



# Sulphur for yield and quality in malting barley

## Deficiency increasing

Sulphur deficiency has become more widespread and affects an increasing range of crops, which now includes malting barley.

HGCA-funded trials were carried out in 2003 and 2004 to determine yield and quality responses at four sites on soils where deficiency was likely.

Winter barley variety Pearl was grown in Docketing, Norfolk and Woburn, Bedfordshire. Spring barley variety Optic was grown in Corsekelly, Aberdeenshire and Bishop Middleham, County Durham.

Sulphur was applied as gypsum at 0, 10, 20 and 40kg S/ha, combined with two rates of N, which

differed between sites. In addition, two treatments tested application of S at a later timing. Grain samples from the 0 and 20kg S/ha treatments were analysed for malting quality.

Soil samples, taken before spring fertiliser application, were analysed for soil extractable sulphur. Leaf tissues, sampled at tillering and stem extension, were analysed using diagnostic indicators (total S, sulphate-S, N:S ratio and malate:sulphate ratio) to determine if responses to S could be predicted.

## Yield effects

Significant yield responses to S were found in five of eight trials over two seasons. Yield increases

ranged from 0.2-1.2t/ha with the rate of S producing maximum yield typically varying from 10-20kg S/ha.

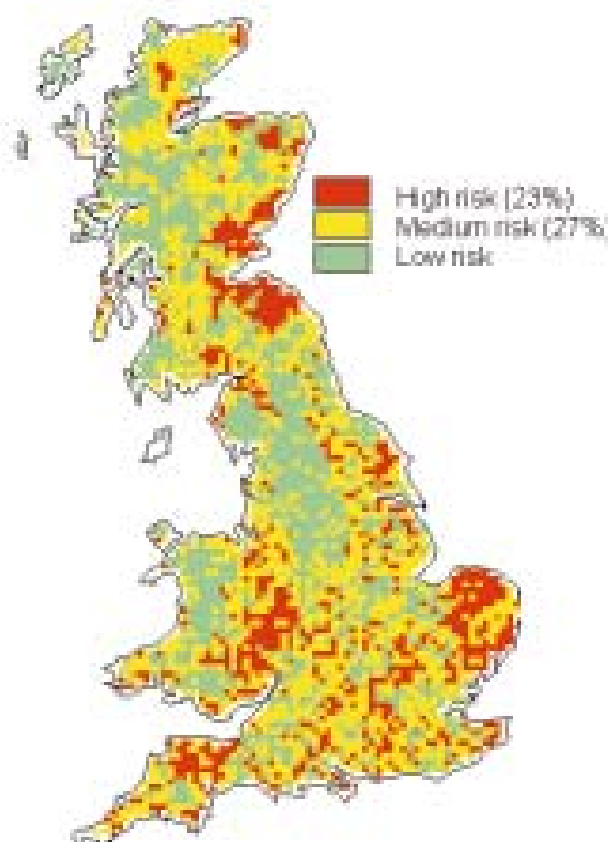
Figure 1 shows yield data for two responsive trials in 2004. S-responsive trials had soil extractable S in the range 2.8-4.1mg/kg; non-responsive trials had soil extractable S in the range 6.4-14mg/kg.

These trials indicated that sulphur should be applied to winter barley between mid-March and mid-April.

## Action:

- Locate your farm on a sulphur deficiency risk map (see right) to determine likely risk of S deficiency by location and soil type.
- In a medium or high risk area, test soil in spring for soil extractable S.
- If S levels are below 5mg/kg soil extractable S, apply a sulphate-containing fertiliser - usually at 10-20kg S/ha in mid-March to mid-April with nitrogen main or top-dressing.

Sulphur deficiency risk for cereals

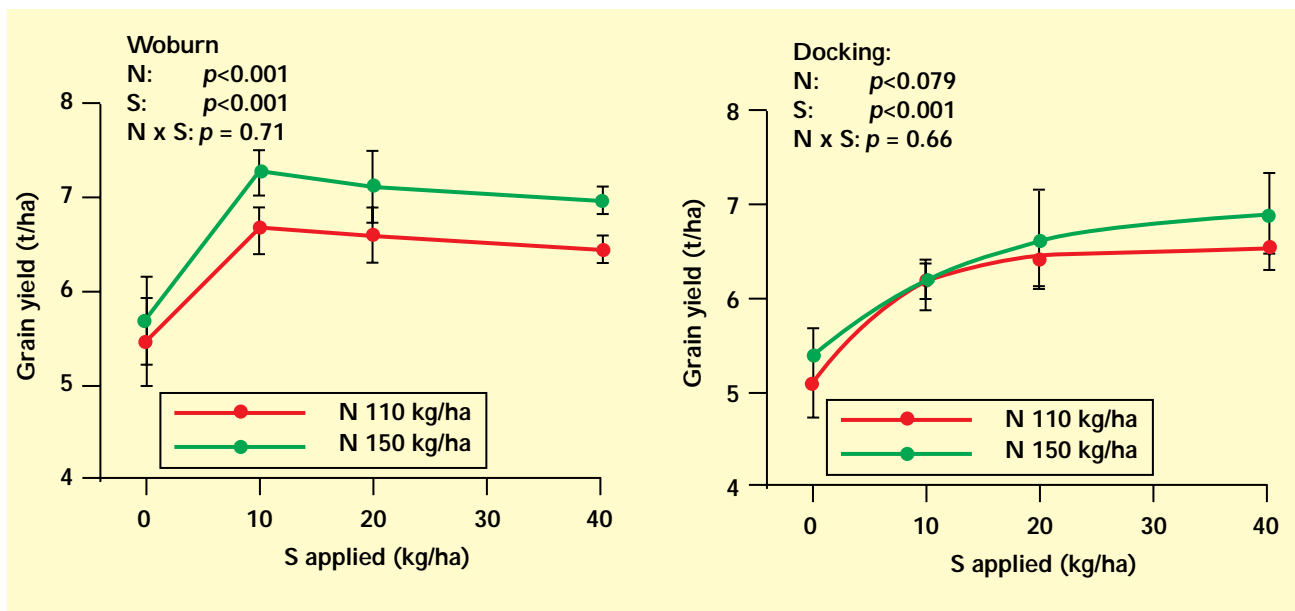


*If you are unsure about any of the suggested actions, or want them interpreted for your local conditions, consult a professional agronomist.*

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Figure 1. Yield responses of winter barley to N and S applications at 2 sites in 2004 (85% dry matter)



## Effects on quality

When N supply was limiting, S applications decreased grain N concentration due to a dilution effect as grain yield increased. Sulphur gave no significant effect on grain N concentration when N was not limiting.

At some sites where S gave a response, an increased proportion of small grains (<2.25mm) and lower thousand grain weight was recorded. Increasing N produced similar effects at some sites.

Sulphur had positive effects on malting quality, and in some cases on beer flavour (depending on beer type), at sites where S was deficient.

Where S was adequate, or only marginally deficient, S applications had little effect on grain or malting quality.

## Predicting S response

Soil analysis was the best predictor of likely response to applied sulphur in these trials. Responses were obtained at trial sites with less than 4-5mg/kg soil extractable sulphur (determined by an ICP instrument).

Leaf N:S ratio and sulphate-S concentration, measured at stem extension, distinguished the two most responsive sites from the rest. Critical values were >17:1 and <0.25mg/g respectively.

Grain N:S ratios above 17:1 also separated the two most responsive sites from the others. However, this test is of no value in determining S need for the current crop.

## Summary

Sulphur deficiency can result in yield losses of 1t/ha or more in barley on susceptible, usually sandy, soils. Deficiency can also adversely affect some malting and brewing characteristics.

HGCA-funded trials carried out by Rothamsted Research, TAG, SAC and Newcastle University on winter barley in England and spring barley in Scotland and Northern England show that an application of 10-20kg S/ha on deficient sites is likely to correct deficiency and provide cost-effective yield responses.

### Further information:

Professor Steve McGrath,  
Rothamsted Research  
steve.mcgrath@bbsrc.ac.uk

Dr Fangjie Zhao,  
Rothamsted Research  
fangjie.zhao@bbsrc.ac.uk

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Home-Grown Cereals Authority

Research & Development  
Caledonia House  
223 Pentonville Road  
London N1 9HY

Tel: 020 7520 3945  
Fax: 020 7520 3992  
e-mail: research@hgca.com  
http://www.hgca.com

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