Final Project Summary

Project title	Site-specific land management of cereal crops based on proximal soil sensing		
Project number	RD-2010-3728	**Final Project Report**	SR35
Start date	29 November 2010	**End date**	30 April 2014
AHDB Cereals & Oilseeds funding	£37,500	**Total cost**	£98,600

What was the challenge/demand for the work?

Precision agriculture holds the promise of enhancing input efficiency while reducing adverse environmental effects and increasing the economic benefits of farming. Soil is a complex medium and can be said to have infinite variation. A key aspect of this goal is the adoption of advances in technology and science to improve the evaluation of soil spatial variability. For practical purposes, areas of homogeneity within a field, management zones, can be delineated by inclusion of several soil attributes such as texture, nutrient levels and topography. These distinct units (or management zones) can then be managed in the most appropriate way by the grower.

How did the project address this?

In this project, a more innovative approach was used in order to improve the performance of management zones delineation. The method employed a mobile, visible and near-infrared spectroscopy (vis-NIRS) sensor system to obtain fine-scale information about the spatial variability of main influential soil properties. This data was combined with in-season measurements of crop growth using data fusion techniques to provide management zones which better reflect the yield potential of different areas within the field. The effectiveness of the innovative approach was compared with the traditional method of management zones delineation by using them to inform a variable-rate and a homogeneous-rate application of nitrate fertiliser in adjacent strip-trials over growing seasons.

What outputs has the project delivered?

The results indicate that the innovative method could provide increased yields while reducing the amount of nitrogen fertiliser used in the fields studied, when compared to the traditional and homogenous approaches. The innovative approach increased yields by up to 6.5% and used as much as 14% less fertiliser than the homogenous approach. It is likely that future work will improve the prediction models for soil properties and refine the geostatistical methods used – to provide further economic and environmental benefits to the farmer. Also improvements to the Phosphorus model were achieved by using the largest data set of soil samples. The success of this strategy was likely due to the large range of P values which provided a more representative model. The online vis-NIR sensor platform can be successfully used to acquire fine-grained (>1500 sample per ha), field-wide information on a range of influential soil properties linked to soil fertility.

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Who will benefit from this project and why?
The success of site specific management approach in agricultural research has led to the establishment of commercial precision agriculture services, which provide management zone-based variable rate services to growers. Typically, these companies provide input application maps, which allow the farmer to derive application schemes for nitrogen, potassium, phosphorus or micro-nutrients – varying the rates for each zone according to the soil requirements. Some companies also provide management zone maps to assist variable-rate seeding, cultivation and irrigation. Both commercial adoption and the results from scientific research confirm that site specific approach can provide practical economic and efficiency benefits to farmers and growers in term of maximising resource use efficiency as well as profitability. This project demonstrated that novel technologies and sensors applications can improve site specific land management for cereal crops using proximal soil sensing, which will benefit farmers in the first instance as well as commercial precision farming service providers to improve their services.

If the challenge has not been specifically met, state why and how this could be overcome
The results of this exploratory study should lead to increase the adoption of precision agriculture due to the attractions of the soil management zones delineation approach which provides increased yields and N-use efficiency, together with a reduction in unused N lost to the environment. In a likely scenario, where environmental legislation becomes more stringent, chemical fertiliser prices increase and agricultural area decreases due to urbanisation, growers with soil spatial variability on their land will need to invest in a site-specific management strategy. One of the challenges in this project was to integrate within-season factors with significant impacts on yield such as weather, pests and diseases. Therefore, online vis-NIRS sensor approach that includes information about weather, pests and diseases should lead to more consistent and predictable yields from each field. Further research into the application of the online vis-NIRS sensor approach for other crops (e.g. vegetables) may be of interest to growers in important agricultural sector. Investigations into the use of yield potential soil management zones for variable rate seeding in cereals, could be of further interest to cereal growers.

This project was funded by AHDB Cereals & Oilseeds as a PhD studentship. The thesis has not been submitted for examination.

Lead partner	Cranfield University
Scientific partners	Douglas Bomford Trust
Industry partners	None
Government sponsor	None