Timing of late applications of N fertiliser and season on grain yield and protein in wheat

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Abstract

The efficacy of late applications of N fertiliser on the yield and grain protein content of wheat was evaluated during two seasons at Wongan Hills, Western Australia. Nil and 50 kg N /ha were applied at seeding to generate crops with low and high N status. Late N at 30 kg/ha was applied at stem elongation, booting and anthesis as ^{15}N-urea. The end of the season was manipulated by 2 different planting dates. Maximum increases in grain yield of 0.6 t/ha and protein of 1.7 percentage units occurred with uptake efficiencies of about 55% for the N applied at stem elongation in the early sown crop under high plant N status. Increases in both yield and protein were associated with rainfall events(>12 mm) after late N was applied.

Keywords:

Short season variety, time of seeding, N status, sandy soil, ^{15}N urea.

Introduction

Increases in payments for grain protein content have made decisions on the application of fertiliser N to wheat more critical for profits. Post-tillering N fertiliser is often applied as a means of increasing grain protein content in seasons when yield potentials are high and protein is expected to be low (2). Evidence from earlier research on the efficacy of late applications of N fertiliser on the grain protein content of wheat grown in Western Australia indicates that they seldom increased grain yield or protein content (3,4). However, during the last ten years the average sowing date of the wheat crop has advanced by 3-4 weeks in Western Australia (1) implying that grain is being filled and protein accumulated under cooler and wetter conditions. These more favorable conditions for grain filling indicate that there may be an increased chance of obtaining a response to N applied late in the growing season.

Methods

Field experiments were conducted over the June-November growing season of 1997 and 1998 at Wongan Hills in the central wheatbelt of Western Australia. The site is located in an area with an average of 390 mm of rainfall and the soil is deep yellow earthy sand. In each year the site had been planted to wheat in the previous season. Wheat (*Triticum aestivum* L.) cv. Amery was sown on 4 June and 8 July 1997 and cv. Kalannie on 3 June and 1 July 1998 to a final density of 110 plants m^{-2}. At seeding two rates of N were applied in a randomised block design in four replicate plots. The N rates were Nil and 50 kg/ha applied as top dressed urea. Post-tillering N at 30 kg/ha was applied to these plots when the crop was at stem elongation (DC 25), booting (DC 42) and flowering (DC 61). Microplots (0.045 m^2, 5 plants) were established after sowing within each experimental plot and post-tillering N was applied as ^{15}N-urea in order to quantify precisely the uptake efficacy of late applications of N in increasing grain protein content.

Results

Uptake efficiencies of about 55% occurred when fertiliser N was applied at stem elongation to the early sown crop in 1997. The benefit from this application was an increase in 0.6 t/ha and 1.7 percentage units protein in the high N status crop and 1.6 percentage units in the crop with low N status (Fig. 1). These increases were associated with a 14 mm rainfall after the N was applied. No yield advantage resulted from late N applications to the late sown crop in 1997, but protein was increased by 1.6-1.8 percentage units, regardless of the N status.

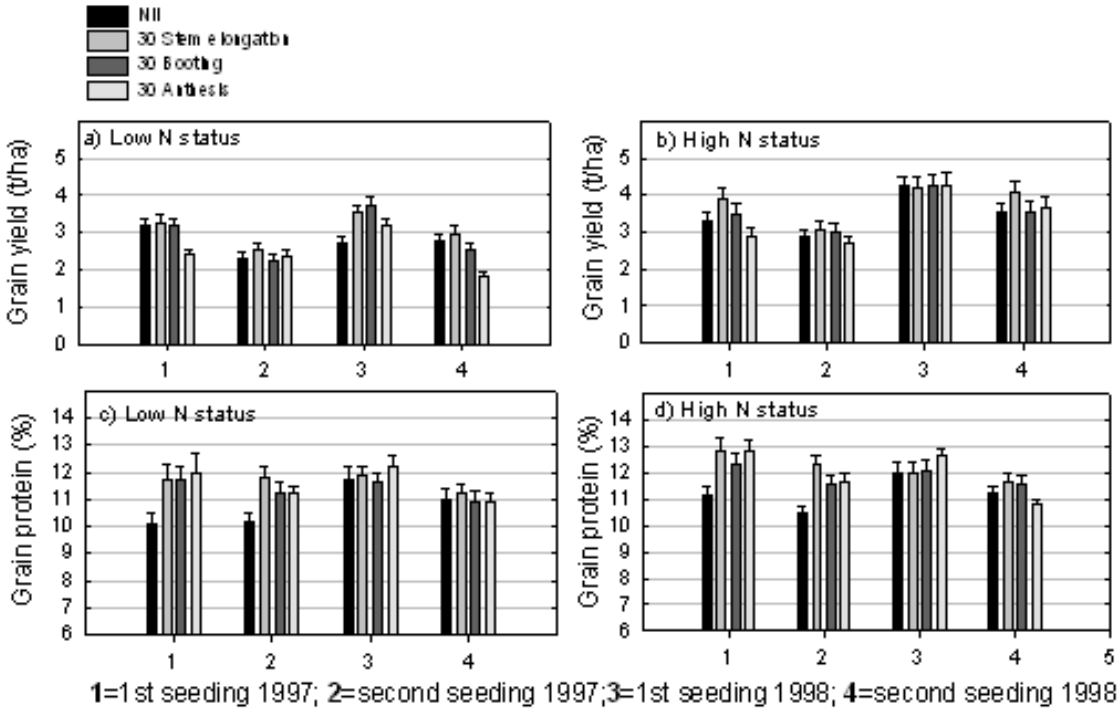

Fig 1. Yield and protein results from post-tillering N applied at stem elongation, booting and anthesis to wheat crops sown early June 1997 (1) and 1998 (3), and early July 1997 (2) and 1998 (4) and grown under low (a and c) and high (b and d) N status.

Uptake efficiencies of about 69% occurred when fertiliser N was applied at stem elongation and booting to the early sown crop in 1998. The benefit from this application was 0.8-1.0 t/ha increase in yield in the low N status crop. No grain yield or protein advantages resulted from late N applications to the late sown crop in 1998.

Conclusion

Increases in wheat grain yield and protein content from post-tillering applications of fertiliser N can be achieved in seasons when significant rains after stem elongation are capable to keep the soil surface moist for long enough to allow the fertiliser N to be taken up by the crop. Consequently, an assessment of the chances of getting late rains that keep the soil surface moist is required to increase grain yield and protein by late N intervention.

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