FLUID FERTILISERS: A SOUTH AUSTRALIAN MANUAL

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INTRODUCTION

After 10 years of fluid fertilizer research a need was identified to collate and package the research information for farmers, agribusiness and researchers. Therefore, a manual was prepared with the aim of providing a review of the South Australian (SA) experience with fluid fertilizers in dryland agricultural systems. Originally, the research program was designed to address the poor performance of cereals on highly calcareous (15-90% calcium carbonate) grey soils on Upper Eyre Peninsula in SA. Early P-rate field trials comparing fluid and granular rate responses showed that fluid sources of P were more efficient than granular triple superphosphate (TSP), monoammonium phosphate (MAP) and diammonium phosphate (DAP) –fluid P was up to 15 times more effective than granular P in a "horizontal" comparison where the amount of P required to produce the same yield was compared. It was also shown that the efficiency of delivery of micronutrients was also improved when they were included in NP solutions compared with as a coating or when incorporated within NP granules. The soil chemistry behind these differences was then investigated in detail and the results from this work were amalgamated into a Fluid Fertilizer Manual, aimed at South Australian farmers in particular, but with a view to be of use to agriculturalists in similar environments world wide.

TYPES OF FLUID FERTILIZER

Due to the small fertilizer market share occupied by fluid fertilizers in Australia, and SA in particular, a section of the manual is dedicated to types of fertilizer. The purpose of this section is to alert people to the products available locally. A health and safety expert was consulted to provide advice to fertilizer users as to the potential hazards and legal requirements of storing and mixing fluid fertilizers in Australia. The majority of SA farmers who have adopted fluid fertilizer use phosphoric acid as a base product, adding urea and micronutrients as required. Hence two hazards emphasized are the storage and use of phosphoric acid and the requirements for risk assessment of mixing of fertilizer products. The relevant State regulations and guidelines are provided in an Appendix.

FIELD RESEARCH WITH FLUID FERTILISERS

The field research section begins with an introduction to some basic principles of plant nutrition, principally the law of the minimum where the correction of a nutrient deficiency may result in another nutrient becoming limiting. Alternatively an excess of one nutrient may result in the deficiency of another. Furthermore, if a soil is not deficient in the nutrient being

tested then a crop response cannot be expected to any source of this nutrient. These principles often require consideration when evaluating nutritional field trial results and the application of these results to other situations.

From 1997 through to 2006, more than 100 replicated randomized block design field trials were conducted by the South Australian Research and Development Institute, CSIRO Land and Water and the University of Adelaide to investigate various aspects of fluid fertilizer performance on alkaline, mainly calcareous soils, in comparison with granular fertilizer. Ninety percent of trials conducted on grey highly calcareous soils produced statistically significant yield increases in comparison with granular products providing the same nutrients at equivalent rates. In the remaining 10% of trials there were no differences in grain yield. On red calcareous soils (5-15% calcium carbonate) fluids were superior in 58% of the trials with no difference in the remainder. On red loamy sands (<5% calcium carbonate) granular fertilizers produced higher grain yields in 31% of the trials, with fluids superior in 8% and no differences in the remainder. It was proposed that the leaching of nitrate from UAN and rapid urease induced hydrolysis of urea in soil-injected UAN could be responsible for the lower performance of fluid fertilizer in this situation. These issues are discussed further in the laboratory research section.

In addition to product and rate testing, a range of fertilizer management issues were tested in field experimentation and reported in the Manual including: fertilizer placement, granular fertilizer particle size, timing of application, soil type, multiple nutrient formulations, varietal responses, disease responses, residual fertilizer availability and application methods.

APPLICATION TECHNOLOGY AND UNIT CONVERSIONS

In the Australian environment land managers may use fluid fertilizer technology to achieve yield benefits over granular fertilizers or because there is a logistical advantage in fluid application technology, or both. This section of the manual refers to differences within various fluid systems including dilution and mixing of nutrients from both compatibility and safety perspectives. There are guidelines provided for undertaking basic tests of compatibility for mixing of nutrient sources.

In the first instance, Australian growers considering fluid fertilizer use will often be converting from a system of applying only granular fertilizer to supplying fertilizers in both liquid and granular form. For example, many farmers gain experience with fluid systems by beginning with micronutrients only. Later, the trend is to convert fully to fluids. This requires a change in delivery equipment and storage facilities. Commercial fluid fertilizer delivery systems can be purchased or equipment can be fabricated on-farm. Each system will differ, depending on the objectives of depth of fertilizer placement and on the tillage requirements for soil conservation. The manual provides a basic outline of some of the factors that need to be considered for the conversion.

For growers familiar with measuring fertilizer amounts required by weight, some unit conversions are required when working with liquids as in Australia products are generally sold on a weight per volume basis. Basic guidelines are provided to ensure growers are applying the correct amount of nutrient required.

BACKGROUND CHEMISTRY AND SOIL AND PLANT TESTING

A short section on soil and fertilizer chemistry provides a basic understanding of factors controlling reaction products of fertilizers in soil. Emphasis is placed on using soil and plant testing to predict whether a given soil type will respond to the application of nutrients. The Australian fluid fertilizer research experience suggests that a significant yield response from using fluid in comparison to granular fertilizers can be reasonably expected only on grey calcareous soils with >5% calcium carbonate. Hence soil testing for calcium carbonate content is recommended and a simple field test suggested in the Manual.

Farmers are encouraged to undertake in-paddock strip testing of fluid products as compared to conventional granular fertilizer prior to large scale investment in fluid technology if the sole purpose of using fluid fertilizer is to gain a yield advantage over granular products. The Manual provides a link to a website where growers can learn about on-farm strip trials, and how to analyze the data from these to determine fertiliser effectiveness.

ECONOMIC PERFORMANCE OF FLUID FERTILISERS

The concepts of relative effectiveness of fertilizer products over a range of application rates are introduced. Further to grain yield response and increased income, economic effectiveness incorporates differences in the cost of nutrient sources and application methods.

In addition to guidelines provided in the Manual, a free cost/returns calculator is available for download from the Australian Fluid Fertiliser website (www.fluidfertilisers.com.au). This enables growers to independently compare the real costs of modifying their fertilizer management practice against income. The provision of the calculator enables farmers to use alternative response curves and data from their own farms to compare economic scenarios.

AVAILABILITY AND USE OF MANUAL

The manual can be downloaded at no cost from www.fluidfertilisers.com.au . It was released in 2008 and the website had 3346 visitors in 2008. Fifty percent of hits were from Australia and 50% from the US. Alternatively a hard copy of the Manual can be ordered via the same website, but the price of the hard copy includes the cost of printing and mailing.

CONCLUSIONS

The Manual is a legacy of the concerted fluid fertilizer research effort in South Australia over a decade. It provides a starting point for agriculturalists investigating management practices for fluid nutrient sources and highlights the issues that need to be considered when making fluid fertilizer decisions. We continue to receive feedback that Australian farmers and agribusiness are consulting the manual when considering their fertilizer management options.

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