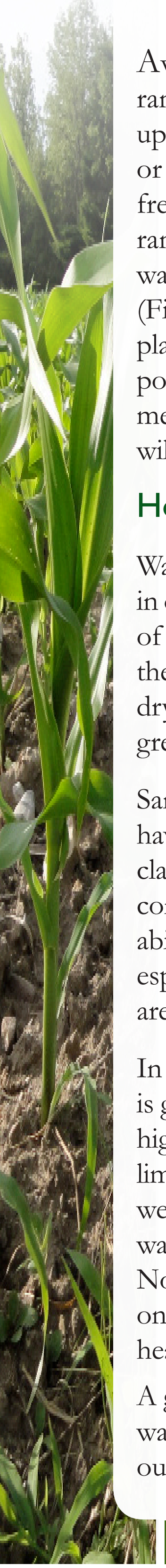
Cornell University
School of Integrative Plant Sciences

Soil Health Manual Series Fact Sheet Number 16-05



Available Water Capacity

Available Water Capacity (AWC) is an indicator of the range of plant available water the soil can store. The upper end of the range is referred to as '*field capacity*' or the condition where saturated soil ceases to drain freely from gravity after wetting. The lower end of the range is called the '*permanent wilting point*', when only water unavailable to plants is left after free drainage (Fig. 1). The water stored in the soil against gravity is plant available until it decreases to the permanent wilting point. Available Water Capacity is determined from measuring water content at field capacity and permanent wilting point in the lab, and calculating the difference.

How AWC relates to soil function

Water is stored in medium and small sized soil pores and in organic matter. Available Water Capacity is an indicator of how much water per weight of soil can be stored in the field, and therefore how crops may fare in extremely dry conditions. Soils with lower storage capacity have greater risk of drought stress.

Sandy soils, which tend to store less organic matter and have larger pores, tend to lose more water to gravity than clayey and loamy soils (Fig. 1). Therefore a common constraint of sandy (coarse textured) soils is their lower ability to store water for crops between rains, which is especially a concern during droughty periods, and in areas where irrigation is costly or not available.

In heavier (fine textured) soils, the available water capacity is generally less constraining, because clays naturally have high water retention ability. Instead, they are typically more limited in their ability to supply air to plant roots during wet periods, and to allow for enough infiltration to store water if rains comes less frequently but more intensively. Note that total crop water availability is also dependent on rooting depth, which is considered in separate soil health indicators - surface and subsurface hardness.

A guide to demonstrating how soil structure can impact water storage is available under the 'Resources' tab on our website: soilhealth.cals.cornell.edu/resources.

Managing constraints and maintaining optimal available water capacity

Short-term strategies:

- Adding stable organic materials, such as composts, that themselves can store larger amounts of water
- Use mulches to prevent water from evaporating from the surface

Long-term strategies:

- Build organic matter and aggregation to enhance porosity for water infiltration and storage
- Reduce tillage
- Long-term cover cropping
- Add amendments such as mulch
- Rotate annual crops with diverse perennials
- Keep actively growing roots in the system to build and maintain soil pores.

In coarse textured soils, building higher water storage is more challenging than in finer textured soils that inherently store more water. Therefore, managing for relatively high water storage capacity, and also for decreased evaporation through surface cover, is important in coarse textured soils. While the inherent textural effect cannot be influenced by management, choosing management options can be, in part, based on an understanding of inherent soil characteristics.

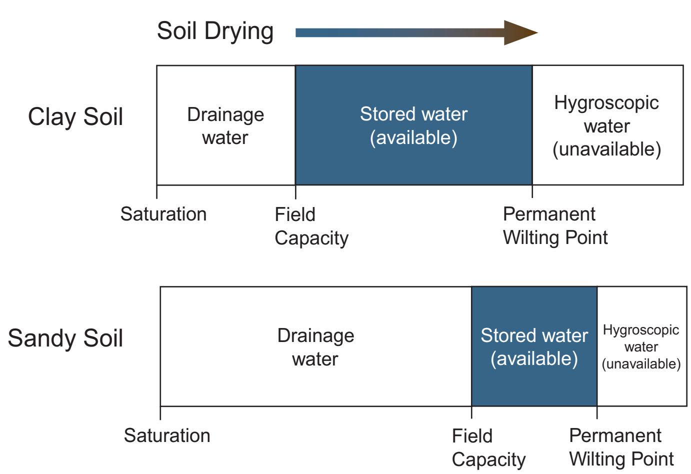


FIGURE 1. Water storage for two soil textural groups. The blue shaded area represents water that is available for plant use.

Available Water Capacity

ABOVE: Residue mulch on the surface from reduced tillage. The cover prevents water from evaporating. *Source: USDA-NRCS*

Basic protocol

- Soil is placed on two ceramic plates with known porosity, and wetted to saturation (Fig. 2a).
- The ceramic plates are inserted into two high pressure chambers to extract water to field capacity (10 kPa), and to the permanent wilting point (1500kPa) (2b).
- After the sample equilibrates at the target pressure, the sample is weighed (2c), then oven-dried at 105C overnight, and then weighed again once dry.
- The soil water content at each pressure is calculated, and the available water capacity can then be calculated as the soil water loss between the 10 and 1500 kPa pressures.

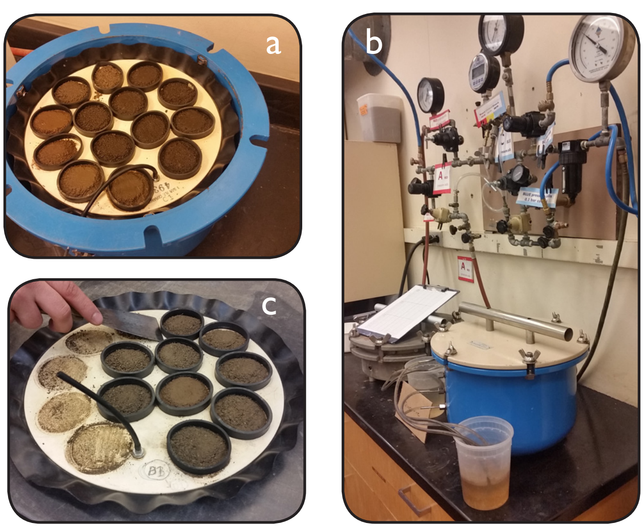


FIGURE 2 a - c. (a) Ceramic plates with soil are (b) inserted into high pressure chambers. (c) Equilibrated samples at target pressure. Samples are weighed, oven dried overnight, and weighed again.

Scoring function

Figure 3 below depicts Available Water Capacity scoring functions and upper value limits for coarse, medium, and fine textured soils. Scoring functions were combined for medium and fine classes because no effects due to texture were observed in the data set.

The red, orange, yellow, light green and dark green shading reflects the color coding used for the ratings on the soil health report summary page.

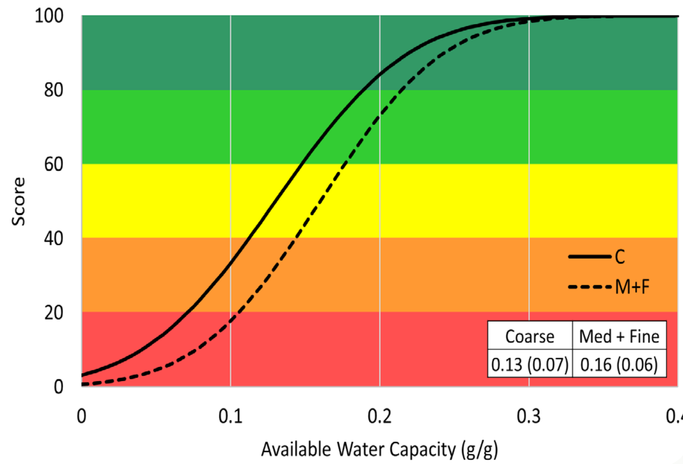


FIGURE 3. Available Water Capacity (AWC) scoring functions and upper value limits for Coarse (C), Medium (M) and Fine (F) textural classes. Mean and standard deviation (in parenthesis) for each class are provided. In this case more is better. Higher AWC scores indicate a greater capacity of the soil to store plant available water.

Cornell Soil Health Laboratory AWC Standard Operating Procedures (CSH 05) can be found under the 'Resources' tab on our website.

For a more comprehensive overview of soil health concepts including a guide on conducting in-field qualitative and quantitative soil health assessments, please download the Cornell Soil Health Manual at bit.ly/SoilHealthTrainingManual.

Acknowledgement

Thanks to the NE Sustainable Agriculture Research & Education Program, New York Farm Viability Institute, USDA-NRCS and Cornell Cooperative Extension for funding and support of the Cornell Soil Health program.

This fact sheet represents the best professional judgment of the authors and does not necessarily reflect the views of the funders or reviewers.

For more information contact:

Cornell University
Soil Health Laboratory
bit.ly/SoilHealthContacts

Harold van Es

Robert Schindelbeck

Aaron Ristow, Kirsten Kurtz and Lindsay Fennell

January 2017