FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

QDS00001

Costs of soil induced stress to the Australian grains industry

PROJECT DETAILS

PROJECT CODE:	QDS00001
PROJECT TITLE:	COSTS OF SOIL INDUCED STRESS TO THE AUSTRALIAN GRAINS INDUSTRY
START DATE:	01.10.2013
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Summary

Soil salinity, sodicity, acidity, and alkalinity, elemental toxicities such as boron, chloride and aluminium and compaction are important soil-induced stresses to agricultural sustainability in many soils of Australia. Each stress has different causes and treatments. However, the management of each soil stress presents an economic opportunity. Despite their significance, the available information on the extent and impact of these stresses on the grains industry is mostly based on extrapolations from soil surveys and expert opinion from individual regions. The Australian grains industry needs accurate information on the costs of these stresses at a national scale to guide management decisions and remediation to minimise productivity losses.

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Achievement/Benefit

It is not possible to map accurately the location of soil stresses at regional scales using either conventional soil survey or soil sensors. However, a multi-year spatial and temporal analysis of remote sensing data can provide a rapid and accurate assessment of areas that are consistently low-yielding over several years, indicating the presence of at least one unknown soil-stress factor. This is because soil stresses are relatively stable over time compared with other growth-limiting factors such as climate and pest incursions. A multi-year analysis of yield variability effectively filters the sources of high frequency temporal variability, retaining the stable signal of soil stresses. The wealth of soil data in the Australian Soil Resource Information System (ASRIS) could be used as guide to identify the most-limiting soil stress factor.

To demonstrate how this approach can be used to identify soil-induced stresses, a farm with some soil stresses was selected as a case study in the present report. The analysis of multi-year remote sensing data successfully separated the relatively stressed areas from the unstressed. This allowed measurement of the magnitude of yield-gap($Y_{G)}$ at farm-scale in both relatively stressed and unstressed areas, and ground-truthing to confirm the causes of Y_G.

However, at regional scale, both the size and causes of Y_G are subject to large variability. Australia has reliable data at a regional scale on areas where crops are grown; however, it is collected at different scales and frequency. The need to use mixed sources in this way reduces the accuracy with which both Y_P and Y_A are determined. It is recommended that the mismatch in data can best be determined by estimating each component separately at many sites and over many years to determine if a robust estimate of Y_G values emerges.

After reviewing available methodologies, we propose a 'hybrid approach' for spatial-temporal representation of the magnitude and cause of Y_G at SLA and national scale based on available data and upscaling from the methodology described for the farm scale case study. The proposed framework would include three layers, a 'data' layer, a 'calculation' layer, and a 'ground-truthing' layer. The data layer provides input data for the other two layers. In the calculation layer, data are used to calculate Y_G and its distribution in space and time. The ground-truthing layer uses data and calculation to provide alternative, on-farm or experimental estimates of Y_G where they can be ascertained (Hochman et al., 2012). The multi-year spatial-temporal analysis of remote sensing data would identify stable, consistently poor performing areas at a similar scale as Y_G (Dang et al., 2011). Soil maps and expert opinion would be used to identify the most-limiting soil-induced stress in the consistently poor performing areas. The spatial distribution of soil-induced stress at SLA scale would then be used to obtain the cost of lost production using soil-induced stress – grain yield models. The potential benefit map of amelioration and/or management would be obtained using benefits-cost analysis for soil-induced stresses at SLA and national scales.

Intellectual Property Summary

nil

Additional Information

Review of existing information and proposed methodology to identify spatial distribution of soil-induced stress to Australian grains industry is attached.

file name: QDS00001 costs of soil induced stress_review.pdf