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Analysis of The Spatial Distribution of Micro and Macronutrients In Soil From Industrial Site Near Nellikuppam Town In Cuddalore District

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Abstract:*This paper is an effort to be carried out to investigate the large amount of waste products generated from industries producing sugar, Chocolates, spirit, paper ,etc.,in Nellikuppam town located at Cuddalore District .The soil samples were collected from in and around the Nellikuppam town and analyzed the physical parameters of the soil such as, electrical conductivity and the chemical parameters such as pH, macro nutrients (Available Nitrogen, Phosphorus, Potassium) & micronutrients (Zinc, Copper, Manganese, Iron).These macro and micro nutrients are analysed by Atomic Absorption Spectrometer(AAS).The results were obtained and compared with the standard values of critical limits available for fertility of Agricultural Purpose. Electrical conductivity ,pH and amount of copper present in all the soil sample were within the critical limits. Slight abnormal changes were observed in chemical parameter like Available Nitrogen, Phosphorus, Potassium, Zinc, , Manganese, Iron due to the presence of some impurity in soil .*

Keywords: *Soil analysis, macro nutrients, micronutrients, pH, Electrical conductivity ,AtomicAbsorption Spectrometer(AAS).*

I. Introduction

Soil is derived from a Latin word – Solum which means earthy materials in which plants grow.[1] Soil is defined as the mineral material that exists in solid (or) unbroken form like boulders, and gravels (or) finely divided particles of mineral matters such as sand, silt, (or) clay, depending upon the texture[6].Soil components are indeed very complex and dynamic. Soil is actually formed as a result of long term process of complex interactions, disintegration and decomposition of rocks due to weathering leading to the production of mineral matrix in close association with interstitial organic matter.[1] Although soils are formed from the underlying rocks, these may be transported to long distances by rivers, glaciers and strong winds. Sand and clay constitute the hard mineral fractions of the soil. Plants need 16 elements for their growth and completion of life cycle. Carbon, hydrogen and oxygen constitute 96 percent of total dry matter of plants .Among them, carbon and oxygen constitute 45 percent each and hydrogen constitutes nearly 6 percent of the total tissue. These elements are abundantly present in atmosphere and need not to be applied[4].The nutrients required in large quantities are known as macronutrients. They are N, P, K, Ca, Mg and S. Among these, N,P. and K are called primary nutrients or major nutrients. [6]
The nutrients which are required in small quantities (traces) are known as micronutrients or trace elements. They are Fe, Zn, Cu, Mn, B, Mo and CI. Though micronutrients are required in traces but they are just as important as the major nutrients.[4]

EID parry industries produce sugar, chocolates, spirit, paper ,etc .The effluents discharged from the industries contain organic and inorganic substances affect the soil characteristics like mineral strength and pH.Any alteration in pH and electrical conductivity makes the soil acidic or alkaline, and deficiency of micro and macronutrients affect the plants growth.

II. Material and Methods

Soil is collected up to the depth of 15cm from at least ten well distributed spots in the field mixed well and about ½ kg of the representative composite sample should be taken.[2]

Tools and Materials

Different soil sampling equipment like soil tube auger, screw type auger post-hole auger, and spade are used for taking samples[5].For sampling of soft and moist soil the tube auger, spade can be used satisfactorily. A screw type auger may prove more convenient on hard / dry soil while the post whole auger is useful for sampling wet area like rice fields. Tools for collecting the samples should be free from rust or any foreign material which may contaminate the samples.[2].A bucket for collecting and mixing the composite sample.Clean, well-labeled bags of size 13cm x 25 cm for storing the soil sample.[8]

Sampling

1. Divide the field area so that each sample represents an area of approximately 1 hr. A sample should be collected separately from areas which differ in soil colour or past management, e.g., liming, manuring, fertilization, cropping pattern, etc. During collection of sample, dead furrow, old manures or lime piles, wet spots, areas near trees and compost pits should be avoided.[2]
2. Scrap away the surface litter and insert auger or sampling tube to a plough depth (about 15cm). Take at least 10 to 15 samples randomly distributed over each area and place them in a clean bucket. A spade can be used if auger is not available. In this case, dig a V-shaped hole to a plough depth (0-15 cm) and cut 1.5 cm thick slice of soil from top to bottom of the exposed face of the shaped hole and place in a clean bucket.[2]
3. Thoroughly mix the soil samples taken from 10 to 15 spots from each area in a bucket. By quartering, reduce the bulk and about 500g of the composite sample is retained [2].

Storage of Samples

Soil samples received in the laboratory should be allotted the laboratory numbers. They should be air-dried if moist and then ground using a wooden pastel and mortar and sieved through a 0.5mm polyethylene sieve. It is important that the samples are processed in a separate room away from the instrument room and working laboratory. The samples, thus prepared should then be transferred to the soil samples storage room. [2]

Precautions

Soil samples should be dried only under shade and not in the bright sun or in an oven. All materials used for collection and processing of samples should preferably be made up of stainless steel, plastic or wood in order to avoid contamination due to undesirable materials.[5]

During processing of samples efforts should be made to repeatedly crush and pass the whole of the soil sample through the polyethylene sieve and contamination through carryover from one sample to the other should be avoided.[2]

Electric PH Meter Method

Determination of pH: It expresses the acidity and alkalinity of soil, it was determined by weighing 10 g of air –dry soil and placed in a 50 or 100 ml beaker and add 20 of 0.01 M calcium chloride solution and stirred for 20-30 seconds using glass rod and the resulting solution pH were measured using combined glass electrode using electric pH meter method [5]

Measurement Of Electrical Conductivity

Amount of soluble salts in a sample are estimated from EC of aqueous soil extracts. The instrument consists of an AC salt bridge or electrical resistance bridge and conductivity cell having electrodes coated with platinum black. The instrument is also available as an already calibrated assembly. (Salt bridge) for giving the conductivity of solutions in mill mhos per centimeter or deci Siemens per meter at 25^0C.[5]

Estimation Of Available Nitrogen In Soil By Alkaline Permanganate Method (Sabbash & A Sija (1956)

The amount of soil nitrogen released during oxidation as part of the soil organic matter by $KMnO_4$ estimated by distillation with NaOH. The distillate is collected in boric acid containing double (mixed) indicator and titrate against standard H_2SO_4.[2]

Estimation of Available Phosphorus By Olsen's Methods

This method of extraction of available soil phosphorus is suited for calcareous and alkaline soils. The CO_3^{2-} ions from $NaHCO_3$ will react with Ca^{2+} and $CaCO_3$ is precipitated, thus allowing the P to come into the solution. The amount of P extracted is determined calorimetrically at 660nm.[2]

Estimation of Available Potassium By Neutral Normal Ammonium Acetate Method (Stanford And English, 1949)

The potassium ions in the exchange sites are replaced with ammonium ions and brought into solution. The amount of potassium present in the extracted solution is quantified using a flame photometer. The intensity of the characteristic lilac blue colour produced by the excitation of potassium atoms is read in the galvanometer of the Flame photometers.[2]

Estimation Of Micronutrients By (AAS)

The available Zn, Cu, Fe and Mn in the soil are extracted by using DTPA extract and measuring in AtomicAbsorptionSpectrophotometer.(AAS)[2]

Reagents :

DTPA EXTRACT: Dissolve 1.865gm of DTPA, 14.9ml of Trienthanol amine and 1.47g of Calcium chloride and make up the volume to one liter with double distilled water. Adjust the pH to 7.3 by using dil. HCI.[2]

Procedure

Weigh 10gm of air dry soil and transfer it to a 100 ml polythene shaking bottle.Add 20ml of DTPA extractant and shake the contents for 2 hours in a mechanical shaker. Filter through Whattman No. 40 or 41 filter paper. The extract is fed into the atomic absorption spectrophotometer for detection of amount of Cu, Fe, Mn and Zn [2].

Available Element	Wavelength measured (nm)
Copper	324.75
Iron	248.33
Manganese	279.48
Zinc	213.86

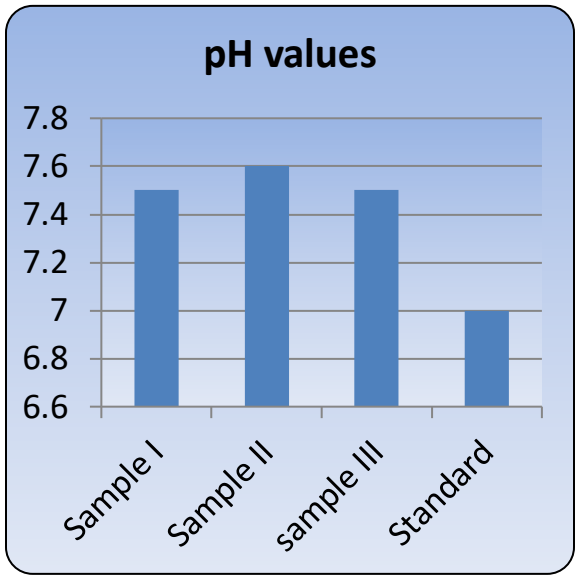
III. Result

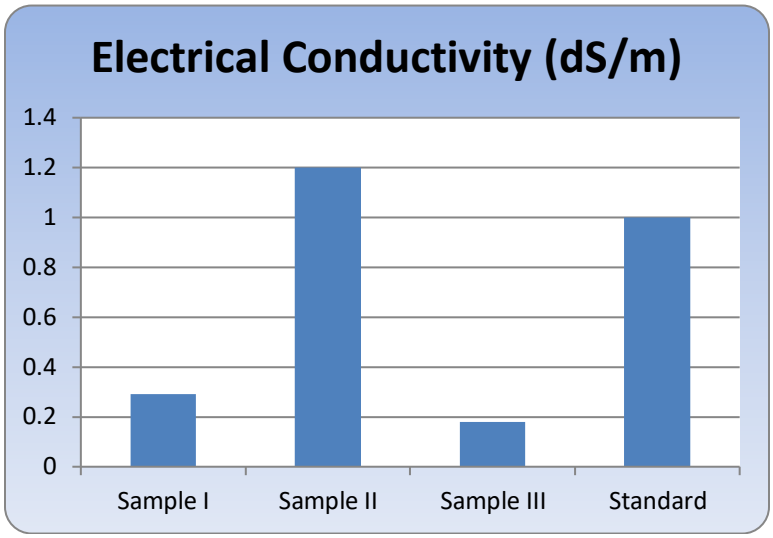
The various results obtained for the different parameters are compared with the critical limits. The soil samples from in and around the Nellikuppam town were collected,

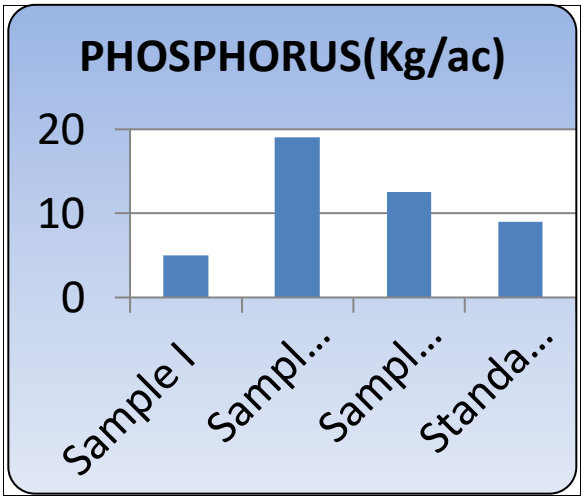
Sample I : Near the EID Parry area (Nellikuppam town)

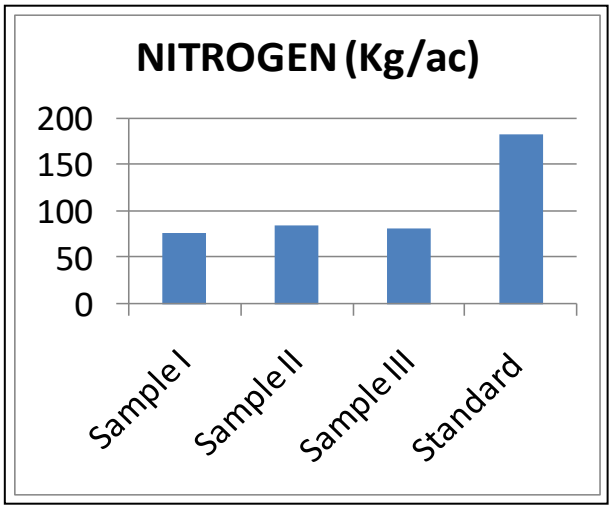
Sample II : 4 km from Industrial site.

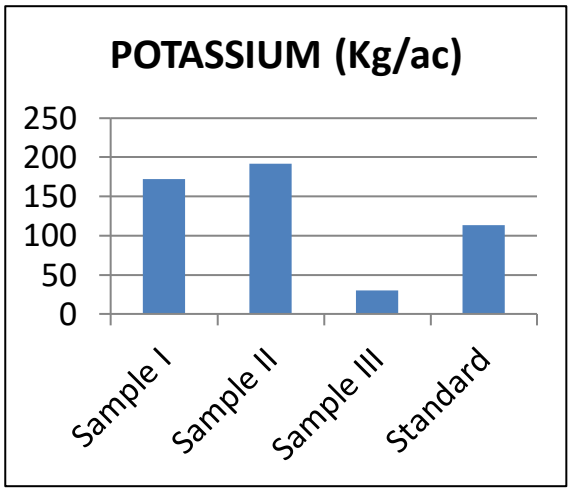
Sample III : 8 km from Industrial site.

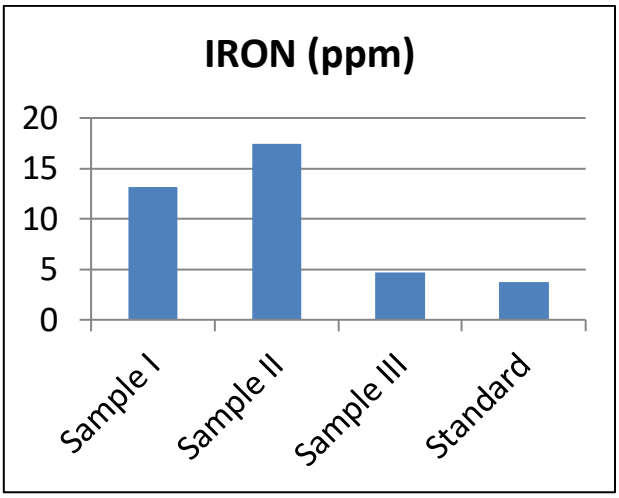

pH values
7.8
7.6
7.4
7.2
7
6.8
6.6
Sample I
Sample II
sample III
Standard

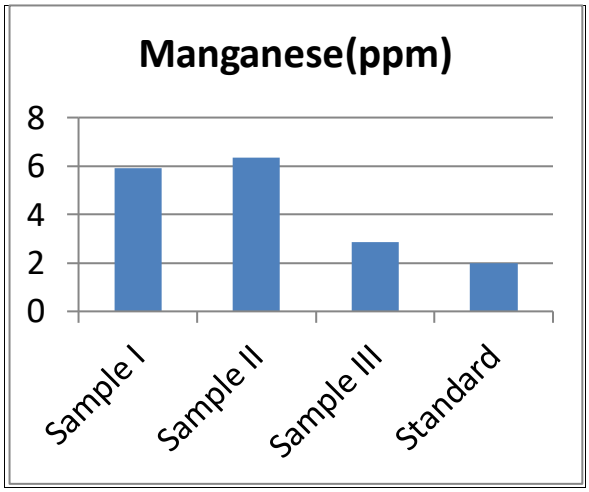

Electrical Conductivity (dS/m)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Sample I
Sample II
Sample III
Standard

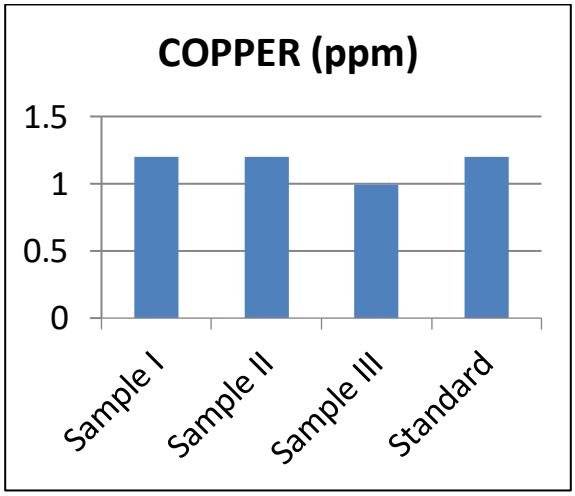

PHOSPHORUS(Kg/ac)
20
10
0
Sample I
Sampl...
Sampl...
Standa...

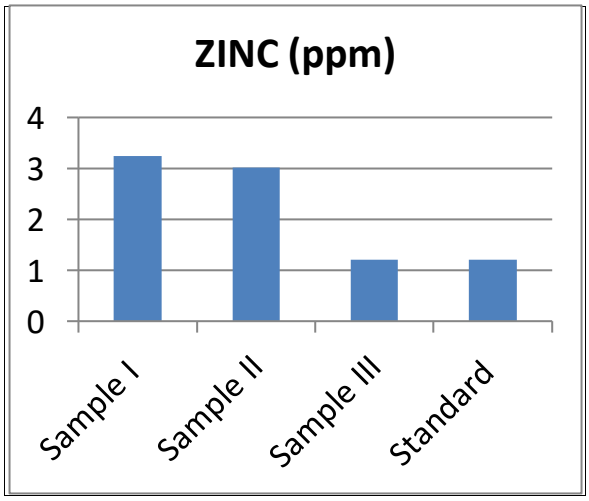

NITROGEN (Kg/ac)
200
150
100
50
0
Sample I
Sample II
Sample III
Standard


POTASSIUM (Kg/ac)
250
200
150
100
50
0
Sample I
Sample II
Sample III
Standard


IRON (ppm)
20
15
10
5
0
Sample I
Sample II
Sample III
Standard


Manganese(ppm)
8
6
4
2
0
Sample I
Sample II
Sample III
Standard


COPPER (ppm)
1.5
1
0.5
0
Sample I
Sample II
Sample III
Standard


ZINC (ppm)
4
3
2
1
0
Sample I
Sample II
Sample III
Standard

Comparison of Micro and Macronutrient In Soil With Standard Values

S.NO	PARAMETER	SAMPLE I	SAMPLE II	SAMPLE III	STANDARD
1	pH	7.5	7.6	7.5	7.0 to 7.5
2	Electrical conductivity(dsm-1)	0.29	1.20	0.18	Below 1 (dsm-1)
3	Available nitrogen (kg/ac)	77	85	81	
4	Available phosphorus (kg/ac)	5	19	12.5	
5	Available potassium (kg/ac)	172	192	30	
6	Iron (ppm)	13.14	17.46	4.00	3.7 ppm
7	Manganese (ppm)	5.91	6.33	2.85	2 ppm
8	Copper (ppm)	1.2	1.2	0.99	1.2 ppm
9	Zinc (ppm)	3.24	3.01	1.2	1.2 ppm

Macronutrients Rating – Chart For The Soil Test Data

Nutrient	Low	Medium	High
Available Nitrogen	Below 114 kg/ ac	115-182 kg/ac	Above 183 kg/ac
Available Phosphorus	Below 4 kg/ ac	4-1-9-0 kg/ac	9.1-18.4 kg/ ac
Available potassium	Below 48 kg/ac	49-113 kg/ac	above 113 kg/ ac

IV. Discussion

The nitrogen content in sample I,II &III was found to be lower than standard value. It leads to stunted growth in plants and change of colour on older leaves. The sample II & III show Phosphorous contents higher than the critical limits may be due to the presence of effluent in the soil. The critical level of Potassium is 113 kg/ac in soil medium, But sample I,& II shows above the critical limit due to sample being contaminated with the other soil impurities. Iron is micronutrients, even in a slight deficiency or excess is harmful to the plants. It is absorbed by the plants in the form of Fe^{2+}, Fe^{3+}. The critical limit value for Iron in soil is – 3.7ppm. Here all the sample, (I, II& III,) have the values greater than the critical value and it produce some symptoms in plant like reduction in growth and browning of roots. Fe involved in the photosynthesis yet their excess in soil has lethal effects on crop. Manganese is a micronutrients and it is observed in the form of Mn^{2+}. The critical limits value of Manganese is 2ppm. Here all the sample (I,II,&III) have the greater concentration of Manganese and cause the symptoms like chlorotic of leaves .Copper is micro nutrients this elements are very efficient and minute quantity produce optimum effect ,copper is used as catalyser and activator. It's absorbed in the form of Cu^{+}, Cu^{2+}. Hence the copper concentrations present in all the samples are within the critical limits. Hence there are no harmful effects on plants. Zinc is another micronutrients it is absorbed by the plants in the form of Zn^{2+}.The critical limits value of zinc in soil is 1.2 ppm. Except III, all the soil samples have the value above the critical limits. It produces some

toxicity in plants , especially affected leaves shows the rolling of margins, roots turn brown and often necrotic and Cereals are generally resistant.

V. Conclusion

Nellikuppam is highly populated area and has a tremendous growth ,development and industrialization. It has many industries whose production meets the requirements of National Market level. Along with the development of the industry, the pollution has also increased which affects the environment to the great extent. The soil sample are tested near the industrial area, under investigation shows that till today, the soil is not much affected by Industrial effluent.However some slight abnormal change is observed in available potassium, this is due to some impurity present in soil and some samples have the concentration of iron, and manganese, Zinc is slightly high it produce less harmful effects in plants but it is curable one . In all the above parameter of discussion of Nellikuppam area the soil characteristics is not much affected and hence suitable for cultivation.

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