MURRAY DAIRY - AUTUMN START-UP WORKSHOPS.

Technical Note: PERMEABILITY & WATER MOVEMENT IN MEDIUM & HEAVY CLAY SUBSOILS.

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Description of the issue and importance: The permeability rate and internal drainage characteristics of Riverine soils are controlled by the presence of medium and heavy clay subsoil. Given their low or slow rates of permeability, the primary mechanism for allowing moisture movement into clay soils is the immediate flow of water down cracks created from drying of the profile. Medium and heavy clay subsoils are often sodic and dispersive, which further reduces the speed of water movement into and through clay layers when they are wet or swelled.

Figure 1. Typical Red Brown Earth in the Riverine Plain with medium or heavy clay subsoil, dispersive subsoil conditions and low or slow rates of permeability.

Problem Identification: The simplest method for determining the presence of low permeability clay subsoils is to dig with a shovel or pick and expose the subsoil. If the subsoil sample contains any of the following characteristics, low permeability is expected:

- Medium or heavy clay textures
- Massive or poorly structured material
- Saturated conditions
- Dispersive conditions determined by jar testing
- Sodic or high exchangeable sodium percentages, determined by laboratory testing
- Presence of manganese staining on the faces of peds

- Presence of calcium carbonate nodulation
- Presence of gypsum crystals
- High chlorides
- Moist conditions from capillary rise of moisture from a shallow water table.

Apart from some well-drained light-medium clay subsoils throughout the Riverine Plains, most subsoils evince low rates of permeability. Saturation of the A horizon after rainfall is a good indicator of the presence of low permeability clay. Figure 1 is a photograph of a soil profile in the Goulburn Valley evincing medium clay subsoil, with sodic and dispersive conditions detected.

Management options: Medium or heavy clay textured subsoils are an inherent and fixed property that require monitoring with respect to moisture content and chemistry. There are options for chemical management however the most practical option is to manage soil moisture content and ensure subsoils are constantly shrinking and swelling (moving), which aids the development of structured aggregates provide space for air, water and plant roots to colonise. The shrinking and swelling of clays also promotes slickensides, where clay aggregates rub together, forming a polished face.

Surface drainage is the first step to managing the moisture content of medium and heavy clay subsoils, along with the production of a pasture or crop to improve water utilisation.

Chemical amelioration using high rates of gypsum can improve the growing conditions of medium and heavy clay subsoil. Gypsum is the primary soil ameliorant used for rendering dispersive soil non-dispersive. Calcium obtained from gypsum displaces sodium, magnesium and potassium, creating a more stable condition with reduced dispersion. Gypsum also elevates the EC (salinity) level of clay. Upon application and dissolution with water, a flocculation or 'fluffing' effect occurs to clay, favouring improved soil structure.

Gypsum treatment helps improve soil chemical conditions however remediation of subsoil dispersion is often cost prohibitive, because of the rates of gypsum required. Leaching of gypsum from surface soils into deeper clay subsoils has been trialled as a soil chemical ameliorant with limited success. Until the A horizon contains an abundance of calcium, the attraction between available calcium and clay is strong and leaching will occur once most clay exchange sites that can be held by calcium are exploited, leaving surplus calcium to leach to the layer below. Typical rates of 2.5 t/ha rarely achieve leaching of the calcium fraction within gypsum, unless sandy loams with limited clay content are the dominant topsoil material.

Subsoil manuring has been trialled in the low to medium rainfall zone with limited success. This process deposits manure in the upper B horizon and creates an abundance of nutrient along with an increase in EC (soil salinity). Further work is required to determine the true effects of the treatment on soils in this region for improving hydraulic conductivity, porosity and bulk density.

EM38 mapping is known to correlate with soil ESP which may provide an indicator of subsoil drainage patterns. Careful moisture management may yield the most productive outcome.