.30
	Kilvelur	Clay loam	7.64	0.30	0.42
Mayiladuthurai	Sirkazhi	loam	7.85	0.70	0.26
	Pandhanallur	loam	7.60	0.50	0.22
Thiruvarur	Nannilam	Clay loam	7.20	0.30	0.24
	Thiruthurai poondi	Clay loam	7.52	0.25	0.19
Thanjavur	Orathanadu	Sandy clay loam	7.69	0.41	0.39
	Papanasam	Clay loam	8.10	0.40	0.45
Cuddalore	Kattumannar koil	Clay loam	7.0	1.20	0.64
	Kumaratchi	Clay loam	7.50	0.58	0.73

Table-2. Nutrient status of soil samples collected from Cauvery delta zone of Tamil Nadu

Cauvery delta zone	Name of the location	Available Nitrogen (Kg ha^{-1})	Available Phosphorus (Kg ha^{-1})	Available Potassium (Kg ha^{-1})
Nagapattinam	South Poigai Nallur	271	20.00	292
	Kilvelur	283.75	17.00	284
Mayiladuthurai	Sirkazhi	125.0	37.50	350
	Pandhanallur	227.5	17.50	390
Thiruvarur	Nannilam	273	19.20	285
	Thiruthurai poondi	280	16.70	282
Thanjavur	Orathanadu	246.25	10.63	350
	Papanasam	295.05	18.75	312.50
Cuddalore	Kattumannar koil	126	07.86	232
	Kumaratchi	130	8.79	257

The study concluded that a physical properties of Cauvery delta soil samples was good. The pH ranges was neutral and slightly alkaline, hence, EC suitable for all crops. Moderate organic carbon and adequate Nitrogen, Phosphorus and Potassium content is present in the soil sample. For better production of the crops and maintain the soil fertility for further cause Integrated Nutrient Management should be adapted.

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