Soil Health Focus November 2023

POOR SOIL STRUCTURE – HAVE YOU IDENTIFIED IF IT IS COSTING YOU PROFITABILITY?

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Poor soil structure has a negative effect on crop and pasture productivity. Well structured and stable soils allow plants to develop extensive root systems that explore the soil profile, accessing water, nutrients and oxygen. These soils are generally loosely packed with low bulk density and have a high porosity compared to poorly structured soils.

Soil structural stability is defined as the resistance of soil aggregates to breakdown when subject to disruptive stresses such as cultivation, compaction, and raindrop impact. Soils with low stability quickly lose their structured condition.

Adding water to soils can cause two types of structural instability:

- Chemical (dispersion)
- Physical (slaking)

Slaking generally occurs in soils that contain low levels of organic carbon. Soil aggregates breakdown to form small particles, forming soil crusts which reduce seedling emergence, water infiltration and soil aeration.

Dispersion (sodicity) is a collapse of soil aggregates and a separation of clay particles. This is generally caused by too much sodium (Na) (ESP > 6%), potassium (K) and/or magnesium (Mg), with a lack of soluble calcium (Ca). Dispersion can also occur in soils with very low electrical conductivity (EC). The interactions of these factors produce a variety of situations where dispersion can occur.

Dispersion results in hard setting surface crusts. This reduces seedling establishment and causes impermeable sub-soil layers which affect air and water movement, reducing root penetration and nutrient and water uptake. The trafficability of these soils by machinery and animals is also affected.

Get to know your soil structure

Many agronomists and growers use soils stability indices such as:

- Calcium to magnesium (Ca:Mg) ratio.
- Exchangeable sodium percentage (ESP).
- Exchange magnesium percentage (EMgP).

These ratios are used to interpret soil structural stability and to calculate the quantity of soil ameliorant required to improve soil structure. Note however the Ca:Mg ratio does not always predict which soils require soil ameliorants such as gypsum.

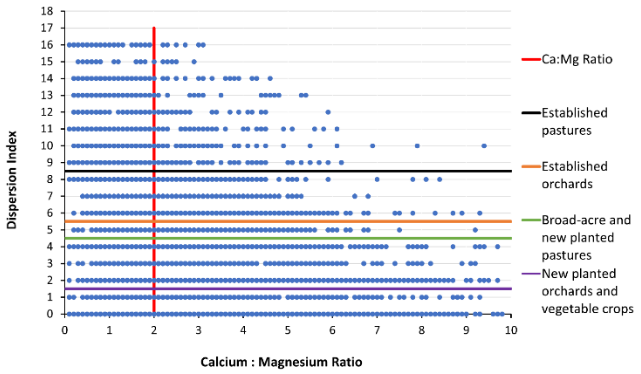
For a comprehensive assessment of soil structural stability, test your soils using the Loveday & Pyle Dispersion & Slaking test.

Air dried unground and re-moulded soil aggregates are assessed wafter 2 and 20 hours to rate the degree of slaking and dispersion. A combination of both methods is used to calculate the dispersion index, which generates index numbers between 0 and 16.

To highlight the benefit of the Loveday & Pyle Dispersion & Slaking test, 5,000 soils samples were selected from the Nutrient Advantage Laboratory results from 2019 to 2022 which contained both Ca:Mg ratio and dispersion index. These results are displayed in Figure 1.

Generally, Ca:Mg ratios >2 are rated as stable soil, right of the vertical red line in Figure 1. All samples to the right (i.e. greater than 2.0) should be structurally stable and all samples to the left (i.e. less than 2.0) should be unstable. However, this is not the situation as there is a range of stabilities on either side of the red line.

Figure 1: Graph of Dispersion index vs Ca:Mg ratio.



The horizontal lines in Figure 1 represent different dispersion index guidelines for various crop production industries; purple < 2, green < 5, orange < 6 and black <9.

If we used these categories to classify the selected soil samples, the samples that are stable or have minimal dispersion for the different crop/pasture industries are located below the appropriately coloured line.

For this data set:

- new planted orchards and vegetable crops (purple line) – 32% of all samples.
- broad-acre and new planted pastures (green line) – 64% of all samples.
- established orchards (orange line) – 72% of all samples.
- established pastures (black line) – 82% of all samples.

Samples located above the appropriately colour lines would suffer from varying levels of dispersion and impact crop establishment and production.

If we based this assessment on Ca:Mg ratio, 62% of all soil samples would be stable and 38% would be affected by varying degrees of dispersion, leading to inappropriate recommendations for soil ameliorants.

As highlighted in figure 1, there is no relation between Ca:Mg ratio and dispersion index and therefore the Ca:Mg ratio alone is a poor indicator of soil stability.

To gain a better understanding of soil stability and where soil ameliorants are required, add the Dispersion & Slaking test (Loveday & Pyle, Index 1 to 16) (Add-on Code – PHYS2) to your existing test code when sampling this season.

Further Information

For more information, please contact:

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