

Shihab Uddin¹Ehsan Tavakkoli¹¹ NSW Department of Primary Industries, Wagga Wagga Agricultural Institute, Wagga Wagga, Australia**Background:**

More than 60% of the 20 million ha of cropping soils in Australia are characterised by an alkaline dispersive subsoil with pH>8.5 (Rengasamy 2002). The physicochemical properties of alkaline dispersive subsoil restrict crop rooting depth, hence the extraction of water and nutrients from the deeper in the soil profile. This constraint leads to a yield gap between potential and actual yield.

Objective:

While there are large advantages to be gained by ameliorating alkaline dispersive subsoils, sometimes small or even negative yield responses can occur, resulting in a significant net financial loss for the farmer. Therefore, our study aimed to achieve a better understanding of the underlying mechanisms and the longevity of ameliorating alkaline dispersive subsoils with various organic and inorganic amendments combinations.

Methods:

A field experiment was established on a farm near Rand in southern NSW in February 2017 with a range of organic (manure, wheat and pea stubbles as palletised) and inorganic (gypsum and nutrients) amendments or their combinations applied either at the soil surface or incorporated in the subsoil (20 – 40cm depth) as a 50 cm band. The residual effect of that once-off application of amendments on grain yield and soil physicochemical properties was monitored for six years (2017 – 2022) with canola growing the rotation in 2019 and 2021 seasons.

Results:

During the third growing season in 2019, canola grain yield was significantly ($P < 0.001$) increased by the amendments applied in 2017. Compared to the control, deep banding a combination of pea stubble and nutrients increased the grain yield by about 35%. Deep banding of gypsum also resulted in a similar improvement in grain yield. In the same season, deep banding of different amendments significantly increased the root growth in the amended layer.

Also, during the fifth growing season in 2021, canola grain yield was increased by the amendments applied in 2017 but to a lesser extent (only 12 – 15%) than in 2019. Deep banding of the amendments also resulted in significant changes in the soil's physical (aggregate stability and hydraulic conductivity), chemical (pH, EC and ESP) and biological (microbial biomass carbon) properties in the amended layer.

Conclusions:

The marked increase in the grain yield with the deep banding of organic and inorganic amendments and their combinations indicates the potential for this approach to reduce the yield gap associated with the alkaline dispersive subsoil in major cropping regions of Australia. This yield improvement was facilitated by a reduction in soil pH and ESP% and increased microbial activity leading to improved soil aggregation and better root growth. This impact in turn increased soil water use from the deeper soil profile during the critical grain filling period. Our results also demonstrated a strong residual effect on grain yield indicating the potential longevity of the subsoil amelioration with different amendments under dryland conditions.

References:

Rengasamy P (2002) Transient salinity and subsoil constraints to dryland farming in Australian sodic soils: an overview. *Australian Journal Experimental Agriculture* 42: 351-361. <https://doi.org/10.1071/EA01111>