

Wet Aggregate Stability

Wet Aggregate Stability is a measure of the extent to which soil aggregates resist falling apart when hit by rain drops and wetted. It is measured using a Cornell Rainfall Simulator that steadily rains on a sieve containing a known weight of soil aggregates. The unstable aggregates slake (fall apart) and pass through the sieve. The fraction of soil that remains on the sieve is used to calculate the percent aggregate stability (see following page).

How aggregate stability relates to soil function

Stable aggregates are built by biological activity, as aggregates are largely “stuck” together by fungal hyphae, microbial colonies, and plant and microbial exudates. Aggregates can break down, however, in intensively managed and clean-tilled soils

Aggregate stability can be used as an indicator of both physical and biological health:

- Soils with low aggregate stability tend to form surface crusts and compacted surface soils. This can reduce air exchange and seed germination, increase plant stress and susceptibility to pathogen attack, and reduce water infiltration and thus storage of water received as rainfall. This leads to runoff, erosion and flooding risk downstream during heavy rainfall (Fig. 1) as well as a higher risk of drought stress later. Poor soil aggregation also makes the soil more difficult to manage, as it reduces its ability to drain excess water, potentially causing it to take longer before field operations are possible.

Enhanced friability and crumbliness from aggregation in fine textured soils, makes the soil less dense, so that it is lighter, and is easier to work with less fuel.

A well aggregated clay soil allows for excess water to drain through fissures between crumbs, while storing water for plant use within the stable aggregates.

- Good aggregation is critical for resilience to extreme weather.



FIGURE 1. Poor soil aggregation tends to form surface crusts and compacted surface soil. This can reduce water infiltration and storage and lead to excessive runoff and erosion.

Source: indianapublicmedia.org

Tips for managing constraints and maintaining optimal aggregate stability

We want soil to have favorable, stable structure (tilth) so that plant roots can fully develop with minimal effort while maximizing rainfall infiltration and water storage for later plant use. This means:

- Plentiful fresh and diverse organic materials (such as green manures, cover crops with vigorous fine roots, animal manures, and mulches) are needed to sustain soil biota, so that they can stabilize soil aggregates.
- Repeated tillage breaks down stable soil aggregates, especially when organic additions are too low. Such soils can be so degraded that they become addicted to tillage, where crop establishment requires a soil loosening operation.
- A successful transition to reduced tillage usually requires focused tillage for crop establishment, and significant organic additions or rotation with a perennial forage or cover crop, to build the soil for minimized disturbance.
- Reduced tillage, soil cover, diverse species and crop rotations with active living roots will build and maintain stable aggregates in the long term.

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Basic protocol

- Soil is air-dried and placed on stacked sieves of 2.0 mm, 0.25 mm and a catch pan. The soil is shaken for 15 seconds on a Tyler Coarse Sieve Shaker to separate out aggregates of 0.25 - 2.0 mm size for analysis.
- A single layer of aggregates from 0.25 - 2.0 mm in size is spread on a 0.25 mm sieve (Fig. 2a).
- Sieves are placed at a distance of 500 mm (20 inches) below a rainfall simulator, which delivers individual drops of 4.0 mm diameter (2b).
- The test is run for 5 minutes and delivers 12.5 mm of water (approximately 0.5 inches) as drops to each sieve. See soils starting to wet in (2c). A total of 0.74 J of energy thus impacts each sieve over this 5 minute rainfall period. Since 0.164 mJ of energy is delivered for each 4.0 mm diameter drop, it can be calculated that 15 drops per second impact each sieve. This is equivalent to a heavy thunderstorm.
- The slaked soil material that falls through during the simulation, and any stones remaining on the sieve are collected, dried and weighed, and the fraction of stable soil aggregates (WSA) is calculated using the following equation:

$$WSA = W_{stable} / W_{total}$$

where: $W_{stable} = W_{total} - (W_{slaked} + W_{stones})$

where: W = weight (g) of stable soil aggregates (stable), total aggregates tested (total), aggregates slaked out of sieve (slaked), and stones retained in sieve after test (stones). Corrections are made for stones.

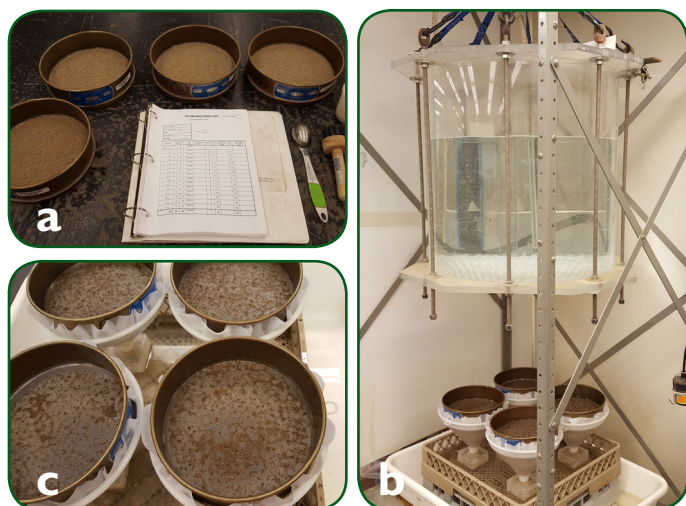


FIGURE 2 a - c. Aggregate Stability test. A rain simulator is used for 5 minutes on 4 sieves containing soil aggregates.

Scoring function

Figure 3 below depicts Wet Aggregate Stability scoring functions and upper value limits for coarse, medium, and fine textured soils.

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.

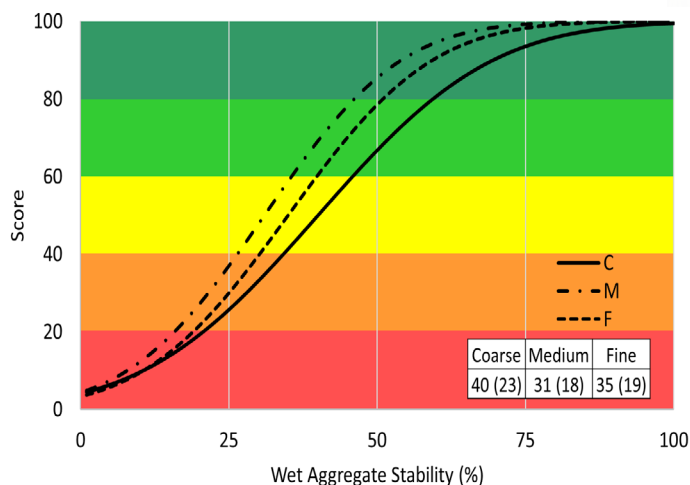


FIGURE 3. Wet Aggregate Stability scoring functions and upper value limits for Coarse (C), Medium (M) and Fine (F) textural classes. Mean and standard deviation (in parenthesis) for each class are provided. In this case more is better. Higher scores indicate a greater ability of the soil aggregates to resist falling apart when exposed to rainfall.

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.

Acknowledgment

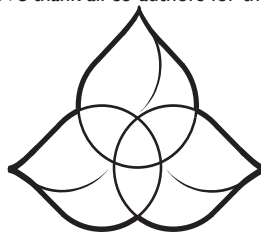
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