Which Soil should We Choose?

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Notes for the teacher

- The choice of the place is very important. It is suggested, if possible, to choose an area where a lagoon and a forest come together, since the characteristics of the soil in the coast of the lagoon will not be the same than the one extracted under a pine grove, or in a low pasture area. Different soils of the zone can also be selected so that each group gets distinct results. Once the place is chosen, make a prior reconnaissance of the area that will be used so that the display points have different physical characteristics in order to stimulate discussion and interchange of ideas in the plenary meetings.

- Examples of techniques of analysis that can be used in the development of this activity are enclosed.

- The bibliography of this topic is wide and varied .The necessary information can be obtained through different books of soil analysis.

- By Internet it is easy to accede to the Edaphology Institute of Barcelona that has very interesting scientific material. (http://edafología.ugr.es)

Worksheet Nº 1

1.-Texture: Granulometric analysis of the soils.

1.1.-Introduction

The texture of soil or its granulometric composition refers to a proportion of soil particles that are classified according to their size once the aggregates are destroyed. The texture depends on the chemical composition of the soil and determines its physical properties and chemical reactivity; therefore the soil fertility.

1.2.-Materials and necessary reagents.

1 jar with a lid

1 measuring pipette of 5 ml

1 Porcelain capsule

1 pipette of 100 ml or 1 graduated test tube.

Solid “calgon” or any other detergent.

Drying heater

Analytical balance.

1.3.-Taking of samples

The taking of samples is carried out in foils of 15cm per 15 cm, 10 cm deep. Be careful not to break the block structure.

1.4.- Procedure

Pulverise and sift a soil sample using <2mm (a spaghetti colander may be used).

Dry with a heater for one hour.

Weigh approximately 5g of the sample (Ps)

Put the sample in a jar with a lid. Add exactly 100 ml distilled water (V). (The mixture should not occupy more than 2/3 parts of the jar).

Add a small amount of “Calgon”. Shake hard, let settle for one minute and shake again. Repeat this step 5 times.

After the last shaking, take the lid off and let settle for one minute.

Measure, with the pipette in the middle of the suspension (that contains mud and clay, the sand deposits itself quickly), exactly 5ml and decant into a porcelain capsule previously cleaned, dried and tared.

Evaporate the measured suspension to dryness starting softly on the wire cloth and then heated for one hour.

Let it cool in the drier and weigh. (By difference we will obtain the weight of mud and clay (Pla).

After 8 hours (never before 4 hours), 5 ml of the suspension are measured again and transferred to a china capsule previously tared (in this period the mud has already deposited, whereas the clay remains in suspension).

Heat to dryness with the same precautions than in the previous case.

Weigh, The amount of clay of the sample will be obtained by difference (Pa)

With the data obtained we can determine approximately the percentages of each of these components in the sample.

1.5.-Terminology: Detersive, mud, clay.

Worksheet Nº 2

2.- Content of water in the soils.

2.1.- Introduction

The capacity of retention of water in the soil allows the availability of water for the plant, with its nutrients dissolved, and the free space that can be occupied by the air. It is interesting to know the content of water in the saturation point, in the field capacity, in the fading point of the plant and the hygroscopic water.

2.2.- Necessary materials and reagents

1 tin of 500 g, cut and marked at 10 cm

1 funnel bigger than 10 cm

1 Graduated test tube of 100 ml

1 metal ring and metal feet

Permeable cloth

Impermeable cloth

Scale

Heater

2.3.- Taking of samples

Trying not to break the structure, take a soil sample of 10 cm diameter and 10 cm deep. (This task can be carried out with tins with the bottom already cut)

2.4.- Procedure

Weigh the soil, if possible in the place where the sample has been taken (Psitu)

Add water until the soil begins to be flooded. [The soil is in its maximum saturation capacity. It is weighed (Pmx)]

Let it drain for two days, protecting the soil from evaporation.[The soil is in its field capacity, it is weighed and you obtain (Pc)]

Cut the upper part of the bottle to encourage evaporation. Leave to evaporate for three days. [The content of water that remains in the soil is the hygroscopic water, the reserve of soil humidity (Ph)]

Further dry using a heater at 105-108C for 8 to 24 hours. [The water retained is the reticular water].

Weigh and write down (Ps)

The water percentage in each point is determined taking into account:

Psitu-Ps = humidity of the soil IN SITU, hydric balance.

Pmx-Ps = Maximum saturation capacity

Pc-Ps = Field capacity (reserve of water in the soil)

Ph-Ps = Hygroscopic water, not available for the plant.

2.5.- Terminology: Hygroscopic, reticular.

Worksheet Nº 3

3.- Permeability of the soils

3.1.- Introduction

The different permeability of the distinct types of soil indicates that water is retained more or less energetically according to the soil texture and structure. For the same soil, the retention force grows when the content of water is smaller in the soil.

The permeability of a soil is expressed by the infiltration speed of the gravitative water, which is greater when the macroporousness of the soil is greater too. It also depends on the soil composition, the greater the permeability, the smaller the clay content of the soil.

3.2.- Necessary materials and reagents

1 tin of 500 g, cut and marked at 10 cm

1 graduated strip of paper

1 funnel bigger than 10 cm

1 test tube of 100 ml

1 metal ring and metal feet

Permeable cloth

Impermeable cloth

Chronometer

3.3.- Taking of samples

Trying not to break the structure, take a soil sample of about 10 cm diameter and 10 cm deep (This task may be carried out with tins of 500g with the bottom already cut)

3.4.- Procedure

Cover the bottom of the bottle with a permeable net or cloth, and then with an impermeable one; [it may be an auto-adherent plastic].

Add water until the soil absorbs it completely; then till the recipient is flooded, surpassing 2 cm the edge of the soil.

Percolate on a graduated recipient, keeping in each aggregate the level of volume of water. Check the time taken for 100 ml of water to drain.

The permeability is calculated by: volume of percolated water/ percolation time.

3.5.- Terminology : to percolate, macro-porousness.

Worksheet Nº 4

4.- Soils porousity

4.1.- Introduction

It is important to know not only the content of water of the soils, but also the fraction available for the plant, that will provide dissolved nutrients, and the free space that the air can occupy. All this is conditioned by the movement of the water through the pores, the possibility of its course and the retention force of the water through the soil.

The total porousity of a soil comprises the micro and macropores, and the volume of the soil hollows can be occupied by the water and air.

The percentage of macropores depends on the soil structure, and a sign is the permeability, the gravitic water circulates through the macropores.

In the macropores the water is retained by capillarity. The volume occupied by the microporosity will be the volume of water retained by capillarity, that is to say, the volume of water in the soil at field capacity (more exactly the retention capacity)

4.2.- Necessary materials and reagents

1 tin of 500g

1 funnel bigger than 10 cm diameter

1 test tube of 100 ml

1 metal ring and metal feet

Permeable cloth

Impermeable (foil)

Scale

Heater

4.3.Taking of samples

Trying not to break the structure, tale a soil sample about 10 cm diameter and 10 cm deep (this task may be carried out with tins with the bottoms already cut).

4.4.- Procedure

Cover the bottom of the bottle with a permeable cloth, and then with an impermeable one. Add water until the ground is saturated. Let it drain over a graduated recipient for 2 hours.

Measure the amount of water drained. [This volume is the gravitative water and it gives us macropore volume.]

(By calculating the volume of the soil used in the experiment we can determine the percentage of macropores.

The percentage of macropores can be calculated taking into account the difference between the soil weight drained by a heater (Ps) and the soil weight at field capacity(Pc) – see water content in soils).

4.5.- Terminology: macropores, micropores.

Worksheet Nº 5

5.- Apparent density of soils

5.1.- Introduction

The apparent density of soils is a sign of the total porosity grade. It can be approximately calculated in the following way.

5.2.- Materials and reagents

1 metal tin, cut and marked at 10 cm.
Ruler graduated to mm.
Balance
Heater

5.3.- Taking samples.

Trying not to break the structure, take a sample of soil about 10cm. of diameter and 10 cm of depth. (use tins with the bottom cut).

5.4.- Procedure

The tins with the soil, must be colocated in heating at 120 ºC for 24 hours. (or until the weight is constant).
Then, it is weighted in the balance at 0,01g to give (Ps).
The volume of the soil is determined measuring the dimensions of the recipient that contains it and using the formula of volume of the cylinder. By the difference with the tare of the tin, the mass of the soil is determined.
With this data the apparent density is calculated by

♎ = m / v

Worksheet Nº 6

6.- Interaction water-soil

6.1.- Introduction

The water is retained by the soil with more or less strength according to the characteristics of the soil. The retention strength is measured by the pf.
The interaction of the water in the micropores and in the soil surface by chemisorption is a real chemical reaction. It is an exothermic reaction.

6.2.- Necessary materials and reagents

Portion of soil

Heating

Thermometer

6.3.- Procedure

A portion of soil is dried at 120 C for 2 hours.

It is left to cool and the temperature measured.

A thermometer is introduced in the soil, while it is soaked with water little by little. (the water must be at the same temperature than that of the soil)

The temperature of the humid paste is measured. The increase in temperature is due to the heat of water absorption through the soil. Calculate the variation of the temperature of the system.

6.4.- Terminology: chemisorption, exothermic.

Worksheet Nº 7

7.- Suitable water for plants

7.1.- Introduction

It is very interesting the water available for plants which is the one the plant absorbs through its roots against the retention of the soil. The capillary water retained energetically by the soil, which cannot be absorbed by the plant and this one is shrivelled.

The water reserve depends also on the soil density and the roots depth of the plants.

7.2.- Necessary materials and reagents

Portion of soil

Petri dish

Heating

Balance

Spoon or spatula

Ethanol

7.3.- Procedure

A portion of soil is put on a petri dish or porcelain capsule, previously tared.

It is heated and drained at 120 C for 2 hours.

It is cooled down and it weighed.

The sample is smoothed and a spatula soaked in alcohol is run over it. (The soil will adhere to the surface of the spatula).

Water is added little by little until the soil is not adhered to the spatula. (It is at this point when the water of the soil is suitable for the plant).

It is weighed again to give (pm).

The sample is left for 2 days, then it is weighed again, (giving the content of water when the soil is at field capacity).

The suitable water available for the plant is the difference between pc and pm .

The amount of water in the shrivelled state is pm – ps

Calculate the percentage of water in the shrivelled state.