



Soil Health

Key Soil Measurements

Soil health influences crop productivity, water management, nutrient cycling, and long-term sustainability. At DFWT, in addition to regular soil testing, we conduct three in-field tests to assess soil physical properties and help producers evaluate management impacts. While multiple methods exist, the following tests are those used by DFWT during field assessments.

Bulk Density

Bulk density is the mass of dry soil per unit volume, including pore space. It is expressed in grams per cubic centimeter (g/cm^3)

Significance: Bulk density measures how compacted soil is. When bulk density is high, there is less space between soil particles for air and water. Compacted soil can restrict root growth, reducing crop yields. Water moves more slowly in compacted soil, causing surface ponding, which can drown crops. Fields will also be more susceptible to surface run-off.

Measurement: Bulk density is measured by collecting a core sample of known internal volume. Soil is dried at low temperatures in an oven or microwave until a constant weight is achieved. The weight of the dry soil divided by the total soil volume gives us bulk density.

Improvement: When organic matter is incorporated into soil, it binds particles into aggregates, which increases the volume of air and water-filled pores, reducing bulk density.

- Cover crops help increase organic matter when incorporated into the soil.

Soil compaction presses soil particles closer together, so more soil mass occupies the same volume, increasing bulk density.

- Minimize tillage and avoid working wet soils to decrease compaction.

Soil Type	Bulk Density Range (g/cm^3)
Sandy Soil	1.40 - 1.60
Loam Soil	1.10 - 1.60
Clay Soil	1.10 - 1.40

Ideal bulk density values vary by soil texture. Source: United States Department of Agriculture. (2001).



Aggregate Stability

How well soil particles will hold together when exposed to external forces such as rain, wind, or tillage.

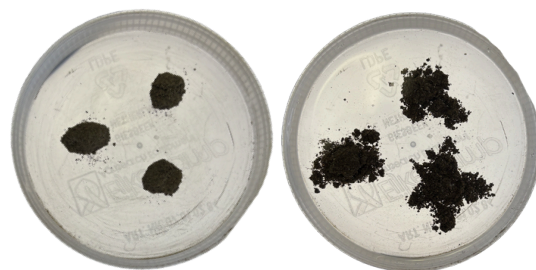
Significance: Soils with low aggregate stability break apart easily, which can lead to crusting, reduced water infiltration, increased erosion, and can lead to poor root health. Soils with stable aggregates can hold more water, allowing crops to access moisture from the soil. Roots can penetrate deeper, helping crops resist drought and improving overall growth.

Measurement: Samples are collected from the top 2 inches of soil, are broken into pea-sized aggregates, and are air dried overnight. Aggregates are submerged in water for ten minutes, and the rate at which they disintegrate can be tracked by using the mobile app Slakes. The app automatically takes images of the aggregates and generates a stability index value.

Reference Ranges: Aggregate stability will vary by soil texture. Sandy soils are more prone to dissolving when exposed to water, compared to clay soils.

Stable	Somewhat Degraded	Unstable	Significant Degradation
1.0 - 0.80	0.80 - 0.65	0.65 - 0.55	>0.55

Aggregate Stability Index range in relation to soil conditions. Source: LandWISE Inc. (2025).



Aggregates with stability index of 0.37

Improvement: Adding organic matter feeds soil microbes that produce “glues” to bind soil particles into stable aggregates

- Cover crops and Grassland Set-asides add organic matter to fields. Plant roots create soil channels, and decaying plant material feeds microbes.

Soil disturbance from heavy rain, winds, or tillage breaks apart aggregates and reduces stability.

- Minimizing tillage, avoiding heavy equipment on wet fields, and keeping the soil covered with a cover crop helps maintain strong, stable aggregates.

Infiltration

Infiltration measures how fast water enters the soil. Often measured in inches per hour.

Significance: Infiltration rate affects the availability of water to crops. Soils with poor infiltration are more prone to surface ponding, runoff, and nutrient loss. Soils with adequate infiltration are able to capture and store rainfall more effectively.

Measurement: Water infiltration is measured using a 6-inch diameter ring, that is driven into the soil. One inch of water (444mL) is added to the ring. The time it takes for the water to be absorbed into the soil is recorded as the infiltration rate. Field moisture will affect the infiltration rate, therefore two measurements are done.

Improvement: Living roots and earthworm activity create continuous channels in the soil, allowing water to move from the surface into deeper layers.

- Planting cover crops or establishing a grassland set-aside increases root density and long-term soil structure, improving infiltration.

Soil Type	Steady Infiltration Rate (inches per hour)
Sands	> 0.8
Sandy and Silty Soil	0.4 - 0.8
Loams	0.2 - 0.4
Clayey Soil	0.04 - 0.2
Saline Clayey Soils	< 0.04

Ideal water infiltration rates by soil texture. Source: United States Department of Agriculture. (2001).

Improving both aggregate stability and bulk density will help increase water infiltration.