International Journal of Applied
and Natural Sciences (IJANS)
ISSN (P): 2319–4014; ISSN (E): 2319–4022
Vol. 9, Issue 4, Jun–Jul 2020; 1–14

International Academy of Science,
Engineering and Technology
Connecting Researchers; Nurturing Innovations

DETERMINATION OF SOIL COMPOSITION – WITH RELEVANCE TO THE PHYSICAL AND CHEMICAL NATURE OF BLACK SOIL SAMPLE

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ABSTRACT

Agriculture is backbone of the economy of a country. Soil is important factor for the agricultural production of crop and crop products. It is the medium through which, nutrient and growth factor is made available to the plants. Soil is the raw source of ground water. Soil contains essential macronutrients and micronutrients, which are necessary for the growth. Agricultural product quality depends on soil quality. Soils have different chemical composition such as macronutrients, micronutrients such as calcium, magnesium, iron, zinc, potassium which decide the chemical status. For this purpose, we do investigate such components in this study. Chemical properties are decided by different chemicals like, calcium carbonate. For the collection of soil sample, we have selected farmer's land, from where we took different samples from the field. Then, we had to decide the Physical nature of the soil. The physical nature decides the different parameter such as Ph, Electric conductivity, color, water holding capacity. The Acidity and basicity are determined by crop productivity salt resistance. The overall investigation was done on the chemical and physical characteristics of the selected soil sample.

***KEYWORDS**: Black soil, Agriculture, Chemical Composition, Physical Nature*

Article History

***Received:** 13 May 2020 | **Revised:** 14 May 2020 | **Accepted:** 26 May 2020*

INTRODUCTION

Agriculture is backbone of economy of any country. Indian farmers are cultivating their farms in traditional ways, but now a days, farmers are adapting new techniques and other experiments in their farms due to which, some advantage as well as disadvantage also occurs. Advantages such as time consuming, higher productivity of crop while harmful effects like using chemical fertilizers, the fertility of soil will be reduced. Hence soilis an important part in agriculture. Soil is the dynamic natural body on the surface of earth in which plant grows, composed of minerals, organic minerals and inorganic minerals present in soil; it is important for the growth of crop. It is medium for the growth of plants. In plant growth, several factors like quality of seed, climate, water supply and plant protection measures etc. play important role. Other factors like fertility status of soil, also impact on the growth of plants but among these factors, climate of soil is more important. That has an overall effect on crop production and the quality of crop. Soil's different components are essential for the plant growth such as microelement and macro element. There are 17 microelements present in soil. Soil contains mineral and non-mineral components. The non-mineral components are carbon, hydrogen and oxygen (C, H, O), which are essential for the different compounds such as protein, carbohydrate, which are prepare from that compound. Total carbon (C) in soils is the

sum of both organic and inorganic C. Most organic C is present in the soil organic matter fraction, whereas inorganic C is largely found in carbonate minerals. This section describes two dry combustion and one wet combustion procedures for total C analysis (Nelson 1982).All such compounds are absorbed from soil by roots. The soil parameters were determined in-situ, and in laboratory for texture, pH, OM, N, P (as P2O5), K (as K2O), Ca, Mg, S, B, Fe, Zn, Cu and Mn of collected soil samples of different layers, following standard analytical methods at Soil Science Division, Khumaltar. (Dinesh 2017).

Macronutrients are required in large quantity such as Nitrogen(N), Phosphorous (P),Potassium(K), Calcium (Ca), Magnesium (Mg), Sulphur (S).Some of micronutrients that are essential for plant growth such as Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Barium (B) and Molybdenum (Mb). Phosphorous is structural component of cell membrane and cell organelles (Chloroplast, Mitochondria and Ribosomes etc.).It participates in all bioenergetics reaction and mainly contains nucleic acid, thymine pyrophosphate and co-enzyme. Copper are a constituent part of cytochrome oxidase and many enzyme prosthetic groups of enzyme. It promotes the formation of vit-Ain plants. Zinc is involved in biosynthesis of plant hormone. IAA is essential as a cofactor of many enzymes. Its deficiency causes delay in flowering and fruit development. Iron is responsible for synthesis and maintenance of chlorophyll in plants, it plays essential role in metabolism. So that during farming, soil is an important part, hence we have to know the quality structure and the chemical composition of the soil. For that purpose, we do soil sampling chemical characterization, physical characterization and nature of soil. In chemical characterization, we take soil sample and do characterization like, to find which chemicals are present such micronutrients and macronutrients etc. Soils are medium in which cropsare grown for the food and cloths of the world. Soil fertility is vital to a productive soil. Certain external factors control plant growth such as air, temperature, light mechanical support, nutrients and water. Plants have elements for their growth and completion of life cycle. They are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassiumetc. (Guptap 2000).

The most important organic compound, carbon is determined by the total organic matter determination method (Nelson 1982). Another type of physical characterization is color of soil, nature, type of soil, water holding capacity of soil etc. to decide physical characterization of soil. There are different compounds we can estimate, one of that is nitrogen. It is done by the rapid procedure of estimation of nitrogen (Subbiah 1956).For the better growth of crop, it is necessary to determine these characters that are helpful for agriculture, by adding fertilizer in soil. Some plants show wilting due to deficiency minerals and chemical compounds if they are present in more amount. Therefore, we have to do soil test. Soil testing is to be done by different procedures; we do as per the recommendations of Delaware University (Schulte E.E.1991), where the most sensible Ph value is considered to determine it solubility. Plants are very sensitive if there was lack of some components, hence they show stunted growth. In market, there are many fertilizers available, which enhance soil's chemical status. Nitrogen (N), potassium (K) and Phosphorus (P) are very essential for plant growth and also for the strengthening of reproductive parts, activation of enzymes and carbohydrate metabolism1. Nitrogen and Phosphorous are not available to the plants directly. They are incorporated in the organic material. Potassium (K) is present in elemental form, exchangeable form or as a part of mineral lattices. Calcium (Ca) and Magnesium (Mg) interfere in soil activity as well as activate a number of plant enzyme systems. The deficiency of any of these elements has retarding effect on the growth of plant (kherkhoff 2006). To improve chemical nature of soil testing is done. During this soil testing, we use different instrument Ph meter, Spectrophotometer, Flame photometer, Kjeldhal assembly and Electrical conductivity, such instrument are used during the soil testing. The plant nutrients' availability is due to the influence of ph. of soil. The ideal ph. range for better growth of crop is 6.5-7.5 ph. (Thomas1957). It notes the ph. range in three parts i.e. acidic, basic, and neutral range. This Physico-Chemical study of soil is based on various parameter like PH, Electrical

Conductivity(EC),Total Organic Carbon, Available Nitrogen (N), Available Phosphorus (P2O5) and available Potassium (K2O) (Sawanti 2014).Electric conductivity is another parameter, which are used to determine different type of salts in soil. Flame photometer is the device to check the micronutrient and macronutrient such as copper, iron, zinc, calcium phosphorous. Several states including Andhra Pradesh, Gujarat, Haryana, Karnataka and Uttar Pradesh have made commendable progress in soil testing programme, in various ways. This compendium is an effort to put together the existing status of soil testing facilities state wise, and highlight main issues in soil testing programme compendium on soil health (rewards 1997). Spectrophotometer is an instrument, used to determine absorbance transmitted. The nature of soil is important factor in plant movement of sap cycle. Calcium carbonate is important plant growth and nutrition as well as cell wall deposition. The primary role of calcium in soil maintained the chemical balance of soil, which reduces the soil salinity and improve the water penetration and increase water holding capacity of soil. The acidity and basicity also impact on the plant growth and development. If fluid sap is more concentrated, it cannot move, but it can be dilute or basic. So, we all need to do soil testing. The overall productivity of agricultural product depends on the soil's chemical composition.

The basic objective of soil testing programme was to give information to farmer about the type of fertilizer that should be used, and to tell them about the chemical status of soil. So that, farmers do specific management practices in soil and the use of bio-fertilizer. This can be helpful in increasing the yield of crop, which is also beneficial for maintaining health. There are numerous things that can be said about the importance of soil for growth of plant. Anything can be changed, but soil is one parameter that decides plant growth.

MATERIAL AND METHODS

Material

The soil samples collected should be from the different representative area, with variation in slope, texture and color. All such characters are observed during the collection of soil sample. Mostly, soil should not be from fertilized and non-rocky area, as it is generally selected from farmers' farms. Collect the sample of soil from 0-6 inch depth of ground. Soils are collected randomly from 15-20 location of fields; p-nitro phenol, Distilled water, Potassium chloride, potassium dichromate, ferrous ammonium sulphate, diphenylamine indicator, ortho-phosphoric acid, sulphuric acid, hydrochloric acid, potassium permanganate, sodium hydroxide, ammonium acetate, sodium bicarbonate.

Methods

There are several methods employed for soil testing

Ph

The ph. value is the negative logarithm of hydrogen ion activity. It is instrumented to determine acidity and basicity of soil. Its working is simple mechanism; first, we have to do calibration of instrument by acid and base buffer. The ph. instrument is having digital display that shows ph. reading. There are two adjusting knobs, with the help of that, instrument will be calibrated. Then we have to prepare sample solution, and check ph. to decide whether the soil sample is acidic or basic, on the basis of ph. range.

EC

Electrical conductivity measure is to decide, how much is the salt content of soil? Electric conductivity measure is done by ECM (Electric Conductivity Meter). Before that we have to calibrate the instrument. There is glass rod sample electric

conductivity that will check, and there is a digital display where readings will be displayed. To accomplish this, soil solution is to be prepared.

Organic Carbon

The soil organic carbon can be estimated by standard protocol. We have to take sample soil from farmer fields. Then, different sample solution to be prepared. The soil sample is added with potassium dichromate and then some concentrated acid, followed by some water, diphenyl amine indicator, then titrated with FAS, and finally the organic carbon content is calculated.

Calcium Carbonate

Calcium carbonate analysis is easily done by simple titration methodology. First, collection of soil sample, then soil solutions are prepared by using distilled water. Take soil sample, add hydrochloric acid of one normality, take some suspension kept overnight, add phenolphthalein indicator, then titrate with sodium hydroxide, take reading and calculate calcium carbonate

Nitrogen

Nitrogen estimation is done by standard protocol. For the estimation, kjeldhal distillation instrument is used, through which soil samples are prepared, they are added into potassium permanganate titrate with distillate water, and the readings are found with the help of formula. And, the available nitrogen I composition is calculated.

Phosphorous

Phosphorous estimation is done by standard protocol. It can be done easily; first, collection of sample, then add sodium bicarbonate, and some amount of charcoal is added. Extract the mixture, add p-nitro phenol, add 5n sulphuric acid and measure the wavelength at the spectrophotometer.

Potassium

Simply, potassium estimation is easily done by standard protocol. First, collection of sample from the fields, then make soil solution, then add ammonium acetate extraction solution and shake well, and take reading on flame photometer and measure potassium.

Calcium and Magnesium

Calcium magnesium is calculated in the same protocol. First, collection of soil sample, then make soil solution, filter it, and test for calcium in one side and another side, magnesium. In calcium test, add ammonium chloride and ammonium hydroxide and titrate with EDTA, and calculate calcium content of soil. In magnesium test, filter the solution, add sodium hydroxide and murexideindicator, then titrate with EDTA and calculate magnesium content of soil.

Iron, Zinc, Copper

The micronutrient like copper, zinc, iron, manganese is calculated by the same procedure. It is estimated by atomic absorption spectroscopy (AAS). In this, take soil sample, make into soil solution, then add DTPA, then it will centrifuge at 180RPM and measure by AAS.

RESULT AND DISCUSSION

Soil testing analysis is done by different protocol. Soil analysis was done by ten field samples of farmers' farm. The sample solution was prepared and the parameter was calculated. Firstly, the Ph. parameter decides soils acidic and basic nature, this was done by Ph meter instrument. The ten samples' detected ph. values are given in table no 11. The Ph of soil ranges from 7-9.The highest ph. range of soil by soil sample number 3 is 8.35, while minimum ph. value shown by soil sample number 2 is 6.3. The overall ph. Analysis is as in figure 11.This figure explains that all soils are more basic in nature. The next parameter, Electric conductivity was examined with soil sample. This was done by ECM. This parameter of soil is good or bad conductor of electricity. Table 11 explains the soil sample electric conductivity, out of all, soil sample number 4 have the highest electric conductivity 0.33, while the lowest electric conductivity in soil sample is number 0.10.The overall electric conductivity analysis is shown in fig 11- EC analysis of soil. The result of electric conductivity in soils shows that it is not a good conductor of electricity. The next parameter is their chemical analysis. The first chemical estimation is the organic carbon of the soil, which is done with the standard protocol. The estimation of organic carbon tells that (table 1),analysis of organic carbon of soil sample number 2 have the highest organic carbon 0.78 %, and the lowest organic carbon in 0.35% in soil sample number 6. The soil organic carbon analysis is explained by figure 1- organic carbon analysis of soil. Another chemical parameter is calcium carbonate. The calcium carbonate analysis is shown in table number 2. It shows that, the highest calcium carbonate is present in soil sample number 7 that is 9.90%, while minimum in soil sample number 5, is 3.35%. The overall range of calcium carbonate in soil is explain by fig no 2 Soil analysis of calcium carbonate. The other chemical parameter Nitrogen is done by standard protocol. Table 3 - Analysis of nitrogen tells that, the highest nitrogen in soil sample number 7 is 605.2 kg/ha, while the minimum in soil sample no 3, that is 119.5 kg /ha. The overall soil analysis is given in fig 3- Soil analysis of nitrogen. The nitrogen is important part soil, which is important for soil fertility. The next chemical parameter is phosphorous. Table 4 gives the Analysis of phosphorous of soil, it shows that highest is soil sample number 6, that is 11.29 kg/ha, and lowest in the soil sample number 3, that is 4.14 kg/ha. The fig 4 presents the analysis of phosphorous soil, which tells that soil contained more amount of phosphorous. The next chemical parameter is potassium. The table 5 presents potassium analysis of soil, which shows that the highest in the soil sample number 10, that is 619.24kg/ha and lowest in sample number 1, that is 141.2kg/ha. The potassium analysis is shown in fig 5. It shows the overall analysis of potassium. The next is chemical parameter-calcium. The table 6 presents calcium analysis of soil. It shows that the highest in the soil sample number 9, that is 934.0 ppm and lowest in sample number 7, that is 496ppm. The figure 6 shows the overall calcium analysis and its level. The next chemical parameter is magnesium. The table 7presents magnesium analysis of soil, which shows that the highest is in the soil sample 6, that is 294.0ppm, and the lowest in sample number 4, that is 91.2 ppm. The magnesium analysis presented in fig7 shows the overall analysis of magnesium level. The other chemical parameter is copper. The table 8- copper analysis of soil shows that the highest in the soil sample is5, that is 4.58 ppm and lowest in sample number 3,that is 1.42 ppm. The copper analysis presented in fig 8 shows the overall analysis of copper and its level. The next chemical parameter is zinc. The table9- zinc analysis of soil shows that, the highest is in the soil sample 9, that is 0.92ppm, and the lowest in sample number 6, that is 0.10 ppm. The zinc analysis in fig 9 shows the overall analysis of zinc level. The next chemical parameter is iron. The table 10 -iron analysis of soil shows that the highest is in the soil sample 5 that is 9.46 ppm and the lowest in sample number 7 that is 0.26 ppm. The zinc analysis given in fig 10 shows the overall analysis of iron and its level.

Tables

Table 1: Organic Carbon Estimation

Sr No.	Burette Reading	Organic Carbon percentage (%)
1	17.3	0.37
2	14.6	0.78
3	17.4	0.38
4	18.1	0.26
5	17.0	0.42
6	17.5	0.35
7	17.9	0.28
8	17.2	0.39
9	17.7	0.41
10	15.8	0.69

Table 2: Analysis of Soil Calcium Carbonate

Sr No.	Burette Reading	Calcium Carbonate Percentage (%)
1	14.4	9.10
2	17.3	5.55
3	14.9	8.50
4	13.9	9.70
5	19.0	3.35
6	15.8	7.35
7	13.8	9.90
8	14.3	9.20
9	15.3	8.7
10	16.0	7.9

Table 3: Analysis of Soil Nitrogen

Sr No.	Burette Reading	Available Nitrogen (kg/ha)
1	7.6	207.1
2	5.4	138.0
3	4.8	119.2
4	6.8	181.9
5	6.2	163.1
6	7.5	203.8
7	20.3	605.2
8	5.3	134.8
9	7.1	191.3
10	9.5	266.6

Table 4: Phosphorous Analysis of Soil Sample

Sr No.	Spectrophotometer Reading	Available Phosphorous in Soil(kg/ha)
1	0.009	4.29
2	0.0014	6.28
3	0.009	4.14
4	0.021	9.91
5	0.019	8.91
6	0.024	11.29
7	0.011	5.14
8	0.016	7.58
9	0.020	9.29
10	0.011	5.06

Table 5: Analysis of Potassium of Soil

Sr No.	Flame Photometer Reading	Available Potassium of Soil (kg/ha)
1	13	141.2
2	24	260.7
3	37	401.9
4	14	152.0
5	29	315.0
6	14	152.0
7	38	412.8
8	41	445.42
9	13	141.2
10	57	619.24

Table 6: Soil Analysis Calcium

Sr No.	Burrette Reading	Calcium Analysis (PPM)
1	40.6	806
2	25.4	502.0
3	35.7	706.6
4	37.2	738.0
5	26.7	528.0
6	35.3	500.0
7	25.1	496.0
8	36.5	723.7
9	47.0	934.0
10	40.2	798.1

Table7: Soil Analysis - Magnesium

Sr No.	Burrette Reading	Magnesium Analysis (PPM)
1	52.9	136.8
2	48.6	267.6
3	49.0	149.7
4	45.7	91.2
5	49.1	258.0
6	50.7	294.0
7	46.5	246.0
8	45.5	97.38
9	64.5	199.3
10	46.0	58.94

Table 8: Soil Analysis of Copper

Sr No.	Absorbance	Copper Analysis (PPM)
1	0.127	3.46
2	0.094	2.54
3	0.053	1.42
4	0.064	1.72
5	0.167	4.58
6	0.109	2.96
7	0.094	2.54
8	0.111	3.02
9	0.104	2.84
10	0.064	1.72

Table 9: Soil Analysis of Zinc

Sr No.	Absorbance	Zinc Analysis (PPM)
1	0.093	0.42
2	0.149	0.68
3	0.036	0.16
4	0.154	0.70
5	0.075	0.34
6	0.023	0.10
7	0.512	2.34
8	0.128	0.58
9	0.202	0.92
10	0.154	0.70

Table 10: Soil Analysis of Iron

Sr No.	Absorbance	Iron Analysis (PPM)
1	0.082	8.52
2	0.018	1.88
3	0.009	0.90
4	0.060	6.30
5	0.091	9.46
6	0.039	4.10
7	0.002	0.26
8	0.030	3.16
9	0.033	3.40
10	0.060	6.30

Table 11: Soil Analysis of Ph., Electrical Conductivity

Sr No.	Ph	Electrical Conductivity
1	7.48	0.10
2	6.4	0.23
3	8.35	0.2
4	8.4	0.33
5	7.7	0.16
6	7.1	0.18
7	7.16	0.19
8	7.87	0.10
9	7.9	0.15
10	8.04	0.19

Figures

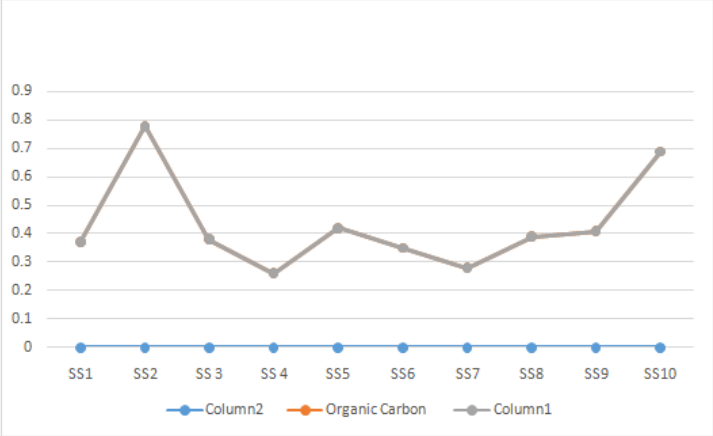

Figure 1: Organic Carbon.

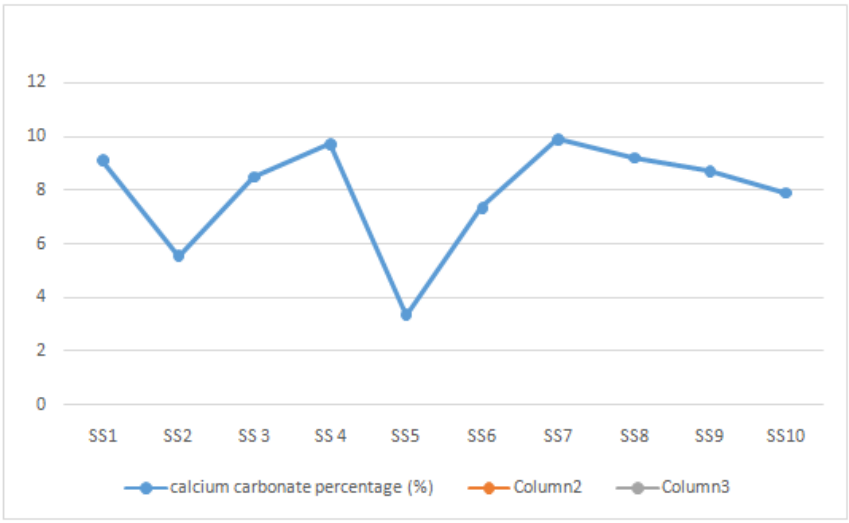

Figure 2: Calcium Carbonate.

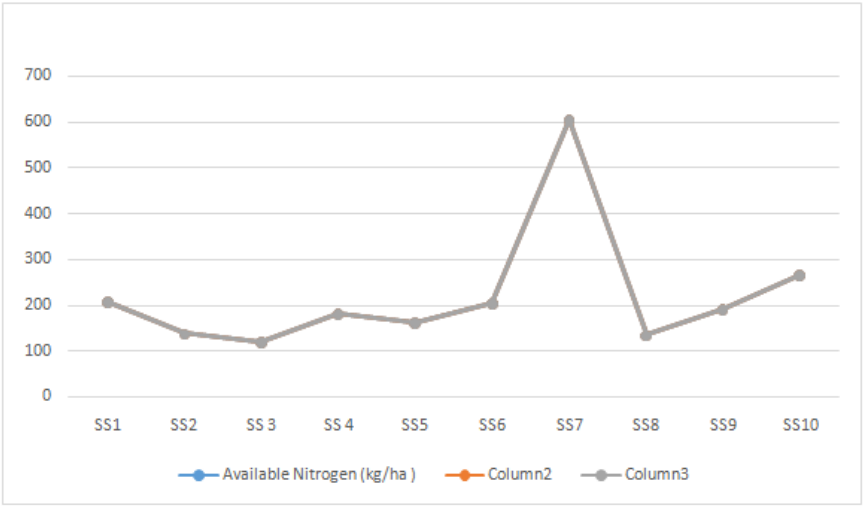

Figure 3: Nitrogen.

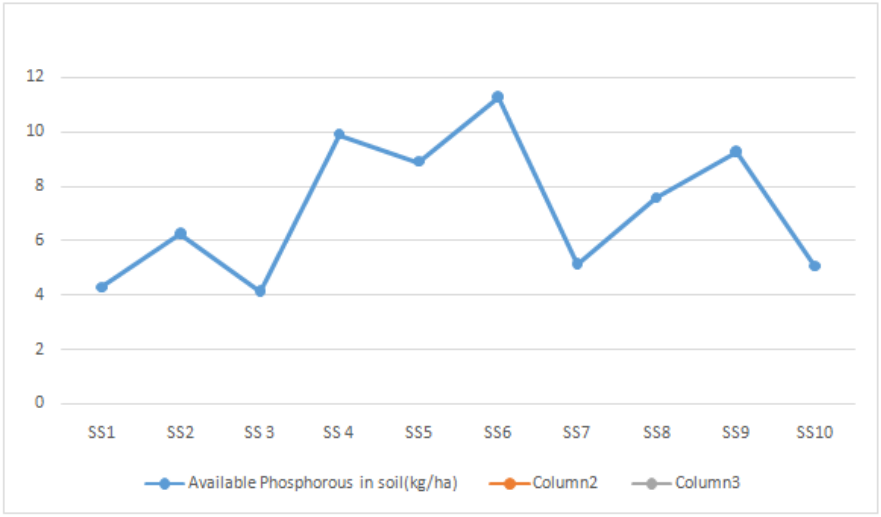

Figure 4: Phosphorous.

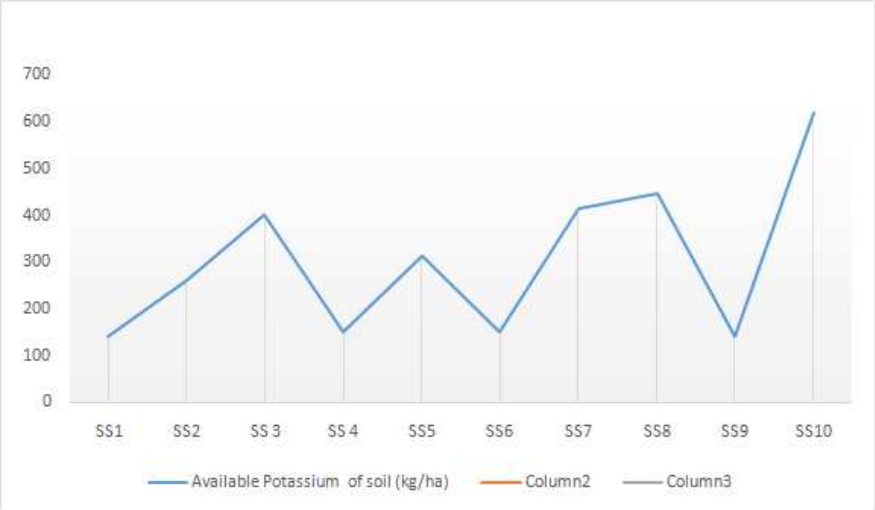

Figure 5: Pottasium.

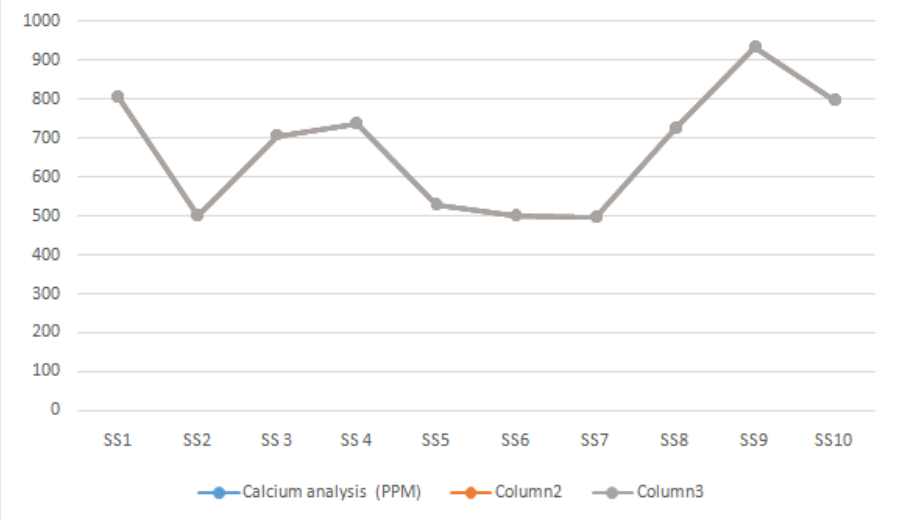

Figure 6: Calcium.

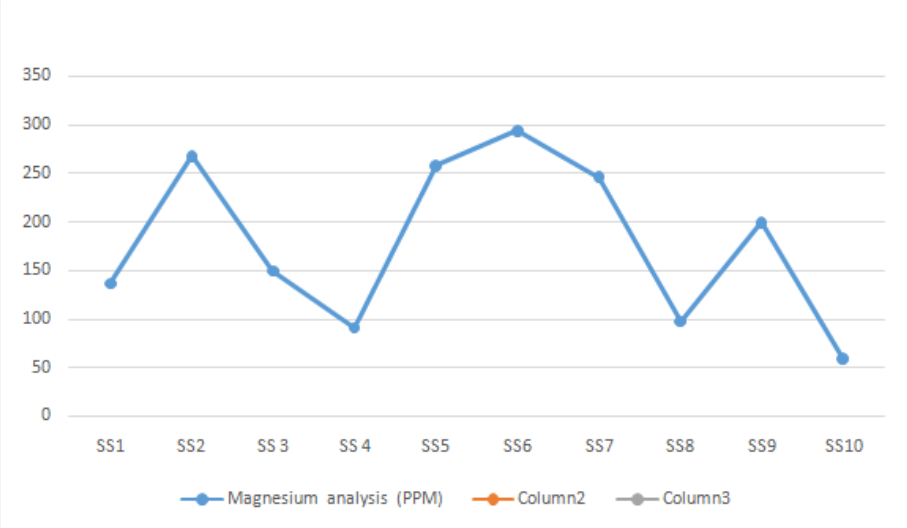

Figure 7: Magnessium.

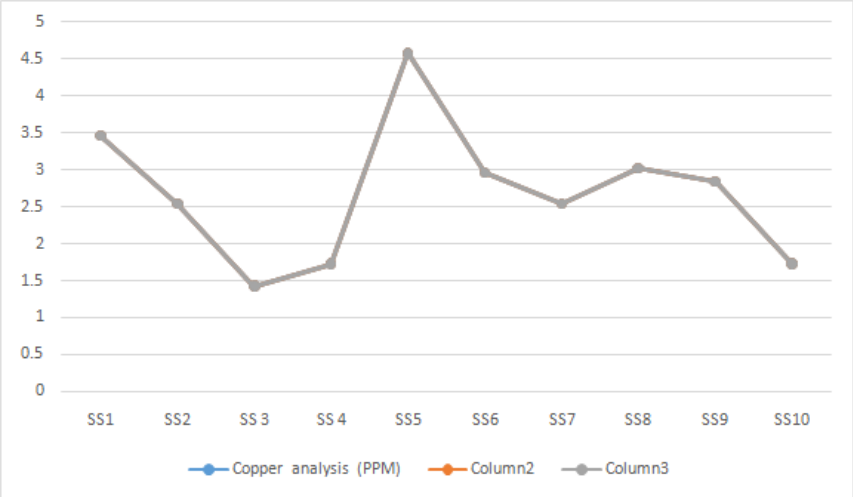

Figure 8: Copper.

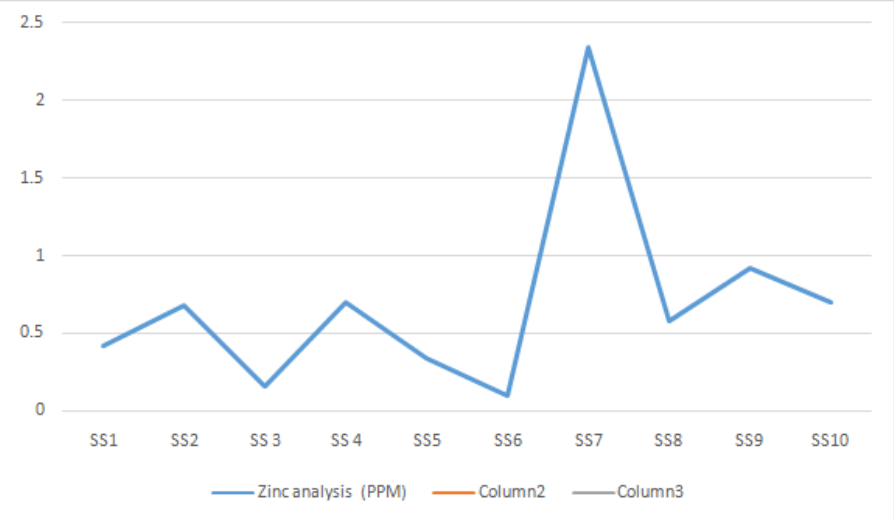

Figure 9: Zinc.

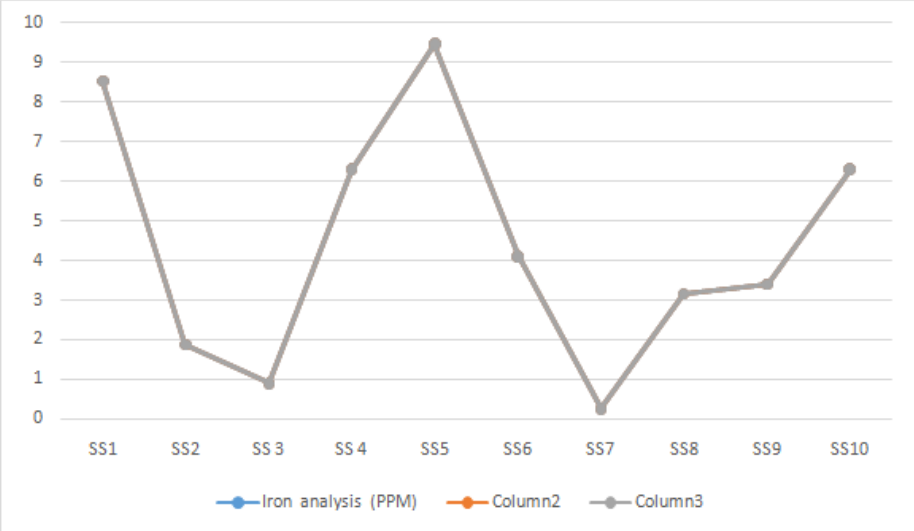

Figure 10: Iron.

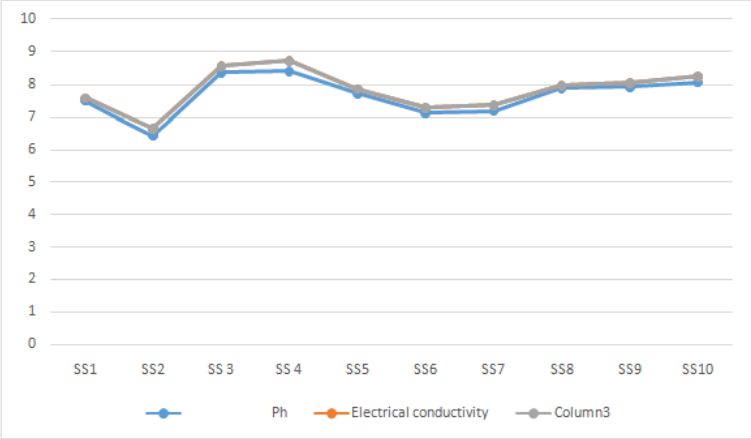

Figure 11: Ph EC.

CONCLUSION

All relevant soil samples were collected for the test. During test, different parameters such as Ph., Electric conductivity, organic carbon, nitrogen, calcium carbonate, macronutrient, micronutrients were calculated. The result of test shows that the Ph of value concluded with all samples how near about medium, that is, the soil samples are having near about neutral ph. range. Then the electric conductivity tells that, all samples are good conductor of electricity. Nitrogen is an important compound of soil, which enhances productivity of crop and growth of crop, and majority of soil samples have rich nitrogen content. Soil quality is decided by differently contained phosphorous; and 50% sample are more rich in phosphorous. Many of soil samples are rich in potassium content. It is also responsible for plant growth and development. The crop production depends on the nutrient status of soil such as micronutrient and macronutrients like potassium, calcium, and near majority of samples have high level content of it. Micronutrient such as copper, iron, manganese are rich in soil sample, due to which, soil fertility will increase. Crop productivity depends on chemical status of soil, hence the need to determine soil status.

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