

**Evaluation of Nitrogen Use Efficiency
(NUE) in Wheat**

By

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A thesis submitted for the degree of Masters in
Agricultural Science

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2009 - 2011

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DECLARATION

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Bahaddin Abdullah Faraj and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Bahaddin Abdullah Faraj

ACKNOWLEDGMENTS

I appreciate very much my principal supervisor Dr. Brent Kaiser for his help and opportunity in securing a scholarship for this study and for supporting me with advice and information I needed during my study.

I would like to thank Dr. Mamoru Okamoto for supporting and providing advice I needed during my study.

I would like to thank Dr. Trevor Garnett and Dr. Daren Pallet for supporting and providing advices related to this research.

I thank Neenah Mackenzie for her support and for her work on plant tissue sample analysis and measuring N and C by running the Isotope Ratio Mass Spectrometer.

I thank Dr. Haydn Kuchel for providing advice and information on the field trials (2010).

I thank Australian Grain Technology (AGT) for conducting field trials in 2010 and providing materials.

I thank Prof. Peter Langridge, Chief Executive Officer, and Australian Plant Functional Genomic Centre (ACPGF) for his support.

I thank Adelaide University and (ACPGF) for funding this project.

Finally, I thank my family for their support, their encouragement and their patience to get here where I am now.

List of Abbreviations

ADP	Di-ammonium phosphate
AGT	Australian Grain Technology
ANOVA	Analysis of variance
GH	Glasshouse
GY	Grain Yield
HI	Harvest Index
LSD	Least significant difference
N	Nitrogen
NH_4^+	Ammonium
NO_x	Nitrous oxide
NO_3^-	Nitrate
NUE	Nitrogen Use Efficiency
NupE	Nitrogen uptake efficiency
NutE	Nitrogen utilization efficiency
TGN	Total grain nitrogen content
TGW	Thousand grain weight

Abstract

Nitrogen fertilizers are a major input required for cereal crop production worldwide. The management of this resource is a significant challenge to most agricultural systems as it can have significant impacts on yield and the environment. The use of applied nitrogen fertilisers in cereals is poor, where only 30-40% is actually used by cereals and the remainder lost to the environment by surface runoff, soil denitrification and volatilization (Ehdaie et al., 2010; Butterbach-Bahl and Dannenmann 2011). Improving cereal nitrogen use efficiency (NUE) is imperative to achieve yield and quality with less direct N inputs. In this study, experiments were conducted in 2010 to evaluate the effect of N fertilizer application (0, 50, 100, 150 kg urea/ha) on the growth and yield of wheat varieties at specific locations across South Australia while a small pilot glasshouse study was conducted at the Waite Campus, Adelaide University. The field experiments were designed as a randomised split-plot with three replications for each wheat cultivar and N treatment. Plant response to N treatment was measured through estimates of plant height, leaf chlorophyll content (SPAD meter), plant spike number, grain yield, 1000 grain weight, shoot biomass weight, grain N % and final grain protein content, harvest index (HI) and NUE. Restrictions in space and large growing pots limited the controlled glasshouse study to a technical study.

The results found little variability between the three field sites in Grain %N in response to increasing N provision. There was a trend of increasing grain %N at both Mintaro and Pinnaroo, which was broadly in evidence across the individual lines. Grain yield was highest at Mintaro and was double of that achieved at both Pinnaroo and Tuckey. Whereas, in the glasshouse experimental results show that there was a strong response in grain %N to increasing N provision when plants were grown over the spring/summer season but not during the autumn/winter. Nitrogen use efficiency (NUE) was found to be greater at low nitrogen treatment (N1) in all experiments and decreased roughly with increased N application. In general, the results indicated that wheat cultivars responded well to nitrogen application with the medium rate of application within experiments, while beyond this rate caused no significant improvements in plant growth and yield.

Key words: Wheat varieties, nitrogen fertiliser (varied levels), nitrogen use efficiency (NUE), Yield, grain protein content