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New soil health facilities to enhance translation of research outputs into practical applications

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The gap between field work and research microcosms has long been identified as a problem towards advancing research outputs into practical applications. Both approaches have advantages and shortcoming. For example, field trials are often expensive to run but more importantly subject to environmental heterogeneity and unpredictability of the climate which often adds additional noise to data. In order to bridge the gap we designed new facilities in partnership with industrial stakeholders. The new Soil Health assets offer world-leading facilities where the complex interdependencies between water, soil, tillage and crops can be simulated, not just within seasons, but throughout the rotational cycle at representative spatial and temporal scales, whilst controlling soil and weather variability that often complicates interpretation of field trials. The facilities comprise large (1 m3) lysimeters which can be tessellated to form a continuous soil volume upon which tillage operation can be performed in a purposely designed soil processor. The soil processor can perform tillage operation that mimic those applied in the field, thereby producing realistic physical conditions in each lysimeter. Irrigation is automated and evapotranspiration is measured continuously under controlled environmental conditions. Uniquely, however, the lysimeters can be returned to the soil processor at the end of the growing season enabling investigation of the impact of crop rotations on soil and crop health.
Lysimeters can be equipped with sensors including rhizotrons to monitor root growth over time. A glasshouse gantry mounted novel sensors is used to monitor crop health and development. This gantry includes the following: RGB camera – Allied vision (3 band, 400-750 nm), FLIR IR Camera (7.5 to 13 μm) for temperature measurement, Laser scanner (0.25 mm resolution in 3 axis), PRI (photochemical reflectance index) sensor (531$\pm$3, 570$\pm$3 nm with 10 nm FWHM) and hyperspectral sensors (380-1000 nm with 935 spectral bands, and 950-2500nm with 267 spectral bands).

The facility enables realistic combinations of tillage * soil type * climate * crop rotation to be investigated. In this presentation we will present the first results of trials in this new facility focusing on the following treatments: (1) stress induced by deep compaction, (ii) impact of cover crops with different root traits on soil physical conditions, and (iii) stress induced by drought and wetness. We will test crop responses to these stresses. We will discuss the unique aspects of these pilot scale facilities and the ability to advance soil and plant health research.