Final Project Summary

Quantifying the sulphur (S) supply from farm manures to winter wheat crops

Project number	RD-2008-3606	**Final Project Report**	PR522
Start date	Oct-2009	**End date**	Apr-2013
HGCA funding	£187,865	**Total cost**	£221,997

What was the challenge/demand for the work?

Sulphur (S) has important effects on the yield and quality of crops. Sulphur deficiency in susceptible arable crops has become more widespread over recent decades, as levels of atmospheric S deposition have continued to decline (and are now estimated at only 10% of levels deposited in the 1980's). Fertiliser S is now routinely recommended for susceptible crops in areas of high risk of S deficiency. Organic materials contain useful quantities of S, as well as other plant available nutrients and organic matter, and are used on around 70% of farms in Britain. Prior to this project, there was very little data on the crop availability of S from organic materials, and the current 8th edition of Defra's Fertiliser Manual (RB209) does not provide advice on the S fertiliser replacement value of organic materials.

The overall aim of this project was to quantify the S supply from organic materials to winter wheat crops, in order to improve current recommendations on the use of farm manures and biosolids as sources of crop available S for arable crops.

How did the project address this?

The S content of organic materials may be variable; for livestock manures, this depends on the S content of feed, bedding use (solid manures) and dilution (slurries), and for biosolids the source of waste water and biosolids treatment process. A synthesis of published and unpublished UK data was collated on the range and typical concentrations of S in livestock manures and biosolids.

Field experiments were carried out at 3 sites cropped with winter wheat over 3 harvest years (2 harvest years at each site; 6 harvest years in total). At each site, there were 7 organic material treatments, including autumn applied cattle farmyard manure (FYM), pig FYM, broiler litter and two biosolids products, and spring applied broiler litter and pig/cattle slurry. Three of the 6 sites responded to S and at these sites the organic material treatments were compared with inorganic (water soluble) fertiliser S response treatments (0, 12.5, 25, 50 and 75 kg/ha SO_3) to determine the S fertiliser replacement value and hence crop available S supply from the applied organic materials.

What outputs has the project delivered?

The synthesis of data on the S content of organic materials showed good agreement with the 'typical' values given in Defra's Fertiliser Manual (RB209) for livestock manures (cattle FYM, pig FYM, cattle slurry and pig slurry) and digested liquid, lime stabilised and thermally dried biosolids. However, for digested biosolids cake and composted biosolids, mean total SO_3 contents were higher than the 'typical' values given in Defra's Fertiliser Manual (RB209). The S content of organic materials, both total SO_3 and 'extractable' (i.e. readily available) SO_3 was shown to be variable, hence, analysis of a representative sample is advisable to ensure that crops grown on potentially deficient sites receive adequate S.

For spring applied organic materials, readily available ('extractable') SO_3 appeared to be a good indicator crop available S supply. Analysis of organic materials used in the current project showed that the 'extractable' SO_3 content varied from around 15% of total SO_3 for cattle FYM up to around 60% of total SO_3 for broiler litter. Results from this project showed that for spring applied organic materials; readily available SO_3 was equivalent to inorganic water soluble fertiliser S.

Readily available S from organic materials applied in the autumn may be lost via overwinter leaching; losses will depend on soil type and overwinter rainfall. Results from this project showed lower S use efficiency from autumn compared with spring applied organic materials; typical autumn S use efficiencies were in the range of 5–10% of total SO_3 for livestock manures and 10–20% of total SO_3 for biosolids.

Table 1. Sulphur – percentage of organic material total SO_3 that is crop available (winter wheat)

Organic material	% total SO_3 available
Autumn applied	
Livestock manures	5-10%
Biosolids	10-20%
Spring applied	
Cattle FYM	15%
Pig FYM	25%
Broiler litter	60%
Cattle/pig slurry	35%
Biosolids	20%

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Who will benefit from this project and why?
This work has lead to a better understanding of crop available S supply from organic materials and produced guidance for farmers on the availability of S from applications of organic materials. This is likely to improve farm profitability by ensuring that crops receive adequate amounts of S from applied organic materials or, where necessary, that supplementary inorganic S fertiliser additions are made to meet crop needs. If it is assumed that spring applications of organic materials have an average fertiliser S replacement value of 20–25 kg/ha SO_3, and S fertiliser costs £0.15/kg SO_3 (may vary between S fertiliser products), this represents a potential saving in purchased S fertiliser of £3–4/ha.

If the challenge has not been specifically met, state why and how this could be overcome

Lead partner	Dr Lizzie Sagoo, ADAS UK Ltd.
Scientific partners	Prof. Steve McGrath, Rothamsted Research
Industry partners	Anglian Water Severn Trent Water
Government sponsor	None