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Determination of Nitrogen in Soil Samples of Tiwasa Region in Amravati District

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ABSTRACT

Soil fertility evaluation of an area or region is an important aspect in context of sustainable agricultural production. The Tiwasa Region of district Amravati was selected for the study. Five representative villages were chosen and different number of surface soil samples collected and analysed for available Nitrogen status. It will stimulate above ground growth, and produces the rich green colour that is the characteristic of healthy plants, because of this Nitrogen is essential for plant. A method for the determination of total (Kjeldahl) nitrogen in soil is presented. The Kjeldahl method permits the available nitrogen to be precisely determined in the plant and in the soil. The method of determination involves three successive phases which are, Digestion of the organic material to convert nitrogen into HNO3.Distillation of the released Ammonia into an absorbing surface or medium.

Keywords : Soil Samples, Kjeldahl Method

I. INTRODUCTION

Soil fertility is an important factor, which determines the growth of plant. Soil fertility is determined by the presence or absence of nutrients i.e., macro and micronutrients4. Macronutrients such as nitrogen (N), phosphorus (P) and potassium (K) together make up the trio known as NPK. All these nutrients are accumulated by the plants in their bodies in different concentrations. However, these nutrients are usually lacking from the soil because plants use them in large amounts for growth and survival. Hence, these nutrients are known to govern the fertility of the soils, control the yields of the crops and hence have agronomic importance. Assessment of Soil Macronutrient Status of Some Threatened Medicinal Plants of Kashmir Himalaya, India1. - Methods of Analysis of Soils, Plants, Waters and Fertilizers2. Determination of nitrogen in soil by the Kjeldhal method3. Soil samples were found low in organic carbon, available nitrogen and phosphorus while medium in potassium. About 62 % of samples were found deficient in available sulphur. Significant positive correlations were found to exist between organic carbon and available N, P, K and S status of soil under study. Available macro nutrients (N, P, K and S) in the soils of Chiraigaon block of district Varanasi (U.P.) in relation to soil characteristics4. Estimation of Soil Organic Matter, Total Nitrogen and Total Carbon in Sustainable Coastal Wetlands5. Nitrogen is the most important limiting nutrient in wetland soils and a sensitive indicator for measuring the soil nutrient levels in wetlands6. Estimating of soil total nitrogen concentration based on hyperspectral remote sensing data in Minjiang River estuarine wetland7. Total Nitrogen Analysis of Soil

and Plant Tissues8. Kjeldahl digestion, which converts nitrogen to ammonium, is probably the most common method of analyzing substances for nitrogen 9-11.

II. METHOD AND MATERIAL

Sample Collection:

For making composite sample collect small portions of soil up to the desired depth by means of sampling tools like tube augher, spade or khurpi from 15 to 20 well distributed spots. moving in a zigzag manner from each individual sampling, site after scrapping off the surface litter if any, without removing soil from field having standing crops in row draw samples in between the rows. Mix together the soil collected from all the spots within one field very thoroughly by hand on a clean piece of cloth or polythene sheet reduce the bulk to about 500 g by quartering process. for this spread the entire soil mass, divided into four quarters discard two opposite ones and remix the remaining two repeat the process until about 500 g soil is left.

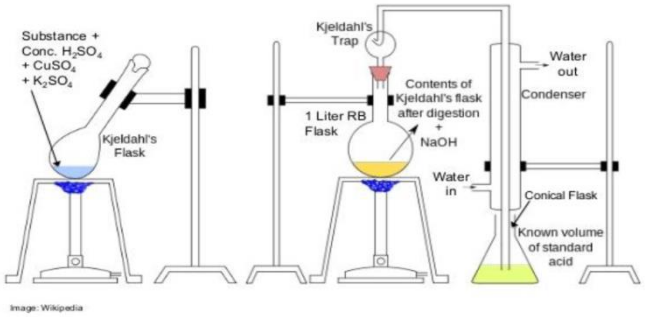
Sample Processing:

Air dry the soil sample in shade discard the plant residues, gravels and other materials, if present. Crush the soil clods lightly and grind with the help of wooden pestle and mortars. Pass the entire quantity of sieved soil thoroughly and preserve for analysis.

KJELDAHL FLASK / APPARATUS:

INSTRUMENTATION:

VELP Scientific has developed the widest range of Kjeldahl apparatus consisting of digestion units, Such instruments respond to the different need in QC, QA, laboratories. Today, The traditional Kjeldahl apparatus for digestion consists in a 250 ml flask capacity. Macro Kjeldahl flask started to appear for volume from 400-800 ml, suggested for soil, grain or protein samples with a very low amount of nitrogen and handle relatively big sample sizes, Micro Kjeldahl apparatus consisting 30-180 ml volume, commonly used with low sample amount. The typical Kjeldahl apparatus for distillation is designed to accept straight digestion tubes directly from the block digester. Steam distillation is much more rapid than classical kjeldahl distillation.



USES / APPLICATIONS

Kjeldahl flask is a round bottom flask with a long wide neck that is used in determination of nitrogen by kjeldahl method.

- The kjeldahl flasks are used in small digestion up in processes.
- Kjeldahl method is used for determination of total nitrogen in a sample.
- Distillation on the basis of kjeldahl method.
- Kjeldahl flasks are round bottom flasks with long wide neck that are used in kjeldahl method for quantitive determination of sample nitrogen content.

Kjeldahl flasks are typically manufactured from borosilicate glass, which is resistant to heat and chemicals. Flasks are available in a wide range of capacities with or without tooled necks or reinforced bead at the top.

METHODOLOGY:

Determination of Nitrogen on soil by the KJELDAHL METHOD.

As it was not convenient or practical to employed to kjeldahl methods tested modifications of these methods were employed that permitted the use of smaller amounts of reagents and of soil.

REAGENTS / PREPARATION OF REAGENTS

Ferrous Sulphate (0.5M=0.5N) – Dissolve FeSO4.7H2O in about 800ml water and add 100 ml to 1 liter in volumetric flask.

Diphenylamine indicator - Dissolve 0.5gm in a mixture of 20 ml water and 100 ml of conc. H2SO4.

Sulphuric Acid- Concentration not less than 96%. If high amount of chloride is present in the samples and silver sulphate (Ag2SO4) at the rate of g/lit. to the acid.

Ortho-phosphoric acid (85%) /Sodium fluoride chemically pure.

Liquid paraffin (extra pure)

Sulphuric acid 0.02 (N/50)

Mixed indicator – Dissolve 0.07g methyl red with 0.1g bromocresol green in 100ml of 95% ethanol.

Boric acid indicator solution- Dissolve 20g of pure boric acid (H3BO3) in about 700 ml of hot water. Transfer the cooled solution to a 1 litre volumetric flask containing 20 ml ethanol and 20 ml of mixed indicator solution. After mixing the contents of the flask add approx. 0.05 NaOH continuously until the colour is reddish purple. Then dilute the solution to volume with water and mix it thoroughly.

KJEIDAHL DIGESTION

Digestion was performed in 500ml Pyrex Kjeldahl flask. Accurately 1g of soil and was placed it into this flask. The Pyrex Kjeldahl flask using the gas heated six-flask digestion stand as the vapour tubes provided with these stands. The top plate of each stand was covered with a sheet of asbestos drilled with holes. At full heat of the burners on the stand brought 200 ml distilled water. It includes two blanks to standardize FeSO4 solution.

Potassium dichromate solution (10 ml) was poured in the flask, Swirl the flask gently and keeps it on an asbestos sheet.

Conc. H2SO4 (20 ml) was mixed in the flask by directing stream into the suspension. Then again swirl flask for 2-3 times.

The flask was allowed to stand on the asbestos sheet for 30 min. Then after there was addition of water (10 ml), 10 ml phosphoric acid and 1 ml diphenylamine indicator .

The content of the flask was titrated with ferrous ammonium sulphate till the colour flashes from blue violet to green.

If burette reading was 0.4 ml then repeated with less soil. If it was 17 ml or higher repeated it with more soil. As in this process kjeldahl flask to a rolling boiled in approximately 3-5 min.

Digestion were generally performed using the full heat of the burners so that sulphuric acid about one-third of the way up the neck of the flask.

KJELDAHL DISTILLATION AND TITRATION

Kjeldahl flask containing two glass beads (to reduce bumping). 20g soil was introduced in 800 ml dry kjeldahl flask. Two drops or 1ml of liquid paraffin added, as to prevent frothing bumping, respectively during distillation and 20 ml water was added and then swirled it. After that 100ml of each 0.32% KMnO4 and 2.5% NaOH solution were mixed in the flask. The flask was connected to the distillation apparatus and its contents were made alkaline, mixed and distilled.

Heat was regulated so that the rate of distillation was about ml/min, the distillate was collected in (250 ml) flask containing 20ml of boric acid solution with mixed indicator. With the absorption of ammonia the pink colour of boric acid solution turned to green. Nearby 100 ml of distillate to be collected in about 30 minutes. Later on, the contents of the flask were titrated with 0.02% H2SO4 to the original shade (pink). Blank titration (without soil) reaction was to be made for the final calculations.

III. RESULT AND DISCUSSION

KJELDHAL DIGESTION

OBSERVATION TABLES:

BLANK TITRATION:

Sr. No.	Vol. Of K2Cr2O7	Water	Phosphoric Acid	Concentrated H2SO4	Vol. Of EDTA added	Mean
1.	0.5 ml	5 ml	100 ml	5 ml	4.1 ml	3.75 ml
2	0.5 ml	5 ml	100 ml	5 ml	3.4ml	

MAIN TITRATION

Soil Sample No. 1

Sr. No.	Soil Sample No.1	Vol. Of K2Cr2O7	Water	Phosphoric Acid	Concentrated H2SO4	Vol. Of EDTA	Mean
1.	5 gm	5 ml	100 ml	5 ml	10 ml	3.5 ml	3.35 ml
2	5 gm	5 ml	100 ml	5 ml	10 ml	3.2 ml	

Soil Sample No. 2

Sr. No.	Soil Sample No.2	Vol. Of K2Cr2O7	Water	Phosphoric Acid	Concentrated H2SO4	Vol. Of EDTA	Mean
1.	5 gm	5 ml	100 ml	5 ml	10 ml	3.1 ml	2.75 ml
2	5 gm	5 ml	100 ml	5 ml	10 ml	2.4 ml	

Soil Sample No. 3

Sr. No.	Soil Sample No.3	Vol. Of K2Cr2O7	Water	Phosphoric Acid	Concentrated H2SO4	Vol. Of EDTA	Mean
1.	5 gm	5 ml	100 ml	5 ml	10 ml	4.2 ml	4.05 ml
2	5 gm	5 ml	100 ml	5 ml	10 ml	3.9 ml	

Soil Sample No. 4

Sr. No.	Soil Sample No.4	Vol. Of K2Cr2O7	Water	Phosphoric Acid	Concentrated H2SO4	Vol. Of EDTA	Mean
1.	5 gm	5 ml	100 ml	5 ml	10 ml	3.4 ml	3.15 ml
2	5 gm	5 ml	100 ml	5 ml	10 ml	2.9 ml	

Soil Sample No. 5

Sr. No.	Soil Sample No.5	Vol. Of K2Cr2O7	Water	Phosphoric Acid	Concentrated H2SO4	Vol. Of EDTA	Mean
1.	5 gm	5 ml	100 ml	5 ml	10 ml	4.5 ml	4.2 ml
2	5 gm	5 ml	100 ml	5 ml	10 ml	3.9 ml	

CALCULATIONS:

(For Blank solution):

1. Organic carbon % =10 (B-T)/B × 0.003 ×100/Wt. of soil =10 (3.35–3.2)/3.35× 0.003 ×100/0.5
= 0.26%

B – Blank titration
B-T = Blank titration reading 1 – Blank titration reading 2

2. Actual organic carbon (%) = (% × 1.3)
= 0.26 × 1.3
= 0.33%

3. Organic matter (%) = Actual % × 1.724
= 0.33 × 1.724
= 0.56%

For soil sample 1:

4. Organic carbon % =10 (B-T)/B × 0.003 ×100/Wt. of soil
=10 (3.75–3.4)/3.75× 0.003 ×100/0.5
= 0.55%

B – Blank titration
B-T = Blank titration reading 1 – Blank titration reading 2
5. Actual organic carbon (%) = (% × 1.3)
= 0.55×1.3
= 0.71%

6. Organic matter (%) = Actual % × 1.724
= 0.71×1.724
= 1.23%
For soil sample 2:
7. Organic carbon % =10 (B-T)/B × 0.003 ×100/Wt. of soil
=10 (2.75–2.4)/2.75× 0.003 ×100/0.5
= 0.76%
B – Blank titration
B-T = Blank titration reading 1 – Blank titration reading 2

8. Actual organic carbon (%) = (% × 1.3)
= 0.76×1.3
= 0.98%

9. Organic matter (%) = Actual % × 1.724
= 0.98×1.724
= 1.68%

For soil sample 3:

10. Organic carbon % =10 (B-T)/B × 0.003 ×100/Wt. of soil
=10 (4.05–3.9)/4.05× 0.003 ×100/0.5
= 0.22%

B – Blank titration
B-T = Blank titration reading 1 – Blank titration reading 2
11. Actual organic carbon (%) = (% × 1.3)
= 0.22×1.3
= 0.28%

12. Organic matter (%) = Actual % × 1.724
= 0.28×1.724
= 0.48%

For soil sample 4:
13. Organic carbon % =10 (B-T)/B × 0.003 ×100/Wt. of soil
=10 (3.15–2.9)/3.15× 0.003 ×100/0.5
= 0.47%

B – Blank titration
B-T = Blank titration reading 1 – Blank titration reading 2

14. Actual organic carbon (%) = (% × 1.3)

= 0.47×1.3
= 0.61%

15. Organic matter (%) = Actual % × 1.724
= 0.61×1.724
= 1.05%

For soil sample 5:

16. Organic carbon % =10 (B-T)/B × 0.003 ×100/Wt. of soil
=10 (4.2–3.9)/4.2× 0.003 ×100/0.5
= 0.42%

B-T = Blank titration reading 1 – Blank titration reading 2

17. Actual organic carbon (%) = (% × 1.3)
= 0.42×1.3
= 0.54%

18. Organic matter (%) = Actual % × 1.724
= 0.54×1.724
= 0.93%

KJELDAHL DISTILLATION

OBSERVATION TABLE:

B – Blank titration

BLANK TITRATION

Sr. No.	Boric Acid Indicator	Distillate added	Vol. Of 0.02 N concentrated H2SO4	Mean
1.	20 ml	80 ml	1.9 ml	1.65 ml
2	20 ml	80 ml	1.4ml	

MAIN TITRATION

Soil Sample No. 1

Sr. No.	Soil sample added	Boric Acid Indicator	Distillate added	Vol. Of 0.02 N conc. H2SO4	Mean
1.	0.5 gm	20 ml	80 ml	0.5 ml	0.35 ml
2	0.5 gm	20 ml	80 ml	0.2 ml	

Soil Sample No. 2

Sr. No.	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02 N H2SO4	Mean
1.	0.5 gm	20 ml	80 ml	0.8 ml	0.6 ml
2	0.5 gm	20 ml	80 ml	0.4ml	

Soil Sample No. 3

Sr. No.	Soil sample added	Boric Acid Indicator	Distillate	Vol. Of 0.02 N H2SO4	Mean
1.	0.5 gm	20 ml	80 ml	0.6 ml	0.75 ml
2	0.5 gm	20 ml	80 ml	0.3 ml	

Soil Sample No. 4

Sr. No.	Soil sample added	Boric Acid Indicator	Distillate added	Vol. Of 0.02 N conc. H2SO4	Mean
1.	0.5 gm	20 ml	80 ml	1.6 ml	1.45 ml
2	0.5gm	20 ml	80 ml	1.3 ml	

Soil Sample No. 5

Sr. No.	Soil sample added	Boric Acid Indicator	Distillate added	Vol. Of 0.02 N conc. H2SO4	Mean
1.	0.5 gm	20 ml	80 ml	1.5 ml	1.3 ml
2	0.5 gm	20 ml	80 ml	1.1 ml	

CALCULATIONS:

Mineralizable N (kg/ha) = R × 31.36 (for each soil sample)

Where R = Volume of 0.02N H2SO4 in ml requires for Titration.

For blank solution:

Mineralizable N (kg/ha) = R × 31.36

= 1.65 × 31.36

= 51.7%

For soil sample 1:

Mineralizable N (kg/ha) = R × 31.36

= 0.35 × 31.36

= 10.97%

For soil sample 2:

Mineralizable N (kg/ha) = R × 31.36

= 0.6 × 31.36

= 18.81%

For soil sample 3:

Mineralizable N (kg/ha) = R × 31.36

= 0.75 × 31.36

= 23.52%

For soil sample 4:

Mineralizable N (kg/ha) = R × 31.36

= 1.45 × 31.36

= 45.47%

For soil sample 5:

Mineralizable N (kg/ha) = R × 31.36

= 1.3 × 31.36

= 40.76%

The Determination of total Nitrogen from the soil by Kjeldahl Method by digestion and distillation process. By Digestion, the total nitrogen is obtained from each soil is 1.23%, 1.68%, 0.48%, 1.05%, 0.93%. By Distillation, the total nitrogen is obtained from each soil is 10.97%, 18.81%, 23.52%, 45.47%, 40.76%. The rate of plant growth is proportional to the rate of nitrogen supply. If the soil is deficient in Nitrogen, the plants become stunted and pale. However, an excess of Nitrogen can damage the plants just as over-fertilizing the lawn can burn and damage the grass. Nitrogen is essential for plant development, since it plays a fundamental role in energy metabolism and protein synthesis. Soil analysis is a set of various chemical processes that determine the amount of available plant nutrients in the soil, but also the chemical, physical and biological soil properties important for the plant nutrition or soil health, chemical soil analysis determine the nutrients present in the soil. The soil contains large amounts of nutrients, the most need of crop is, how much quantity of nutrients present in the soil. In the Amravati district the soil contains large quantity of nutrients present in the soil.

IV. CONCLUSION

The network of moisture sensors provides real time irrigation and minimizes the load of watering. This helps save water and also prevents over saturation of

soil. FARM-IT is therefore an efficient and important tool for a regular farmer that can help him in his day-to-day agricultural activities and also help improve his farming habits. The results described in this paper should encourage other worker s who wish to analyze nitrogen while living under field conditions. The equipment we used was portable, reliable, and relatively inexpensive. The methods quickly produced accurate estimates of total nitrogen. This rapid feedback improved our study immensely and allowed us to constructively modify our research in situ.

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