Agronomic performance and adoption of liquid fertilisers in Western Australia

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Abstract

The rapid adoption of liquid fertilisers in WA since 2001 is the biggest recent change in fertiliser technology. Forty field trials (1997–2003) comparing urea ammonium nitrate (UAN) applied with a boomspray and topdressed urea showed similar agronomic performance for wheat and canola if the urea was spread uniformly. Average grain yields with urea and UAN applied by boomspray differed by less than 1%. However, banding the UAN near the seed rather than applying it to the soil surface increased N use-efficiency (NUE) by 5–8%, and in a third of the trials it increased wheat yields and N removal by 13–31%. There has been an increase in banded UAN by farmers. Further expansion in the liquid market is predicted.

Key Words

fluid fertilisers, plant nutrition, nitrogen fertiliser, nutrient-use efficiency

Introduction

Liquid fertilisers were first commercialised for the broad-acre market in WA in 2001 with the release of UAN, under the name Flexi-N? (32% N w/w). The adoption of liquid fertilisers has since been relatively rapid and represents the biggest change in fertiliser technology over the past three decades. The rate of liquid fertilisers adoption in WA has exceeded that of the US in the 1960's and 1970's, and further expansion is forecast over the next decade. CSBP is the largest fertiliser company in WA and sales of UAN currently comprise about 60% of our total nitrogen (N) sales. Prior to 2001, most N was applied as urea, usually topdressed before or shortly after sowing. Most early adopters applied UAN through boomsprayers as this involved minimal capital investment. The primary benefits of the change to UAN were improved storage and logistics (Ripper 2004). For example, UAN is more stable in storage than urea and is easy to use with little waste. Boomspray technology also enables fast and uniform application of N, and considerable cost savings are possible when UAN is also used to carry pesticides. There has been a recent trend towards banding UAN near the seed through sowing machinery which also enables the flexible application of in-furrow fungicides and trace elements. The overall aim of this research was to evaluate the agronomic performance of UAN liquid fertiliser applied through boomsprayers and banded near the seed.

Methods

UAN and urea comparisons- Forty wheat and canola trials were conducted in 1997–2003 to compare the benefits of UAN applied through a boomsprayer with urea topdressed. Plots were 2.1m wide (9 or 11 rows) by 20 m or 40 m long. Choice of variety, seed rate, pesticides and other cultural practices were consistent with local standards. The N treatments were applied immediately before sowing and in some cases four to 12 weeks after sowing. In each trial, urea and UAN were compared at between one and three N rates, along with a nil N treatment. All trials included three replicates of each treatment. Application rates of N varied depending on the crop requirements at each trial site, and ranged from 15–134kg N/ha. There were 132 comparisons of UAN and urea at the same rate of N and timing. Plant uptake of N (6–12 weeks after sowing), grain yield and protein (or oil content) were measured, although not all data are reported here.

UAN boomspray and banding comparisons - Between 2000–2005, 32 wheat trials were conducted comparing UAN applied with a boomspray immediately before sowing and UAN banded 30–40mm below the seed. In each trial, banded and boomsprayed UAN were compared at one to three N rates ranging from 20–60kg N/ha. There were 75 placement comparisons at the same N rate. Nitrogen use-efficiency i.e. the percentage of N applied which was removed in the grain was also calculated. Cultural practices and measurements were as above. In both studies data from each trial were statistically analysed with a standard analysis of variance using GENSTAT.

Results and Discussion

UAN and urea comparisons - Across the 132 comparisons, grain yields with UAN and urea were highly correlated for wheat (r^2 = 0.98) and canola (r^2 = 0.91) over the range of N applications (Figs. 1a and 1b). Among the 104 UAN and urea comparisons with wheat yields, 20 differed significantly (P<0.05). Of these, 11 were positive (UAN 4–17% > urea) and nine were negative (UAN 4–16% < urea). For the 28 canola comparisons, seed yield differed significantly on five occasions, with three positive responses (UAN 6–23% > urea) and two negative (UAN 15–20% < urea). Plant uptake of N was similar between UAN and urea for both crops (data not presented). Over the 132 comparisons, average grain yields with urea and UAN differed by less than 1%. These results show UAN applied through a boomspray is equally effective as urea topdressed for wheat and canola crops in WA. One of the practical advantages of UAN over urea is the uniformity of application with boomsprayer technology compared with spreading urea. Since urea was spread uniformly in these experiments this benefit could not be assessed, but farmer experience suggest savings of up to $25/ha are possible in responsive situations (unpublished data).

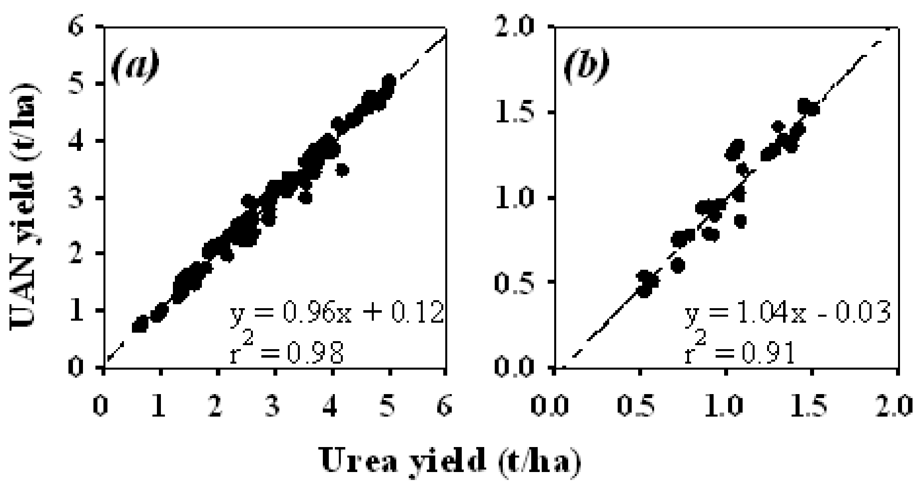

Figure 1. Grain yield of 34 wheat trials (a) and 6 canola trials (b) conducted between 1997–2003 when using UAN compared with granular urea applied at the same N rate. The solid line indicates the 1:1 line

Boomspray and banding comparisons -- In most cases (62%) banding UAN enhanced N uptake and plant growth compared to boomsprayer applications (data not presented). In about a third of the trials, banded UAN significantly increased yields and N removal by 13–31% compared to boomspray applications (Fig. 2). On average over all trials, NUE was increased by 7% with banding, especially when boomspray NUE was low. Assuming N recoveries of 35-50% (typical in WA), banded N applications could be reduced by 15–20% compared to boomsprayed N (or urea topdressed) while producing the same yield and protein. At some sites where a dry start to the season occurred, plant density was reduced when UAN was banded at rates above 50kg N/ha even with the UAN was separated from the seed by 30–40mm. Although UAN is less toxic than urea, good separation from the seed is still required. These trial data and grower experience have resulted in a recent trend towards banding UAN at sowing and many farmers are also using UAN as a flexible way to apply in-furrow fungicides and trace elements. Furthermore, liquid banding technology has led to the development of other liquid fertilisers containing N, P, K, S and trace elements, which are capable of replacing most solid fertilisers. These liquids are currently under evaluation for agronomic performance, and early results suggest increased phosphorus availability on high fixing soils.

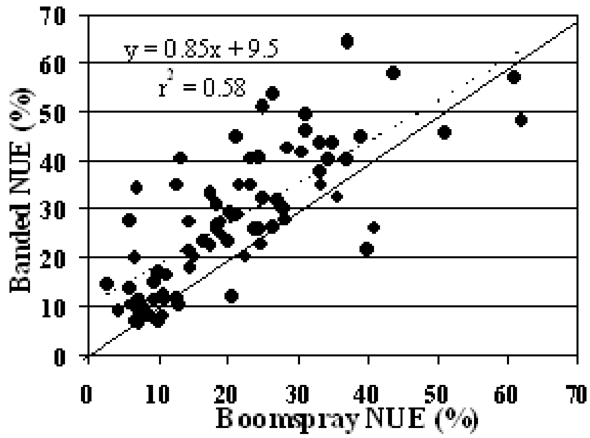

Figure 2. Nitrogen use efficiency (NUE) of 32 wheat trials conducted between 2000–2005 comparing UAN banded or applied through a boomspray immediately after sowing. The solid line indicates the 1:1 line.

Reference

Ripper F (2004). Fluid fertiliser adoption in Western Australia. First Fluid Fertiliser Workshop Proceedings, Eds. Kelly J, Wojcik N, McLaughlin M. September 2004. ARRIS Pty Ltd.