Food and Agriculture Organization of the United Nations

Global Soil Doctors Programme

Physical Properties – Exercise P06b

Soil water content: gravimetric method [1]

Reference poster n. 4

RELEVANCE

Soil water content and moisture represent the amount of water within the pore space. Factors such as soil structure, texture and organic matter content affect the soil's ability to hold and drain water. The weight method provides a direct measurement of soil water mass content, which can be used to adequately calculate irrigation requirements, assess soil moisture conditions for crop growth at specific periods (e.g. planting, flowering, grain or fruit filling, etc), monitor soil water changes, and many other uses. It is advisable to perform the assessment under adequate and representative soil moisture conditions (i.e. outside periods of extreme drought or rainfall).

MATERIALS

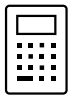

Trowel/ spade/auger


Zipper bag


Marker pen & notebook


Drying container


Weighing scale


Calculator (optional)


Oven (optional)

PROCEDURE

In the field:

1) Obtain a soil sample at a selected depth using the trowel/spade/auger. Place the soil sample in a zipper bag, close it hermetically, and label with location, date, depth and a unique number for each bag. Be sure the bags are completely dry before starting.
Perform texture assessment (exercise P01a or P01b)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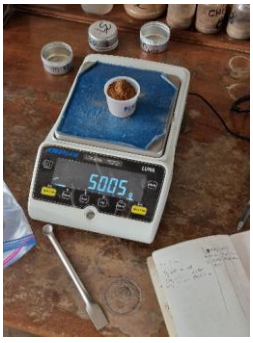
At a table or workstation (same day):

1) Position the drying container on the weighing scale. Place fresh soil on the plate (around 50 g soil) and record the exact moist weight, together with the date, time, depth and sample number in your notebook.

2) Dry the soil until weight stabilises. This can be done: (a) by oven-drying for 24-48 hours at 105 °C; (b) with a microwave (heating repeatedly for 5 minutes at 50% power, using paper containers) until constant weight is achieved (20-25 minutes in total depending on soil type and moisture); (c) by air-drying for about a week.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3) After drying, weigh the containers with soil to obtain the dry weight and proceed to calculate soil water content (next page)

PROCEDURE	4) Calculate the soil water content using this formula: ***Water content % = (weight of moist soil (g) – weight of dry soil (g)) / weight of dry soil (g) * 100*** *Example:* Moist soil: 90g; Dry soil: 76g ***Water content = (90g – 76g) / 76g * 100 = 18.4%***

ADVANTAGES OF THE METHOD	The method is easy to perform and does not require much technical knowledge. It provides direct measurements of water content and allows to estimate available water (soil moisture).
LIMITATIONS OF THE METHOD	Some equipment like oven dryers can be expensive, but the drying of the soil could be done by allowing the samples to air-dry for a period of 7 days. A weighing scale is needed for this method.
QUESTIONS TO BE ADDRESSED	Since last rain, does the soil feel wet? Is there enough water in the soil for your crops to grow well? Do you think the water content is the same all over the field?

EVALUATION EXAMPLES*		
POOR	**MODERATE**	**GOOD**
Coarse texture: • Water content < 8-10 % **Medium texture:** • Water content < 14-15 % **Fine texture:** • Water content < 22-24 % <50% available water Plants experiencing water deficit stress or > 100% available water (waterlogged fields) Plants experiencing excess water stress	**Coarse texture:** • Water content from 8 to 13 % **Medium texture:** • Water content from 14-15 % to 18-20 % **Fine texture:** • Water content from 22-24 % to 25-27 % 50-75% available water Plants at risk of stress if water deficit is prolonged.	**Coarse texture:** • Water content > 11-13 % **Medium texture:** • Water content > 18-20 % **Fine texture:** Water content > 25-27 % >75% available water; Soil in good condition to support plant development.

*Ranges adapted from Brady and Weil 2016. These are orientative ranges, precise thresholds should consider soil water retention curve and soil bulk density

[1] Standard operating procedure for soil moisture content by gravimetric method (fao.org)