

Identifying nutrient management opportunities and threats in the Western Australian grains industry

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Abstract

A 4-step consultation process involving face-to-face discussion, informal phone conversations, focus group discussion and survey assessment was used to (i) assemble a long-list of crop nutrient management issues, (ii) identify nutrient management issues that are significant to the grains industry and (iii) rate these issues in terms of impact and influence on the industry.

The results suggest that 'Farm decision making' about nutrients are particularly important to the industry. Continuously identifying and managing emerging nutrient deficiencies and more effective use of advanced technologies and fertilizer products in crop nutrient management are also critical to sustain the grains industry. More detailed analysis is now underway on the nutrient management issues with high impact/influence on the grains industry, and the findings are briefly discussed in the paper.

Key Words

Crop nutrition, fluid fertilizers, precision agriculture, soil testing and zero-tillage cropping systems

Introduction

The pioneer phase of crop nutrition in the WA wheatbelt was largely complete by the 1980's. Understanding and correcting basic nutrient deficiencies through development of fertilizer practices and soil and plant testing calibrations, dominated the research and extension of that period, when wheat was the dominant crop in rotations with pastures and regular cultivation was a key soil management practice. Much has changed in the WA wheatbelt since then. For some nutrients (phosphorus and trace elements), soil reserves have been increased due to past fertilizer application but for others (such as potassium and sulphur), exports of these nutrients in grain due to increasing yields have not been matched by inputs (for example, potassium was not used until very recently and sulphur inputs decreased as a result of using higher analysis P fertilisers), leading to frequent deficiencies of these nutrients and unknown potential for deficiencies of others (eg. magnesium, and calcium). Large areas of diverse crops are now sown usually with zero-tillage (to replace a wheat-pasture rotation). Economic pressures have pushed the cropping areas further west into the high rainfall zones. A wide range of fertilizer products is now available, and use of precision agriculture (PA) technology could add opportunities and complexity to the crop nutrient management. Fertilizer costs represents about one-third of the variable costs of growing grain crops in WA.

Given the above changes in WA's farming systems, long term depletion of natural soil nutrient reserves, fertilizer products, application technologies and farm production economy, it is important to review assumptions about relevant nutrient management issues. The objectives of this work are to conduct a comprehensive analysis of the opportunities and threats associated with nutrient management in the Western Australian grain growing region, and provide a source of information from which decisions can be made about future directions of research, development and extension.

Methods

Consultation process

A 4-step consultation process was undertaken with farmers, farm groups, farm advisers, fertilizer companies and researchers, (total of 76 people) involving: (i) face-to-face discussion, (ii) informal phone conversations, (iii) focus group discussion and (iv) survey assessment. The face-to-face discussion and informal phone conversations were conducted to achieve familiarisation with crop production issues and secondly to assemble a long-list of crop nutrient management issues that need to be addressed to improve fertilizer investment in the industry, and from which key questions could be developed for follow-up focus group discussions. Focus group discussions were designed to provide an interactive environment where invited producers, consultants, advisers and researchers could discuss nutrient management issues derived from the above processes, and provide their professional views on the importance of the issues and identify nutrient management issues that are significant to the grains industry.

Survey assessment and evaluation

A total of 17 issues from focus groups were outlined (see Table 1) and emailed to participants for rating in terms of impact and influence according to the following definitions:

- **Impact** on the grains industry in the Western Region if the issue was addressed successfully.
- **Influence** that a project team is likely to have in achieving that impact.

Each participant was asked to rate the impact and influence of each of the issues on a scale of 0 (low) to 6 (high). The evaluation was conducted by averaging the ratings of all responses for impact/influence of each issue. The 'groups' of responses were identified by plotting average rating of influence against impact for each issue.

Detailed reviews

For the issues with high impact/influence rating, detailed analysis have been conducted based on critical reviews of key R&D reports, industry reports, peer reviewed literature and discussion with experts to (1) define the 'nature' of the issue, (2) review current knowledge and existing research, (3) identify 'gaps' and (4) conduct benefit-cost analysis of an issue and where appropriate develop RD&E proposals.

Results

Survey

The surveys were sent to 76 people representing different sectors of the grain industry (extension, research, education, grower and fertilizer industry). Overall we had about 30 % response across different sectors. Three 'groups' of responses (high, medium and low impact/influence) were identified. The six issues were rated as having high impact/influence for the industry if they were addressed properly (Table 1). They were: improve soil testing and interpretation (issue 10), understand and optimise liquid fertilizer (issue 8), understand and develop zone management strategies for nutrients (issue 9), consolidate and communicate information on tactical N management (issue 13), develop recommendations for emerging nutrient deficiencies (issue 4), improve access by farmers to quality information (issue 11).

Those issues related to the theme 'Farmer Decision Making', were rated highly, indicating these issues (10, 11 and 13, see Table 1) are important to the WA grains industry and they could have significant impacts on the industry if they were addressed. Only one issue (4) associated with theme 'Impact of Farming System' was rated highly, but this response suggests that research to continuously identify and manage emerging crop nutrient problems is important to sustain crop production. This problem needs to be addressed in the context of cropping systems so that the industry is better prepared if a problem develops in the near future. Issues 8 and 9 associated with the theme 'Application Technologies' were also rated highly, indicating that these technologies potentially could improve crop production if applied properly at a paddock level. The survey also suggests that further research effort to optimise use of these technologies still needs to be done if the potential benefits to maximum fertilizer investment are to be realized.

Detailed reviews

Soil sampling depth, soil sampling in zero-tillage cropping systems and computer-based fertilizer recommendation systems using soil testing information were identified through the survey as three main opportunities for improving the current soil testing and interpretation. The standard soil sampling depth (0-10 cm) based on extensive calibrations for P nutrition in wheat may not provide accurate indications of deficiency and sufficiency for nutrients such as K and S, which are becoming important nutrients for crop production. In zero-tillage cropping systems, where crops are often sown with minimum or no disturbance of soils and fertilizers are banded, alternative sampling methods are needed to random sampling. Possible strategies include: paired sampling techniques based on knowledge of fertilizer band location or direction and the transect soil sampling method to cut slots of soil across the row. Each of these needs to be evaluated for describing the effect of residual nutrient (P and K) bands on the accuracy of current soil testing. Our review suggests that crop yield benefits resulting from using fluid P are inconsistent in WA (by contrast with SA and Vic. Wylie *et al.* 2003), and for liquid N, research in WA indicates that the product is as effective as urea in providing N to crops, but liquid N products offer a greater opportunity to manage N tactically through late foliar application, particularly in WA, where the product is readily available and the price is cheaper than in other states (Wylie *et al.* 2003).

Table 1. Summary of the 17 issues rated by the participants representing extension, research, education, grower and fertilizer industry in a survey of nutrient management issues for the WA grains industry. The 6 issues in bold font were identified as having high impact/influence in the survey and will be the focus of most investigation by the authors.

Theme	Issues
Impact of Changing Farming Systems on Crop Nutrient Management	<ol style="list-style-type: none">1. Understand and optimise nutrient management in existing and emerging no-till and stubble retention systems.2. Understand perennial pasture based rotations impact on N dynamics.3. Develop crop nutrient management systems for high rainfall cropping areas.4. Develop recommendations for managing emerging nutrient deficiencies.5. Better understand and manage nutrient requirements for 'new' crops such as canola, field pea, etc; and identify differences among crop varieties in nutrient efficiency to improve breeding of new varieties.6. Develop recommendations for nutrient management for saline agriculture
Application Technologies	<ol style="list-style-type: none">7. Understand and manage non-uniform nutrient distribution (horizontal and vertical) within soil profiles.8. Understand and optimise use of liquid fertilizer.9. Understand and develop appropriate zone management strategies for nutrient management (precision agriculture, variable rate

technology).

Farm Decision Making

10. Review and improve soil testing methodologies.

11. Improve access by farmers to quality information.

12. Develop information to support growers who want to focus on longer-term, holistic nutrient management.

13. Consolidate information on N management with a particular focus on tactical management and communicate the results effectively to growers and their advisers.

Interaction of Crop Nutrient Management with Other Issues

14. Understand and develop nutrient management strategies to minimise the negative on-site and off-site environmental impact.

16. Understand the role of nutrient management in reducing frost damage.

15. Understand the role of nutrient management in impacting on crop disease.

17. Improve understanding of liming on dynamics changes of different nutrients and manage any liming-induced nutrient deficiencies.

Brief results for the other high impact/influence issues are presented as they are currently still under detailed review. Notwithstanding the amount of yield monitoring practiced, further work is needed to fully realize the potential benefits from the use of precision agriculture (PA) technology at a farm level. Further efforts need to focus on recognition and quantification of temporal variation (apart from spatial variation), and effective use or development of “on-the-go” sensing methods to monitor crop growth, yield and quality and on improving the PA knowledge for producers and advisers through training. Following the trends of nutrient depletion that led to K and S deficiencies, there is emerging evidence that Mg deficiency could develop in WA. Moderately negative Mg balances were found in the 2001 NLWR audit, and this finding is currently under further investigation by the authors through nutrient budgeting and analysis of soil fertility databases. The opportunities to improve access by farmers to quality information include: promotion of the Fertcare programme in WA, improving farmer knowledge of crop nutrition and support for on-farm research as a recent survey suggests that personal experience and local trial results are very important sources of information for improving fertilizer decisions (Pluske 2005).

Conclusion

The issues related to ‘Farm Decision Making’ are important to the grains industry suggesting that there remains a gap between research knowledge and on-farm nutrient management. Continuously identifying and managing emerging nutrient deficiencies and understanding and better use of advanced technologies and fertilizer products in crop nutrient management are also critical to sustain the grains industry. On-going critical analysis of the high impact/influence issues identified in this study provide critical technical information for developing further R&D activities to improve fertilizer investment in WA.

References

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