Raised Bed Cropping in Australia: Yield Stability through Short- and Long-term Soil Health in the Crop Root Zone

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BACKGROUND

The grains industry in Victoria is worth almost $200 million annually with significant yield increases from nearly 60,000ha of raised beds installed on soils prone to water logging. While continuous cropping on raised beds has proved to be significantly more productive under experimental conditions and therefore more popular amongst growers, the contribution to soil health and quality through other rotations has also been significant.

MATERIALS AND METHODS

A long-term farming systems trial was used to compare the productivity of three different systems. The site consisted of two Vertosol (Isbell, 1996) soils different in their shrink-swell characteristics. The self-mulching black Vertosol (BV) was known to be less susceptible to water logging than the grey sodic vertosol (GSV) and therefore known for its higher productivity. System productivity (crops and grazing included) was compared by converting all grain yield to dry sheep equivalent days (DSE days) (Walcott and Zuo, 2003). Soil structure was assessed twice during the trial at three and five years after commencement in 2002 and 2005 respectively. Crop yields and the difference in soil structure between raised beds and flat ground experienced by growing roots were analysed using the residual maximum likelihood procedure (REML) in Genstat 5.42 (GenStat Committee, 2000)

RESULTS

Measured differences (i.e. lower) in soil BD were apparently evident over the entire profile depth to 40cm while significantly lower soil BD was observed at the 15 cm depth in profile in the 2x2 system compared to other systems. In the comparison of soils, the soil BD difference in the black Vertosol was greater than that of the grey Vertosol and its occurrence at 35cm depth was remarkable as this was below the initial tillage depth of 20cm. The increase in soil macro-porosity as a consequence of the decrease in soil BD resulted in more water storage in the profile for plant use. The total profile water storage to 40cm depth can increase or decrease depending on the soil type and its management. Between 2002 and 2004, water storage at depth in the Black Vertosol soil actually improved but at the end of five years of the trial, the more hostile Grey Sodic Vertosol soil had developed a greater capacity to store soil water, showing a better response to raised beds.

DISCUSSION /FUTURE WORK

By nature of their design, permanent raised beds also encourage the concepts of reduced tillage and controlled traffic (CT) in broad acre farming. Bed farmers in the region have experienced an average yield increase of ~20% in wheat, barley and canola crops compared to cropping on flat paddocks despite sub-optimal rainfall experienced in recent times in the region. The impact of different farming systems particularly in the absence of indiscriminate compaction has led to significant differences in soil structure under beds, leading to an increase in plant available water capacity (PAWC) that appears to be contributing to yield stability under these circumstances. The beneficial soil structure outcomes from systems involving pastures did not produce the best yield results in the short-term in our experimental work. However, in the long-term they are likely to contribute more to sustainable soil health outcomes. Reduced compaction and increased aeration will favour soil biological activity when temperature and soil water are at an optimum. Initiatives such as the growing of deep rooted perennial forages (primer crops) on beds and the retention and management of crop residues will

further enhance the build up soil organic carbon which will in turn enhance soil health and favour increased productivity.

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