Comparing grain yield and protein from pre-plant application of anhydrous ammonia and urea over four cereal crops

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ABSTRACT

Frequent discussion occurs within the grain growing community regarding the relative merits of different nitrogen (N) fertiliser sources. An experiment was conducted to compare grain yield and grain protein % resulting from pre-plant, banded applications of anhydrous ammonia (AA) or urea fertilizers over a number of different cropping seasons at the same site. Results from each of 4 cereal crops indicate no significant difference in grain yield or protein % at any N application rate.

KEY WORDS

Nitrogen fertiliser, sorghum, wheat.

INTRODUCTION

Application of N Fertilizers is now standard practice for the majority of cereal grain producers in the northern grain belt of eastern Australia. Much research has been conducted to investigate optimum rates of N fertiliser in cereal crops (Holford *et al.* 1992, Strong *et al.* 1996), use of N in different cereal production tillage systems (Strong *et al.* 1996), and recovery of N fertiliser applied at different times and depths (Strong *et al.* 1992).

Anhydrous ammonia (82% N) and urea (46% N) are the two main N Fertilizers applied pre- sowing however, little work has been reported in Australia regarding the relative performance of these N fertiliser products on grain yield and protein of cereals. Strong and Cooper (1992) reported on a series of experiments conducted during 1978, 1981 and 1982, however this work was influenced by relatively dry fallow and growing periods, which influenced the crop response to N. A field experiment at "Myling", in the Tulloona district on the NW plains, NSW has been conducted since 1996 comparing the performance of AA and urea at 5 N application rates.

MATERIALS AND METHODS

The experiment consists of a factorial combination of 5 rates of N (0, 30, 60, 90, 120 kg/ha/crop), applied as AA or urea, at 3 P rates (0, 10, 20 kg/ha/crop). P was applied as triple superphosphate (20.7% P). Each treatment was replicated three times in a randomised block design. The soil is a grey vertosol with pH ($CaCl_2$) 7.2, CEC (cmol+/kg) 49, Leco C 1.0%, Leco N 0.08%.

Nitrogen is band applied, pre-plant, with both products being applied on the same day, using the same ground engaging tines. Fertiliser application depth is approximately 75 mm.

Four cereal crops have been produced since 1996, wheat (*Triticum aestivum* cv. Pelsart) in 1996, grain sorghum (*Sorghum bicolor* Moench cv. Pacific Seeds "Buster MR") in 1997/98 and 1998/99, and wheat (*Triticum turgidum* L. conv. *durum* cv. Yallaroi) in 1999.

Grain yields and N concentration were measured from all plots in all years. After gravimetric determination of grain moisture content, grain yields and protein were adjusted to 12% moisture. Grains were analysed for N concentration in Kjeldahl digests using automated ammonium-N analysis. Grain protein concentration was calculated by multiplying grain N concentration by 5.7 for wheat and 6.25 for sorghum.

RESULTS AND DISCUSSION

Grain yield (Fig 1a) and grain protein (Fig 1b) were not affected by N source in any of the 4 crops. Data shown are the means of the 5 N rates at the 3 P rates. N application rate was significant for each crop; the maximum grain yield increase from N in each crop was 380 kg for 1996, 56 kg for 1997/98, 1622 kg for 1998/99 and 1883 kg for 1999. Maximum protein increase was 0.8% in 1996, 2.3% in 1997/98, 2.1% in 1998/99 and 5.4% in 1999. The interaction between N rate and N product was not significant in any crop (data not shown) for either grain yield or protein.

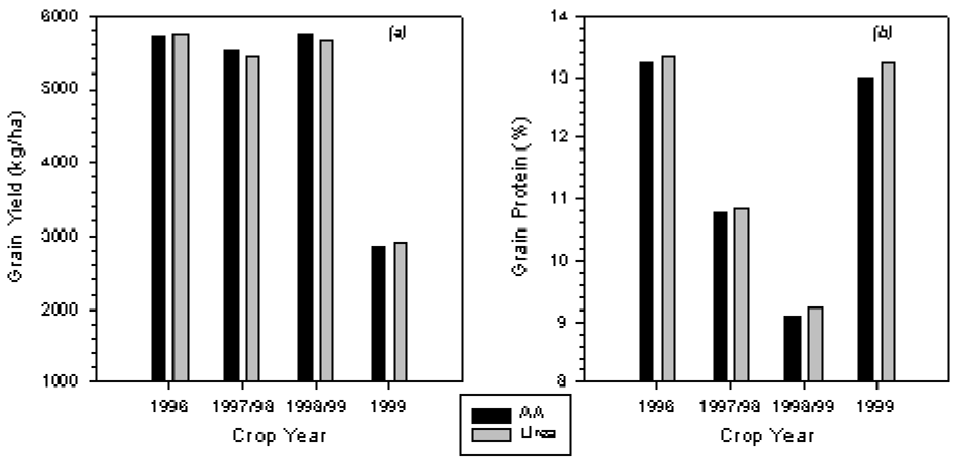

Figure 1. Comparing anhydrous ammonia (AA) and urea over four cereal crops for *(a)* grain yield and *(b)* protein.

The absence of consistent grain yield and protein differences between N fertiliser products when applied with the same implement and soil conditions suggests that in other comparisons, factors other than form of N may be the cause of differences in performance.

Application conditions can play a significant role in effective fertiliser application as a result of effects on N loss mechanisms during and immediately post application. Loss mechanisms that can create differences between AA and urea include applying AA into soil that is too dry or too wet will resulting in volatilisation losses, as will failing to apply it deep enough (Parr and Papendick 1965). Soil moisture, texture and tilth, pH, CEC, depth of placement and within-row concentration can affect adsorption and retention of ammonia in the soil (Parr and Papendick 1965).

When urea is surface applied without incorporation, or applied where there is enough moisture to dissolve the fertiliser but not enough to carry it into the soil, significant amounts of nitrogen may be lost by volatilisation (Havlin *et al*. 1999). Volatilisation losses may also occur where urea is band applied, and the furrow is left open, directly exposing the urea to the atmosphere or where urea is applied too shallow in low CEC soils. In the absences of loss mechanisms, equivalent quantities of N from both sources would be expected to produce similar crop performance.

CONCLUSIONS

No significant differences have emerged between AA or urea applications, where significant crop responses to N are being measured. Under these conditions, N fertiliser product choice of either AA or urea can be determined from other farm management influences such as equipment and labour availability, product supply logistics, and economics of N application.

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