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Bas

SAMPLING SALT-AFFECTED SOILS

Soil sampling refers to the collection of sample in order to determine the characteristics of soils.

The appropriate way to take a soil sample depends on the objective of the sampling if the soil is to be analyzed for salinity and sodicity then composite sample may need to be established by ^{mixing} ~~bulking~~ together a number of samples.

How to take sample.....?

Following ~~points~~ must be considered while taking a sample.

Visible ^{or} suspected salt crust on the soil surface should be sampled separately

If soil shows evidence of profile development then sample should be taken by layers.

In the absence of profile development or distinct stratification the surface sample (excluding the surface crust) should be taken to the plough depth usually to a depth of 6-7 inches.

Succeeding samples must be taken at interval of 6-18, 18-36 and 36-72 inches or other convenient depth, depending upon the depth of root zone, the nature of problem and the detailed required.

Sometimes, soil sample taken for salinity and alkali determination may be composited to reduce analytical work.

Composite Sampling:

The significance of composite sampling is because of substantial variation in soil properties both horizontally and

vertically that is with the depth in soil profile.

Here are two methods for making a composite sample depending upon whether the field is uniform or variable

Relatively Uniform Field:

For 1 acre of land, mark three equally spaced lines across the length and three equally spaced across the width of the field.

Take individual samples at the nine points where these lines intersect. Mix these samples to produce composite sample.

Variable Field:

Evaluate the variability of the field by observing the growth of a crop. Divide the field visually into strongly affected,

moderately affected, slightly affected and unaffected areas. Calculate the relative proportion of these different regions. Take individual soil sample from each area, weighing the number of samples according to the proportion of land in that class. Mix these individual samples to produce composite sample.

The composite subsample should be sealed in a good quality plastic bag marked with the place depth and name of person who collected.

Measuring Soil Salinity:

A saturated soil paste is made by adding pure water to grinded soil sample. The soil paste glinsen as it reflects light, flow slightly

when the container is tipped and its surface glistens.

Measuring Salinity:

Salinity is measured as the electrical conductivity of either the saturated soil paste (abbreviated as EC_e) or the soil saturation extract (abbreviated as EC_s). The unit of electrical conductivity is dSm^{-1} .

Determination of pH:

pH is measured from saturated soil paste by dipping electrode in it.

Determination of EC:

It is measured from the soil extract by dipping electrode of EC meter.

Determination of different anions from a given soil sample.

* Carbonates

Reagents:

Phenolphthalein 1%

$\frac{N}{100} \text{H}_2\text{SO}_4$ or $0.01 \text{N H}_2\text{SO}_4$

Method:

Take 10ml soil extract or filtrate in a china dish with the help of pipette.

Add 2-3 drops of phenolphthalein indicator. Pink color appears it means carbonates are present in the sample. If no color appears it means carbonates are absent in the sample.

Titrate with $\frac{N}{100} \text{H}_2\text{SO}_4$ taken in a burette. Acid should be added dropwise carefully. Stop

titration process when sample becomes colorless.

Note the volume of H_2SO_4 used for this titration and note this reading as R_1 .

keep this sample for further analysis.

Calculations:

$$\text{Carbonate} = \frac{2R_1 \times \text{Normality of acid} \times 1000}{\text{volume of sample taken}}$$

~~Sol~~

Determination of Bi-carbonates:

Reagents:

Methyl Orange

$\frac{N}{100}$ or $0.01 N H_2SO_4$

Procedure:

Add 2-3 drops of methyl orange indicator in the same china dish from which carbonates were determined.

Titrate these contents with $0.01 N H_2SO_4$ till pinkish yellow end point.

Note the volume of H_2SO_4 used and note it as R_2 .

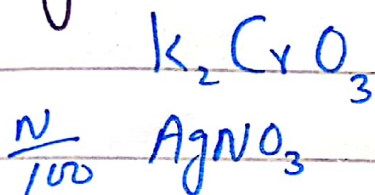
Acid used will be more than used for carbonates.

Calculations:

$$\text{Bicarbonate} = \frac{(R_2 - R_1) \times \text{Normality of acid} \times 1000}{\text{Vol. of sample taken}}$$

Determination of Chloride:

Reagents:



Procedure:

Add 2-3 drops of K_2CrO_3 indicator in the same china dish from which carbonate and bi-carbonate was determined.

Titrate these contents with $\frac{N}{100}$ $AgNO_3$ sol. taken in the burette till brick red color appears.

Note the volume of $AgNO_3$ used for this end point and note this volume as R .

Calculation:

$$\text{Chloride} = \frac{R \times \text{Normality of } AgNO_3 \times 1000}{\text{Vol. of sample taken}}$$

Determination of Sulphates:

are determined by ^{Sulphates} difference method.

$$SO_4 = TSS - (CO_3 + HCO_3 + Cl)$$

$$TSS = EC \times 10$$

~~for~~

DETERMINATION OF CATIONS

Determination of Calcium + Magnesium
in a given soil sample.

Reagents:

Standard $N/100$ EDTA or Versinate sol.

Buffer Solution ($NH_4Cl + NH_4OH$)

EBT Eriochrome black T

Procedure:

Take 10ml soil extract
in a conical flask or china dish.

Add 2-3 drops of buffer solution
and 2-3 drops of EBT indicator
in the china dish.

Mix all these contents with
glass rod.

Start titrating this sample with
 $N/100$ EDTA sol. taken in burette
till bluish-green end point.

Normal \rightarrow bluish Sodic \rightarrow greenish shade

Note the volume of $N/100$ EDTA

used for this titration.

Note the volume as R.

Calculation:

$$\text{Ca} + \text{Mg} = \frac{\text{Vol. of } N/100 \text{ EDTA used} \times \text{Normality of EDTA}}{\text{Volume of sample taken}} \times 1000$$

$$\text{Ca} + \text{Mg} = \dots \text{meq l}^{-1}$$

~~Ans~~

Determination of Calcium from a given soil sample.

Reagents.

$N/100$ EDTA solution

4N NaOH \rightarrow Act as buffer.

Ammonium Perphosphate indicator

.5g in 100g K_2SO_4 *perphosphate*

Procedure:

Take 10ml soil extract in a china dish.

Add 5 drops of 4N, NaOH and approximately 50mg ammonium perphosphate indicator.

Mix all these contents.

Titrate the sample with $N/100$ EDTA sol. taken in burette till orange red or purple end point.

Note the volume of $N/100$ EDTA used.

Calculation:

$$Ca = \frac{\text{Vol. of } N/100 \text{ EDTA used} \times \text{Normality of EDTA}}{\text{Volume of sample taken}} \times 1000$$

Determination of Magnesium:

It is determined indirectly by difference method.

Its direct determination is costly.

$$\text{Mg} = (\text{Ca} + \text{Mg}) - \text{Ca}$$

Unit = me l^{-1}

~~sec~~

Determination of sodium from given soil sample by using flame photometer.

Requirements:

Flame Photometer

Distilled Water

Wash bottles

Standard solution of sodium

Extract of soil sample

PPm

Reading

0

0

10

9.9-1.1

⋮

⋮

100

± 100

Preparation of Stock Solution:

Take 2.54g analytical grade NaCl. Transfer this salt into 1L volumetric flask. Add some quantity of distilled water to dissolve and make volume upto the mark

To make 100 ppm having vol. 1000 ml...

$$C_1 V_1 = C_2 V_2$$

$$V_1 = \frac{C_2 V_2}{C_1}$$

$$V_1 = \frac{100 \times 1000}{1000}$$

$$V_1 = 100 \text{ ml}$$

Take 100 ml from 1000 ppm sol. and transfer it into 1L volumetric flask and make volume upto the mark.

⇒ To prepare standards of 10 ppm, 20 ppm, ..., 90 ppm, take 10 ml, 20 ml, ..., 90 ml from 100 ppm sol. transfer it to 100 ml volumetric flask and make volume upto the mark.

by adding distilled water. Mix these contents thoroughly.

Preparation of Running Standards:

Preparation of 100ppm stock solution:

Take 100ml from main stock solution of 1000ppm in 1L volumetric flask dilute it to the mark. Thoroughly mix the contents. The concentration of prepared solution will be 100ppm having volume 1000ml.

Procedure:

Switch on the flame photometer.

Heat the instrument for running condition for 15 min.

Now feed blank sample and adjust the reading at zero.

After this, feed all standard solutions from 10-100ppm and accordingly note the reading of each standard.

In this way a graph will be prepared.

At this stage, flame photometer is calibrated.

Feed unknown sample and note readings for every sample.

Always feed standard solutions after every 30 samples.

Calculation:

Determine the concentration of each unknown sample by standard graph. This concentration will be in ppm. Divide this reading by 23 to convert concentration into mg L^{-1} .

~~23~~

Determination of Potassium by using flame photometer.

Reagents:

Flame photometer

Distilled water

Wash bottles

Standard solutions of potassium.

Extract of soil sample.

Preparation of Stock Solution:

$$\text{Salt KCl} = \frac{74.5}{39} = 1.91$$

Take 1.91 g of analytical grade KCl. Transfer this salt into 1L volumetric flask and make volume upto the mark and mix these contents thoroughly. The concentration of prepared solution will be 1000 ppm.

Preparation of Running Standards:

To prepare 100 ppm having volume 1000 ml...

$$C_1 V_1 = C_2 V_2$$
$$1000 \times V_1 = 100 \times 1000$$

$$V_1 = \frac{100 \times 1000}{1000} = 100 \text{ ml}$$

Take 100 ml from 1000 ppm sol. transfer it to 1L volumetric flask and make volume upto the mark.

m.l. ~~remaining~~ standards solutions from 100 ppm solution.

c) To prepare standards of 10 ppm, 20 ppm... 90 ppm take 10 ml, 20 ml --- 90 ml from 100 ppm solution. Transfer it to 100 ml flask and make volume upto the mark.

Preparation of 100 ppm stock solution:

Take 100 ml from the main stock solution of 1000 ppm in 1L volumetric flask and make volume upto the mark.

The concentration of prepared sol. will be 100 ppm.

Prepare standards of 20, 30, 40 ppm - ... 100 ppm by using the stock of 100 ppm.

Procedure:

Switch on the flame photometer.

Heat up instruments for running condition atleast for 15 min.

Now feed blank solution adjust the reading at zero.

After this feed standards ranging from 10 - 100 ppm and note the readings accordingly.

In this way a graph will be prepared.

GR for Saline sodic and Sodic Soil:

This experiment consist of two steps:

① Preparation of gypsum saturated solution:

Take 5g salt of analytical grade gypsum powder. Transfer it to volumetric flask. Add 200-300ml distill water and shake it for 10-15 min on mechanical shaker. Make volume upto the mark and filter the solution and then determine Ca+Mg in solution. Value should be in range of 28-32 me/l. Note this conc. as blank.

② Take 5g prepared sample in 250ml plastic bottle. Add 100ml gypsum saturated solution and shake the contents. Filter these contents and find Ca+Mg in this sample. It's value will be less than blank solution.

Calculation:

$$\begin{aligned} \text{G.R.} &= 2 \times \left[\text{Ca+Mg}_{\text{in blank}} - \text{Ca+Mg}_{\text{in soil}} \right] \text{ me/lwg soil} \\ &= y \times 0.86 \Rightarrow \text{tons/Acre} \end{aligned}$$

At this stage flame photometer is calibrated.

Feed unknown samples and note readings for every sample.

Always feed standard solution after every 30 samples.

Calculations:

Determine the concentration of each unknown sample by standard graph. This concentration will be in ppm.

Divide this ppm by 39 to convert the concentration into mg L^{-1} .

Water Analysis

Importance of Water:

Water is the basic need for life.

Water is a symbol of life on earth.

Universal Solvent

Required for chemical reactions.

Nutrient uptake.

Living things can not maintain their shape without water.

Necessary for photosynthesis.

With increase in population, demand of water increases.

Natural sources are limited.

Ground water is not of good quality. 60% of ground water is unfit for irrigation in Pakistan.

Analysis of Irrigation Water:

Why we analyse?

What is objective??

Describe various purposes...?

Objectives:

To determine the quality of irrigation water so that possible effects of this water on soil properties as well as crop growth may be known.

To determine the suitability of water for certain types of crops.

To know the nature, type and amount of salts present in the water to avoid the soil from becoming salt affected.

To recommend suitable measures to the farmers for the use of available water.

Methods of ~~Water~~ Sampling:

Water sample should be representative of the water being used.

10-15 min are required for water analysis.

Water is present in the form of layers in soil profile.

Take sample after running the tube well for 30 min.

Take sample from the mouth of tube well.

Take sample in a clean bottle and do not wash it with soap or detergent.

Do not use insecticides bottle.

Size of Sample:

Size of sample should be about 1 L.

Sol

Determination of different anions from a given irrigation water sample...?

Determination of Carbonates:

Reagents:

Phenolphthalein (Indicator)

1%, $N/100$ H_2SO_4 , 0.01 N

Method:

Take some water sample in a china dish with the help of pipette.

Add 2-3 drops of indicator, if pink color appears it means carbonates are present in the sample on the other hand if ~~no~~ color appears it means carbonates are absent in sample.

Titrate it with $N/100$ H_2SO_4 taken in a burette. Acid should be added dropwise carefully.

Stop titration when sample becomes

colorless.

Note the volume of acid used for this titration and note this reading as R_1 .

Keep this sample for further analysis.

Calculation:

$$\text{Carbonates} = \frac{2R_1 \times \text{Normality of Acid} \times 1000}{\text{Volume of sample taken}}$$

Determination of Bicarbonate:

Reagents:

Methyl Orange (Indicator)

0.01 N H_2SO_4

Procedure:

Add 2-3 drops of methyl orange indicator in the same china dish from which carbonates were determined.

Titrate these contents with 0.01N

H_2SO_4 till pinkish yellow end point.

Note the volume of H_2SO_4 used as R_2 .

Keep these contents for further analysis.

Calculation:

$$\text{Bicarbonate} = \frac{(R_2 - R_1) \times N \text{ of } H_2SO_4 \times 1000}{\text{Volume of sample taken}}$$

Determination of Chloride:

Reagents:

K_2CrO_3 , Potassium Chromate (Indicator)

$N/100$ silver nitrate $AgNO_3$

Procedure:

Add 2-3 drops of K_2CrO_3 indicator in same china dish from

which CO_3 and HCO_3 were determined.

Titrate these contents with $N/100$ $AgNO_3$

sol. taken in burette till end point

brick red color appears.

Note the volume of AgNO_3 used for this end point.

Note volume as R.

Calculation:

$$\text{Chloride} = \frac{R \times \text{Normality of } \text{AgNO}_3 \times 1000}{\text{Volume of sample taken}}$$

Determination of Sulphates:

Sulphates can be determined by difference method.

$$\text{SO}_4 = \text{TSS} - (\text{CO}_3 + \text{HCO}_3 + \text{Cl})$$

$$\text{TSS} = \text{EC} \times 10$$

~~See~~

Determination of different cations from a given irrigation water sample ?

In general there are four water soluble cations present in any given water sample that are Ca, Mg, Na and K.

Determination of Calcium + Magnesium:

Reagents:

Standard EDTA $N/100$ Sol. (versinate sol.)

Buffer Solution ($NH_4Cl + NH_4OH$)

EBT (Erichrome black T).

Procedure:

Take some water sample in china dish / conical flask.

Add 2-3 drops of buffer solution and 2-3 drops of EBT mix all these contents with glass rod.

Start titrating this sample with $N/100$ EDTA sol. which taken

in burette till bluish green endpoint
Note the volume of $N/100$ EDTA sol.
used for this titration. Note volume
as R.

Calculation:

$$Ca + Mg = \frac{\text{Vol. of } N/100 \text{ EDTA used} \times N \text{ of EDTA} \times 1000}{\text{Volume of sample taken.}}$$

Determination of Calcium:

Reagents:

$N/100$ EDTA solution.

4N, NaOH

Ammonium purpurate indicator

Procedure:

Take 50 ml of irrigation
water sample in a china dish.

Add 5 drops of 4N, NaOH and
approximately 50 mg Ammonium purpurate
indicator.

Mix all these contents.

Titrate this sample with $N/100$ EDTA solution which is taken into burette till orange red or purple end point.

Note the volume of $N/100$ EDTA used for this titration.

Calculation:

$$\text{Calcium} = \frac{\text{Volume of } N/100 \text{ EDTA used} \times N \text{ of EDTA} \times 1000}{\text{Volume of sample taken}}$$

Determination of Sodium by using flame photometer.

Requirements:

- Flame photometer
- ~~Distilled Water~~
- Wash Bottles
- Standard sol. of Na.
- Water Sample

PPm Reading

0

0

10

9.9 - 1.1

90

95

100

+100

Preparation of Stock Solution:

To prepare the stock solution of sodium take 2.54g analytical grade NaCl. Transfer this salt into 1 L volumetric flask. Add some quantity of distilled water to dissolve this salt completely. Make volume up to mark of flask by adding distilled water. Mix these contents thoroughly.

Preparation of Running Standards:

Take 100ml from main stock solution of 1000 ppm in 1 L volumetric flask and dilute it to the mark.

Thoroughly mix the contents. The concentration of prepared solution will be 100 ppm having volume 100ml.

Procedure:

Switch on the flame photometer. Heat up the instrument for running condition at least for 15 min.

Now feed blank solution and adjust the reading at zero.

After this feed all standard solutions ranging from 10-100 ppm accordingly, note the reading of each standard.

In this way graph will be prepared.

At this stage flame photometer is calibrated.

Feed unknown sample and note reading for every sample.

Always feed standard solution after every 30 samples.

Calculation:

Determine the concentration of each unknown sample by standard graph. This concentration

will be in ppm.

Divide this ppm by 23 to convert this concentration in mg L^{-1}

Determination of Potassium:

is also determined with the help of flame photometer.

Requirements:

- ~~Flame Photometer~~
- Distilled Water
- Wash Bottles
- Standard solution of K.
- ~~Extract~~ of Water sample

Preparation of Stock Solution:

Take 1.91g of analytical grade KCl. Transfer this salt into 1 L volumetric flask. Add some quantity of distilled water to dissolve this salt completely. Make volume upto the mark

of flask by adding distill water.
Mix these contents thoroughly.

Preparation of Running Standards:

Preparation of 100 ppm stock solution.

Take 100 ml from main stock solution of 1000 ppm in 1 L volumetric flask.

Dilute it to the mark of the bottle.

Thoroughly mix the contents of new prepared solution of 100 ppm.

Take 10 ml from 100 ppm solution to make 10 ppm solution having volume 100 ml.

Similarly, prepare the standards of 20, 30, 40, 50, 60, 70, ..., 90 ppm by taking 20 ml, 30 ml, ..., 90 ml from 100 ppm solution and make volume to 100 ml.

Procedure:

Switch on the flame photometer.
Heat up the instrument for running

condition at least for 15 minutes.

Now feed blank solution and adjust the reading zero.

After this feed all standards varying from 10-100 ppm. note the reading of each standard.

In this way a graph will be prepared.

At this stage flame photometer is calibrated.

Feed unknown sample and note reading for every sample. Always feed standard solution after every 30-50 samples.

Calculation:

Determine the concentration of each unknown sample by ~~feed~~ standard graph. This concentration will be in ppm. Divide this by 39 to convert the concentration into mg L^{-1} .

∴ Gypsum Requirement of Water:-

Formula for gypsum requirement of irrigation water is also known as Eaton's Equation. This equation was given in 1965.

$$GR \text{ of Water} = a + b + c$$

$$a = (\text{Na} \times 0.43) - (\text{Ca} + \text{Mg})$$

$$b = (\text{CO}_3 + \text{HCO}_3) \times 0.7$$

$$c = 0.5$$

Find the gypsum requirement of irrigation water if analysis indicate that

$$\text{TSS} = 14.3$$

$$\text{CO}_3 = 1.5$$

$$\text{HCO}_3 = 9.75$$

$$\text{Cl} = 6.00$$

$$\text{Ca} + \text{Mg} = 5.63$$

$$\text{Na} = ?$$

$$\text{Na} = \text{TSS} - (\text{Ca} + \text{Mg})$$

$$= 14.3 - 5.63$$

$$\text{Na} = 8.67$$

$$\text{SAR} = \frac{\text{Na}}{\sqrt{\frac{\text{Ca} + \text{Mg}}{2}}} = \frac{8.67}{\sqrt{5.63/2}} = 5.167$$

$$\begin{aligned} \text{RSC} &= (\text{CO}_3 + \text{HCO}_3) - (\text{Ca} + \text{Mg}) \\ &= (1.5 + 9.75) - (5.67) \end{aligned}$$

$$\star \text{RSC} = 5.62$$

$$\text{GR for Water} = a + b + c$$

$$\begin{aligned} a &= (\text{Na} \times 0.43) - (\text{Ca} + \text{Mg}) \\ &= (8.67 \times 0.43) - (5.63) \end{aligned}$$

$$= 3.7281 - 5.63$$

$$a = -1.9019$$

$$b = (\text{CO}_3 + \text{HCO}_3) \times 0.7$$

$$= (1.5 + 9.75) \times 0.7$$

$$= 11.25 \times 0.7$$

$$b = 7.875$$

$$c = 0.5$$

$$\text{GR for Water} = a + b + c$$

$$= -1.9019 + 7.875 + 0.5$$

$$= 6.4731 \text{ meL}^{-1}$$

$$6.4731 \times 86$$

$$= 556.686 \text{ mgL}^{-1}$$

$$= 0.5566 \text{ g L}^{-1}$$

$$= 0.0005566 \text{ kg L}^{-1}$$

$$1 \text{ Acre inch} = 102790.15 \text{ litre}$$

$$\Delta \text{ water for wheat} = 20 \text{ inches}$$

$$= 102790.15 \times 20$$

$$\text{Total H}_2\text{O} = 2055803 \text{ litre}$$

$$\text{Required quantity of Gypsum} = 2055803 \times 0.0005566$$
$$= 1144.2599 \text{ kg}$$

$$= \frac{1144.2599}{1000}$$

$$= 1.14 \text{ tons}$$

$$1.14 \text{ ton} \times 20$$

$$= 22.88 \approx 23$$

Approximately 23 bags of gypsum are required.

Find the G.R for given irrigation water sample if analysis shows that

$$EC = 1.06 \text{ meL}^{-1}$$

$$CO_3 = \text{Absent}$$

$$HCO_3 = 8.5 \text{ meL}^{-1}$$

$$Cl = 5.25 \text{ meL}^{-1}$$

$$SO_4 = TSS - (CO_3 + HCO_3 + Cl)$$

$$Ca + Mg = 3.85 \text{ meL}^{-1}$$

$$Na = 6.75 \text{ meL}^{-1}$$

$$\begin{aligned} RSC &= (CO_3 + HCO_3) - (Ca + Mg) \\ &= 8.5 - 3.85 = 4.65 \end{aligned}$$

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}} = \frac{6.75}{\sqrt{\frac{3.85}{2}}} = 4.85$$

$$TSS = 10.6$$

$$SAR = 4.85$$

$$RSC = 4.65$$

$$a = (Na \times 0.43) - (Ca + Mg)$$

$$a = (6.75 \times 0.43) - (3.85) \Rightarrow -0.9475$$

$$b = (CO_3 + HCO_3) \times 0.7$$

$$= 8.5 \times 0.7 = 5.95$$

$$c = 0.5$$

$$\begin{aligned}
 \text{GR for water} &= a + b + c \\
 &= -0.9475 + 5.95 + 0.5 \\
 &= 5.50 \text{ meL}^{-1} \\
 &= 5.50 \times 86 \\
 &= 473 \text{ mgL}^{-1} \\
 &= 0.000473 \text{ kgL}^{-1}
 \end{aligned}$$

$$1 \text{ Acre inch} = 102790.15 \text{ litre}$$

$$\text{A water for wheat} = 20 \text{ inches}$$

$$\text{Total H}_2\text{O} = 102790.15 \times 20$$

$$= 2055803 \text{ litre}$$

$$\begin{aligned}
 \text{Required quantity of Gypsum} &= 2055803 \times 0.000473 \\
 &= 966.2274 \text{ kg}
 \end{aligned}$$

$$= \frac{966.2274}{1000}$$

$$= 0.966 \text{ tons}$$

$$= 0.966 \times 20 \Rightarrow 19.32 \text{ bags}$$

Approximately 20 bags are required.

~~Ans~~