Salinity and Sodicity, Implications for Farmers in Central Queensland

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Abstract

Recent soil characterisation studies carried out in association with the Central Queensland Sustainable Farming Systems Project have revealed significant natural subsoil salinity and sodicity in many of the soils used for dry-land farming in the region. Although these two problems were common, they were relatively unrecognised by the farming community and agricultural service providers. Education in understanding the soil, its processes and limitations is the key to improvements in crop productivity related to salinity and sodicity. Even if these limitations cannot be rectified economically, it is important that they are recognised so that farming systems can be managed to minimise their impact.

Key Words

Sodicity, salinity, plant available water content.

Introduction

In Central Queensland, soils need to store at least 120mm of plant available water for dryland cropping (Muller, 1999). Sodicity and salinity generally occur as layers in the soil and depending on their depth, can reduce effective rooting depth and hence the amount of water that a plant can access from the soil. In Central Queensland, open downs soils (basaltic derived) are generally free of subsoil salinity and sodicity, however these limitations are common on other cropping soils particularly Brigalow (*Acacia harpophylla*) soils. Even if saline and sodic layers are present, they are often too deep to have an impact on crop performance.

Where salinity and sodicity are present and significant in the top 1m of soil, there is unfortunately no economical solution to reducing their impact. Farmers need to treat these limitations as they do with rainfall, by managing around them. Management can involve leaving soils with significant limitations under pasture and concentrating resources (eg cropping) on soils with minimal limitations.

What is sodicity and salinity

Sodicity refers to the amount of sodium in soils. It develops through a process whereby sodium ions build up in preference to other soil cations (particularly calcium) on the exchange complex of the soil. Increases in soil pH and deceases in calcium and magnesium usually accompany this process. Soils with these features are known as *sodic soils* and are relatively common in cropping country in central Queensland. A measure of soil sodicity is known as the *Exchangeable Sodium Percentage* or *ESP*. Dividing the exchangeable sodium over the Cation Exchange Capacity or CEC and multiplying the product by 100 calculates ESP.

Salinity is more widely known and refers to the amount of soluble salt in a soil. Unlike sodicity, movements of water influence salinity. Hence, salinity has been related to clearing and irrigation development and results from changes of land use and water movements in landscapes. Soil salinity is measured by the electrical conductivity (EC) and/or chloride content. It is fairly common for both sodic and saline conditions to occur together in many soils. Locally both are often found in Brigalow soils.

Impacts of sodicity and salinity

Sodicity in soils has a strong influence on the soil structure of the layer in which it is present. A high proportion of sodium within the soil can result in dispersion in soils containing sufficient smectites (2:1 clays). Dispersion occurs when the clay particles swell strongly and separate from each other on wetting. On drying, the soil becomes dense, cloddy and without structure. This dense layer is often impermeable to water and plant roots. In addition, scalding can occur when the topsoil is eroded and sodic subsoil is exposed to the surface, reducing PAWC and increasing erodibility. The influence on sodicity to plant available water content (PAWC) for clay soils in the Emerald district is shown in Figure 1.

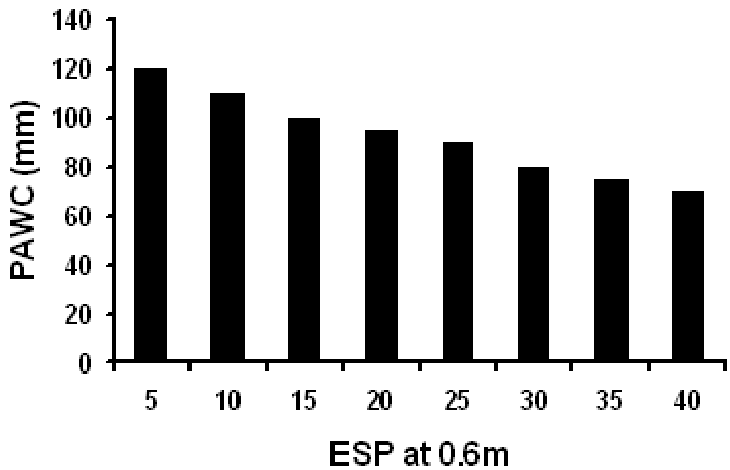

Figure 1. Increasing ESP at 0.6m reduces Plant Available Water Content (Shaw, 1997).

Salinity causes reduced root growth due to osmotic pressure and toxicity. Salinity is as common as sodicity and is largely a result of natural deep weathering and geological accumulation of salt from rainfall. However, when water moves salt to other locations more severe problems such as dry land salting occur, often rendering land unsuitable for agriculture. Research on salinity and its effects on yield for various grain crops have been documented by (DNR, 1997 after Mass and Hoffmann, 1977). Various crops have different tolerances to salinity.

Occurrence of sodicity and salinity in Central Queensland

Sodicity is generally dependent on the parent material from which a soil is formed and is found on older soils where there has been sufficient weathering of clay minerals to cause a dominance of sodium. Within Central Queensland, sodicity occurs on colluvial, older alluvial and scrub soils (non-basaltic). Vegetation is a good indicator of the location of these soils. Dawson Gum (*Eucalyptus cambageana*), False Sandalwood (*Eremophila mitchellii*) and Poplar Box (*Eucalyptus populnea*) are the main trees found on sodic soils. Examples of soils in Central Queensland and their sodicity are shown in Figure 2.

There are three forms of salinity found in the cropping areas of Central Queensland:

1. Seepage salting, where salting occurs when groundwater seeps at the ground surface. This is most commonly found in basaltic (open downs) areas. The occurrence of Black Tea Tree (*Melaleuca bracteata*) is a useful guide to seepage areas (both fresh and salt water);

2. Water table salting, where salts are concentrated on the surface from evaporation of water from a shallow water table. This form of salting is less commonly found in the area and is associated with alluvial landscapes; and

3. Soil salinity, where soils have formed a high salt concentration at depth due to weathering. This reduces PAWC and root depth for dry-land agriculture. This form of salinity is common within the majority of soils and is often associated with high sodicity. It is uncommon on open downs soils or soils derived from basalt.

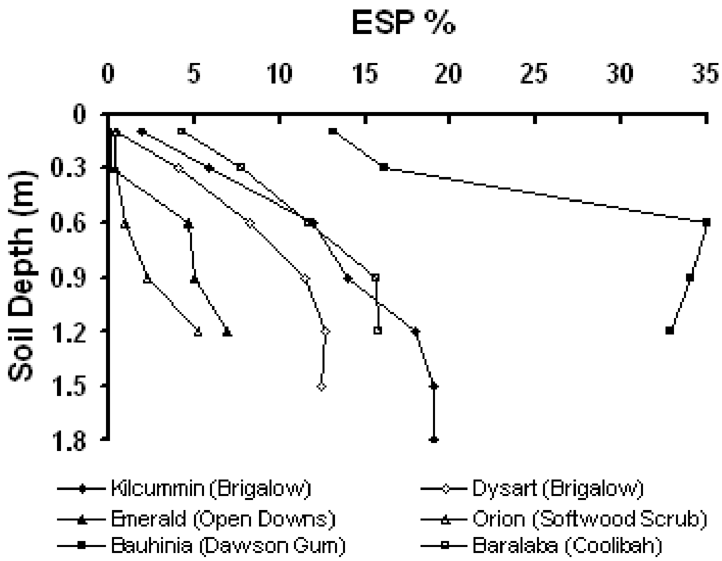

Figure 2. ESP trends differ depending on the formation of the soils indicated by their vegetation.

As with sodicity, soil salinity is also dependent on the soil's formation. Examples of soils in Central Queensland and their salinity are shown in Figure 3.

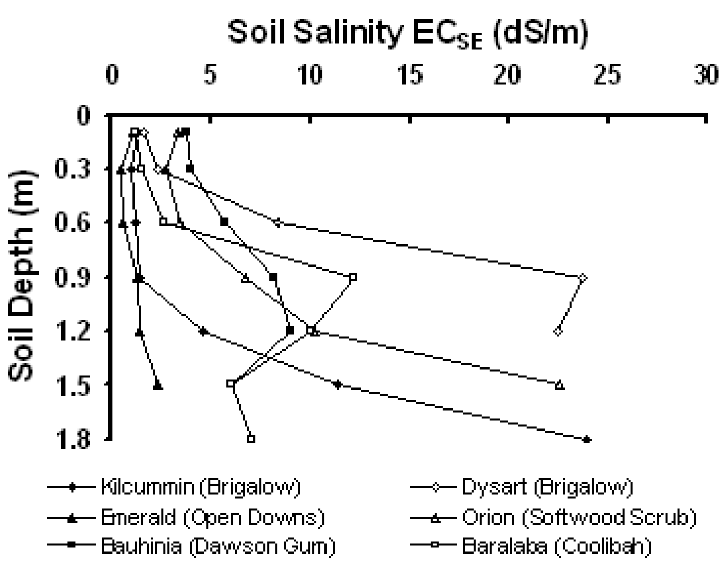

Figure 3. Soil salinity trends differ depending of the formation of soils indicated by their vegetation.

DISCUSSION AND CONCLUSIONS

The sodic and saline soils described in the study areas of the Central Queensland Sustainable Farming Systems project provide insight into the issues of sodicity and salinity faced by Central Queensland farmers. The soil limitations described in this paper are common, yet they are relatively unknown to the farming community. This is probably due to the following reasons:

1. The majority of limitations cannot be seen and can be detected only by sampling at depth; and

2. The actual impacts caused by soil limitations are not noticed due to other variables affecting production, notably climate and may not be well understood.

Limitations even if known, often cannot be corrected. Farmers are therefore often not interested in remedial action. Education in understanding the soil can been seen as an important first step in soil management. Despite the obvious difficulty in reducing some soil limitations it is important that knowledge of limitations is made available, to reduce the unknowns in a farmer's mind and to improve cropping strategies into the future. Knowledge of soil limitations allows better land use decisions. For example, high input cropping activities can be located on soils with fewer limitations, providing more assured returns. Alternatively, soils with greater limitations may be maintained under pasture.

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