



Measurement of Soil Moisture

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To determine if fields have enough soil moisture for wheat planting, in-field sampling will be required. The two predominate types of soil moisture determination include:

1. **Determining gravimetric soil water.** This is the most accurate method for your use.
2. **Hand-feel method.** This is a faster method but is prone to error since it requires experience and can be subjective.

The preferred method for determining soil moisture is the use of gravimetric soil moisture. However, if a person has experience in the hand-feel method and is comfortable in this method, this is an acceptable method. The use of the hand-feel method and gravimetric soil sampling together is strongly encouraged. The hand-feel method will allow for more locations to be sampled while the gravimetric soil sampling can back-up results from the hand-feel. The following procedures will help in determining the amount of stored soil moisture.

Equipment

Equipment needed includes zip-loc bags (preferably freezer bags) or other sealable container, a cooler, soil sampling tool, paper plates and a scale. The soil sampling tool can be a soil probe, auger or even a post-hole digger. Scales should have accuracy to 0.1 grams.

In-field Sampling

Proper sampling of the field is important to obtain a representative sample of the field. Sample a field at a minimum of three sample locations. Choose sample locations that are representative of the entire field. Avoid sampling small areas of low spots or ridges that do not represent the majority of the field. Using a soils map may be advantageous to determine if the field has major change in soil classification. If there are major changes in soil classification within a field, you should break the fields into sub-sites and sample accordingly.

When sampling in field, soil samples should be taken to 2 feet (preferable 3 feet) in one-foot increments with each foot kept separately. If there seems to be large differences in moisture contents between samples, it would be advisable to sample an extra location or two. The hand sampling method will be helpful in such situations when you see disagreement between samples. Take the samples as quickly as possible and store in zip-loc bags. This will prevent the loss of moisture to evaporation. After collecting samples, place the samples in the cooler to keep the samples at a moderate temperature. It is

absolutely imperative that the samples are placed in a sealed container.

Drying of Samples

After soil samples have been taken and returned to the office/lab, quick and careful procedures need to be taken. The following steps will help in drying the samples.

1. Thoroughly mix the samples in the zip-loc bags to ensure uniform distribution of the sample.
2. Weigh the paper plate before putting soil on the plate. This value will be needed for the calculation of soil moisture. Do not use plastic ware in the microwave as it may melt.
3. Place approximately 25 grams of wet/moist soil on the paper plate and record the weight of soil and plate.
4. Drying the sample can be done in either a microwave oven or conventional oven. A microwave oven will be faster for drying. With either device, be sure you have good ventilation in case of fumes. The appropriate steps for drying with a microwave oven are as follows:
 - a. Place sample into microwave and run the microwave oven for 10 minutes.
 - b. Weigh the sample and return to microwave oven for 5 minutes and reweigh. If the weight of the sample has changed, return to the microwave oven for 5 more minutes. Repeat the process until the weight does not change. Typical drying times for a wet sample are close to 20 minutes. Water is the first component of the soil to heat and evaporate. If the sample is dry and microwave drying continues, the soil temperature will increase and oxidize organic matter. This will bias your results.
5. If you are using a conventional drying oven, place samples in the oven at 105 degree centigrade (220 F) for 24 hours.
6. Use the [worksheet](#) for calculation of soil moisture. This will involve inputting the data collected from the field and values from Table 1.

Values in Table 1 show average bulk density, wilting point, and plant available water. These numbers will be used in the calculations on the [spreadsheet](#). For more local information, the use of soil surveys may result in more site-specific information. Also, consult with local NRCS personnel for potential information regarding soil properties.

Table 1. Average bulk density, wilting point and plant available water for 5 soil textures. These values will be used in the [spreadsheet "Soil Moisture Determination"](#). Lower bulk density by 0.1 if soil is recently tilled.

Texture	Bulk Density g/cm ³	Average Wilting Point	Plant Available Water Inches/Ft
Sandy loam	1.60	0.057	1.66
Silt Loam	1.45	0.119	2.00
Loam	1.50	0.097	2.40
Sandy clay loam	1.45	0.137	1.66
Clay loam	1.45	0.157	1.90

Disclaimer: These are average values and can be different than actual field values. These differences can be due to variations in texture, organic matter and structure of the soil in the field and average table values. The only true way to determine the wilting point for a

soil is to use a pressure membrane chamber and an undisturbed soil sample. Many labs will do this test at costs of \$40 or more per sample.

Drawbacks to Gravimetric Soil Water

Although gravimetric soil water may be the most accurate way to estimate soil moisture, it can have serious errors. The use of averages for wilting point, bulk density and plant available soil moisture can be a major cause of error. Although there are many classifications for soil types, there can be major differences within each classification as to those soil water components. Also, how the soil has been managed can have a major impact upon these soil properties. Compaction is the major cause of error in bulk density.

Hand Feel Method

The hand feel method is an acceptable method for determining soil moisture. It is a fast and simple method where many more locations can be sampled. One of the major drawbacks with this method is that the estimation of soil moisture is subjective and is not an exact amount of moisture. Many times this estimation can be off by as much as 10% or more. This method may be used if a person has had sufficient experience in this method. To help with this method, Nebraska has produced Nebguide G84-690-A. It has pictures of different soils at several moisture contents with a description of how the soil should feel and appear. The website for this Nebguide is www.ianr.unl.edu/pubs/irrigation/g690.htm#target2

One use for the hand feel method is; after gathering samples for determination of gravimetric soil moisture, you can use the hand feel method for determining if other areas within the field are drier or wetter than the sample sites. This method can also be used for conflict resolution as mentioned above.

Other Acceptable Methods

There are other acceptable methods for determining soil moisture. However, the use of many of these methods would be very limited due to availability of devices and time.

1. Moisture blocks. The use of gypsum blocks for fine textured soils or Watermark blocks for coarse textured soils is acceptable in determining soil moisture. These are acceptable methods for measuring soil moisture in irrigated fields. The use of these has been very limited in dryland agriculture.
2. Neutron Attenuation. This method needs to be done by a licensed professional because it contains radioactive material. This method also requires extensive calibration for each site. This is generally limited to research locations. If you have a research location nearby that uses this method for soil moisture determination, the results from this research may be helpful.
3. Time-Domain Reflectometry. This method is again limited to research locations because of the expense and accessibility to equipment. If research locations are located nearby that use this method, the results from this research may be helpful.
4. Use of labs. Collection of soil samples and sending them to laboratories such as Colorado State University is an acceptable method. This may be limited in use because of the expense in laboratory fees. Sample analysis will cost between \$5 to \$10 per sample.

If you have any questions about the procedure or results, please call one of the following people

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