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Northern Grains Region Trial Results Autumn 2012

RESEARCH & EXTENSION – INDEPENDENT RESEARCH FOR INDUS

Editors: Loretta Serafin, Steven Simpfendorfer, Matthew Gardner and Guy McMullen

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GRDC Grains Research & Development Corporation

Department of Primary Industries

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This report has been compiled by Loretta Serafin, Steven Simpfendorfer, Matthew Gardner and Guy McMullen on behalf of the authors.

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Foreword

NSW Department of Primary Industries (NSW DPI) conducts a range of research and extension activities on a vast array of agronomic, disease, weed and insect issues related to the successful production of grains throughout the northern and central grains region. Each of these activities is targeted towards assisting growers and advisors to make improvements in the farming systems of our region.

Crop agronomy remains an integral component of successful cropping enterprises. Good crop agronomy needs to consider varietal choice, crop nutrition, weed, disease and insect management not only on an individual crop basis but needs to also account for rotational factors. Agronomic practices need to be well informed by rigorous, scientific independent research.

NSW DPI trials research and extension reported in this book are primarily conducted across the central and northern grains regions of NSW addressing a wide range of production issues in cereal, pulse and oilseed crops. This work often involves collaborative research, development and extension between NSW DPI research groups, district agronomists and external partners such as GRDC, agribusiness, private consultants and grower groups. We would like to acknowledge the contributions of each of these people and their organisations.

This book is a collection of short papers; the third in a series, aimed at improving the awareness and accessibility of the results of the work which NSW DPI staff are involved in across the central and northern grains region. In many cases some of the papers will prompt more detailed questions and we would encourage you to discuss these with your local District Agronomist or the authors of the paper.

Finally, thankyou to all of the authors for their efforts in concisely reporting on their often extensive and complicated work. We hope you enjoy reading and utilising the information presented in this report.

The Research & Extension Team,
NSW Department of Primary Industries

Contents

Agronomy

Nitrogen use efficiency of three barley varieties – Trangie 2011

Rohan Brill

NSW DPI, Coonamble

Introduction

Nitrogen management for malting barley is a balancing act between maximising yield and maintaining protein in the range from 9 to 12%. Buloke$^{\phi}$ and Commander$^{\phi}$ are two accredited malt varieties, with Buloke$^{\phi}$ targeting the export (starch adjunct) market and Commander$^{\phi}$ targeting the domestic (sugar adjunct) market. Hindmarsh$^{\phi}$ is accredited as 'Food' grade, which may attract a premium to feed grade.

Site details

Location: Trangie Agricultural Research Centre

Soil type: Red Loam

Sowing date: 17th May 2011

Harvest date: 3rd November 2011

Available N: 175 kg/ha (0–120 cm)

Treatments

Varieties: Buloke$^{\phi}$, Commander$^{\phi}$ and Hindmarsh$^{\phi}$

Nitrogen rates: 0, 30, 60 and 90 kg/ha (all broadcast on 20th May in front of rain)

Results

Hindmarsh$^{\phi}$ was the highest yielding variety across all nitrogen treatments (Figure 1). There was a significant effect of nitrogen rate on grain yield, but only from the 90 kg/ha N treatment which resulted in a significant yield reduction of 0.2 t/ha compared to the 0 and 30 kg/ha N rates (data not shown).

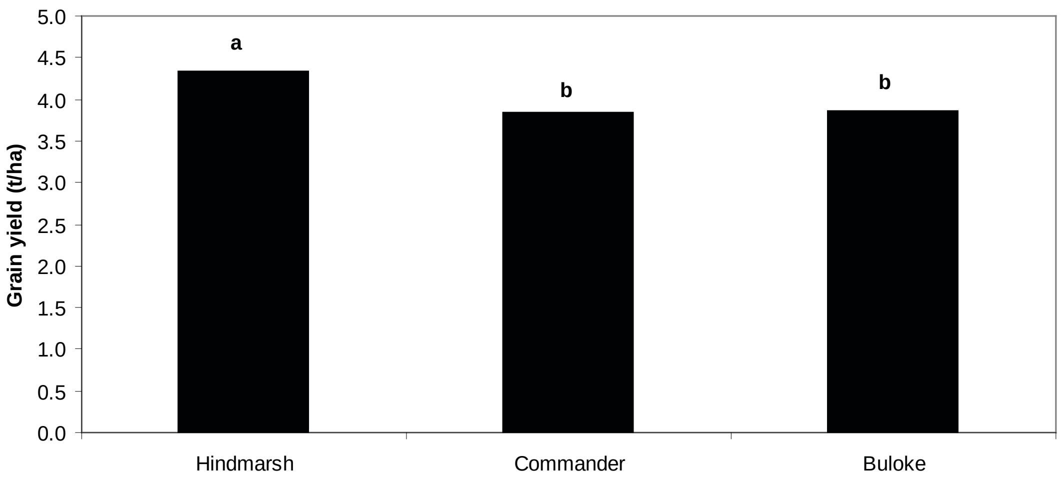

Figure 1. Grain yield of three barley varieties averaged across four nitrogen rates – Trangie 2011

Hindmarsh$^{\phi}$ and Commander$^{\phi}$ had the highest and lowest grain protein concentration respectively, at each of the four N rates. The application of N resulted in increased grain protein concentration for all varieties (Figure 2).

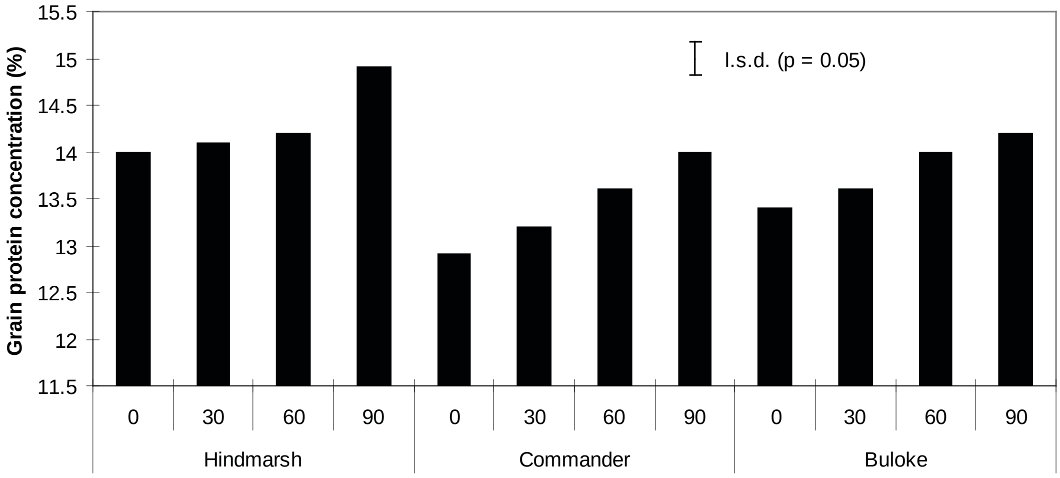

Figure 2. Grain protein concentration of three barley varieties at four nitrogen rates – Trangie 2011

Summary

In this trial, grain yield and grain protein concentration was greatest from Hindmarsh$^{\phi}$, which indicates that Hindmarsh$^{\phi}$ was the most efficient of these three barley varieties at utilising available soil nitrogen.

Where soil nitrogen levels are known to be high, Commander$^{\phi}$ may be an option to limit grain protein concentration in order to target malt quality, however high levels of soil N will predispose the crop to a relatively greater risk of lodging. Commander$^{\phi}$ appears best suited to medium to high rainfall zones or where soil moisture levels at sowing are high, while Buloke$^{\phi}$ and Hindmarsh$^{\phi}$ both appear suited to low to medium rainfall zones.

Acknowledgements

This project was funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131). Thanks to Trangie staff Jayne Jenkins and Rob Pither for technical assistance and Gavin Melville for statistical analysis.

Response to phosphorus of canola and chickpea – Trangie 2011

Rohan Brill[1] and Leigh Jenkins[2]

[1] NSW DPI, Coonamble

[2] NSW DPI, Warren

Introduction

Phosphorus (P) application is a significant input cost for crop producers in most regions of Australia. The primary aim of this trial is to determine how crop choice and applied P in the rotation crop (2011), may effect the P requirement in the following cereal crop (2012). This paper reports on the initial findings from 2011, regarding the response of chickpea and canola to increasing rates of P applied at sowing.

Site details

Location: Trangie Agricultural Research Centre

Soil type: Grey vertosol

Soil P (0–10 cm): 21 mg/kg (Colwell test)

Treatments

Canola: Variety Tawriffic TT$^{\phi}$, planted 4th May 2011

Chickpea: Variety PBA HatTrick$^{\phi}$, planted 6th June 2011

P rate treatments: 0, 5, 10, 20 kg P/ha applied at sowing

Results

Dry matter at mid-flowering

- All rates of applied P (5–20 kg/ha) resulted in significantly greater dry matter of canola at mid-flowering (22nd August) than the nil P treatment, with no increase in dry matter beyond the 5 kg/ha treatment (Figure 1).
- Only the 10 kg/ha and 20 kg/ha P treatments resulted in significantly greater dry matter of chickpea at mid-flowering (15th September) compared to the nil P treatment.
- The dry matter response to P was greater for canola than chickpea, with the application of 20 kg/ha P resulting in a 27% and 10% increase in dry matter for canola and chickpea respectively when compared to the nil P treatment.

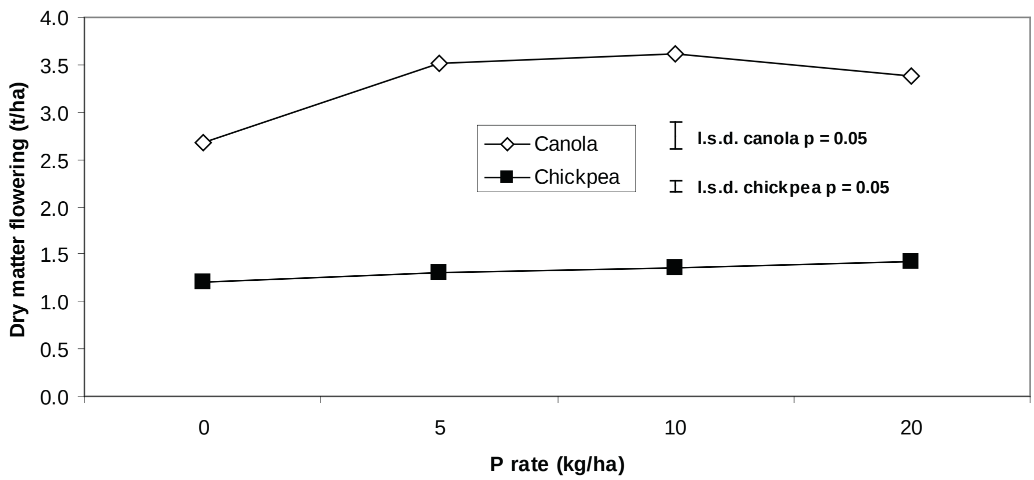

Figure 1. Effect of P rate on dry matter of canola and chickpea at Trangie in 2011.

Grain yield

- The application of 5 kg/ha P resulted in a 0.3 t/ha grain yield increase for canola compared to the nil P treatment. Grain yield continued to increase as P rate increased up to 20 kg/ha, but at a lesser rate (Figure 2).
- The application of 20 kg/ha P resulted in a 0.2 t/ha grain yield increase for chickpea compared to the nil P treatment, however the 5 kg/ha and 10 kg/ha P treatments did not result in significantly greater grain yield of chickpea than the nil P treatment.
- While the yield of chickpea and canola were similar from the higher P rates, chickpea had a higher yield than canola where there was nil P applied.

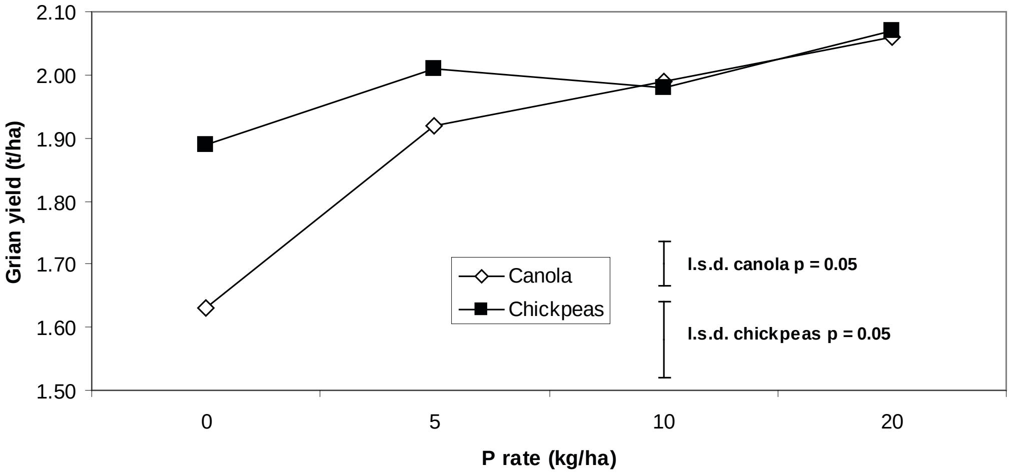

Figure 2. Effect of P rate on grain yield of chickpea and canola at Trangie in 2011

Summary

This trial will continue in 2012 where wheat will be sown over all plots, both with and without added phosphorus to determine the impact of crop type and phosphorus rate in the rotation crop on residual soil phosphorus levels. The impact of canola and chickpea on residual soil nitrogen levels will also be assessed by sowing plots with and without nitrogen.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Variety Specific Agronomy Package Project (DAN00129). Thanks to NSW DPI Trangie staff Jayne Jenkins and Rob Pither for technical assistance, Gavin Melville for trial analysis and to Andrew Verrell (NSW DPI, Tamworth) for support with this trial.

Response of eleven barley varieties to three sowing dates – Trangie 2011

Rohan Brill

NSW DPI, Coonamble

Introduction

Sowing time of barley is determined by varietal maturity and other agronomic factors such as lodging and disease resistance. Further to this the logistical challenges of planting barley in a sowing program with other crop species that are generally considered to be of higher value also needs to be considered.

Site details

Location: Trangie Agricultural Research Centre

Previous crop: Faba beans

PAW: 180 mm

RLN (*P. thornei*): 9,150 nematodes/kg soil in the 0-30 cm zone

Soil type: Grey vertosol

Treatments

Sowing dates:

Three sowing times of:

1. 6th May 2011
2. 18th May 2011
3. 9th June 2011

Varieties: 11 varieties, ranging in maturity from the long season, dual purpose winter type Urambie$^{\phi}$ to the quick variety Grout$^{\phi}$.

Results

There was no significant effect of sowing time overall, but there was a significant interaction between sowing time and variety ($P < 0.001$). Oxford$^{\phi}$ was the highest yielding variety from each of the three sow times, with Schooner being the lowest yielding variety from both the first and second sow times (Table 1).

Variety	Yield (t/ha) and rank within sow time						Anthesis date		
	30th April		16th May		9th June		30th April	16th May	9th June
Buloke$^{\phi}$	5.27	9	5.39	8	5.37	8	1-Sep	8-Sep	20-Sep
Commander$^{\phi}$	5.95	5	5.90	5	5.92	4	4-Sep	12-Sep	20-Sep
Fitzroy$^{\phi}$	5.83	6	5.96	2	5.70	6	5-Sep	17-Sep	24-Sep
Gairdner$^{\phi}$	5.52	8	5.01	10	4.68	11	8-Sep	19-Sep	26-Sep
Grout$^{\phi}$	5.66	7	5.47	7	6.16	2	23-Aug	4-Sep	16-Sep
Hindmarsh$^{\phi}$	6.12	3	5.86	6	5.81	5	28-Aug	5-Sep	16-Sep
Oxford$^{\phi}$	6.60	1	6.68	1	6.23	1	5-Sep	17-Sep	26-Sep
Schooner	4.75	11	4.60	11	5.34	10	29-Aug	6-Sep	19-Sep
Scope$^{\phi}$	4.99	10	5.07	9	5.36	9	1-Sep	8-Sep	20-Sep
Urambie$^{\phi}$	6.11	4	5.93	3	5.99	3	8-Sep	17-Sep	27-Sep
Westminster$^{\phi}$	6.31	2	5.92	4	5.55	7	5-Sep	15-Sep	25-Sep
Mean of sow time	5.74		5.62		5.65				
l.s.d. p = 0.05	0.44								
c.v. (%)	6.70								

Table 1. Grain yield, rank within sowing time and anthesis date of 11 barley varieties sown at 3 sowing times – Trangie 2011.

Discussion

Oxford⁽ᵇ⁾ was the standout variety for grain yield at all three sowing times. It is a feed variety with very good straw strength and disease resistance. It appears most suited to relatively high rainfall regions.

Schooner was the lowest yielding variety from the first and second (6th and 18th May) sowing times. Commander⁽ᵇ⁾ and Buloke⁽ᵇ⁾ appear the most suitable malt varieties to replace Schooner, with Commander⁽ᵇ⁾ being suited to medium-high rainfall regions and Buloke⁽ᵇ⁾ being suited to low-medium rainfall regions.

Hindmarsh⁽ᵇ⁾ yielded consistently well across the three sowing times and other trials have shown that it has relatively stable yield over a range of seasons and environments.

Gairdner⁽ᵇ⁾ is still a popular variety in some regions, but this trial highlighted the need to plant Gairdner⁽ᵇ⁾ early.

Grout⁽ᵇ⁾ had very high yield from the 9th June sowing time. From this sowing date, Grout⁽ᵇ⁾ flowered at a similar time to Oxford⁽ᵇ⁾ sown on the 16th May. Grout⁽ᵇ⁾ has been a reliable feed variety in the north-west, however it is very susceptible to leaf rust.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Variety Specific Agronomy Package Project (DAN00129). Thanks to Trangie staff Jayne Jenkins and Rob Pither for technical assistance and Gavin Melville for statistical analysis.

Response of eighteen wheat varieties to three sowing dates – Trangie 2011

Rohan Brill

NSW DPI, Coonamble

Introduction

Sowing time of wheat is a balance between avoiding frost and heat at flowering and grain fill and also ensuring that water use is optimised. Trials have been conducted at Trangie Agricultural Research Centre from 2009–2011 as part of the GRDC funded Variety Specific Agronomy Packages project to determine optimum sowing dates of a range of varieties and maturity groups of wheat. This paper reports the results of the 2011 trial only.

Site details

Location:	Trangie Agricultural Research Centre
Previous crop:	Faba beans
Plant Available Water:	180 mm
RLN (*P. thornei*):	9150 nematodes/kg soil in the 0–30 cm zone
Soil type:	Grey vertosol

Treatments

Sowing dates:

TOS 1. 30th April

TOS 2. 16th May

TOS 3. 9th June

Varieties:

18 wheat varieties, broadly grouped into three maturities

Early: Axe$^{\phi}$, LongReach Crusader$^{\phi}$, Lincoln, Livingston$^{\phi}$, Merinda$^{\phi}$, LongReach Spitfire$^{\phi}$

Mid: EGA Bounty$^{\phi}$, Bolac$^{\phi}$, Gauntlet, EGA Gregory$^{\phi}$, SUN595B, SUN627A, Sunguard$^{\phi}$, Sunvale$^{\phi}$

Late: EGA Eaglehawk$^{\phi}$, QT15047, Sunzell$^{\phi}$, EGA Wedgetail$^{\phi}$

Results

Grain yield was maximised from treatments that flowered in the window from the 3rd to the 21st of September (Figure 1). Treatments that flowered prior to early September had a yield reduction compared to the optimum period, even in the absence of significant frost events. Treatments that flowered later than 21st September also suffered a yield reduction as temperature increased.

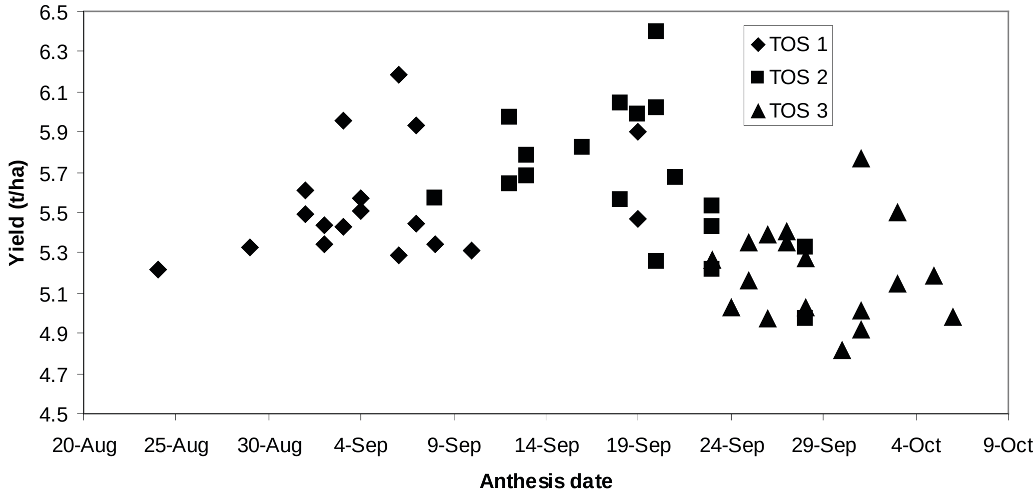

Figure 1. Relationship between anthesis date and grain yield of 18 wheat varieties sown at 3 sow dates – Trangie 2011

EGA Bountyⓓ had the highest yield from time of sowing (TOS) 1, while EGA Gregoryⓓ had the highest yield from TOS 2 and 3. EGA Gregoryⓓ yielded 0.96 t/ha more from the 16th May sow time than the 30th April sow time (Table 1).

Table 1. Grain yield, rank within sow time and anthesis date of 18 wheat varieties sown at three dates at Trangie in 2011.

Variety	Yield (t/ha) and rank within sow time						Anthesis date		
	30th April		16th May		9th June		30th April	16th May	9th June
Axeⓓ	5.22	18	5.57	11	5.26	8	24-Aug	8-Sep	23-Sep
Bolacⓓ	5.93	3	5.25	16	5.14	11	7-Sep	20-Sep	3-Oct
EGA Bountyⓓ	6.18	1	5.68	8	4.81	18	6-Sep	21-Sep	30-Sep
LongReach Crusaderⓓ	5.61	5	5.97	5	5.03	12	1-Sep	12-Sep	24-Sep
EGA Eaglehawkⓓ	5.90	4	5.33	15	5.19	9	19-Sep	28-Sep	5-Oct
Gauntlet	5.43	11	5.99	4	5.27	7	3-Sep	19-Sep	28-Sep
EGA Gregoryⓓ	5.44	10	6.40	1	5.77	1	7-Sep	20-Sep	1-Oct
Lincoln	5.43	11	5.68	8	4.98	15	2-Sep	13-Sep	26-Sep
Livingstonⓓ	5.33	15	5.64	10	5.16	10	29-Aug	12-Sep	25-Sep
Merindaⓓ	5.49	8	5.82	6	5.39	4	1-Sep	16-Sep	26-Sep
QT15047	5.35	13	5.53	13	5.50	2	8-Sep	23-Sep	3-Oct
LongReach Spitfireⓓ	5.34	14	5.78	7	5.35	5	2-Sep	13-Sep	25-Sep
Sunguardⓓ	5.57	6	5.56	12	5.03	12	4-Sep	18-Sep	28-Sep
Sunvaleⓓ	5.28	17	5.43	14	4.91	17	6-Sep	23-Sep	1-Oct
Sunzellⓓ	5.31	16	5.21	17	5.02	14	10-Sep	23-Sep	1-Oct
SUN595B	5.96	2	6.02	3	5.35	5	3-Sep	20-Sep	27-Sep
SUN627A	5.51	7	6.05	2	5.41	3	4-Sep	18-Sep	27-Sep
EGA Wedgetailⓓ	5.47	9	4.97	18	4.98	15	19-Sep	28-Sep	6-Oct
Mean of sow time	5.54		5.66		5.20				
l.s.d. p = 0.05	0.36								
c.v. (%)	5.30								

The yield loss in the late maturity varieties was on average 9 kg/ha per day from the 30th April sowing to the 9th June sowing. The yield loss of the mid-maturity and early maturity varieties from the 16th May sow time to the 9th June sow time was on average 23 kg/ha per day.

There was a yield penalty for early maturity varieties when sown early, even though frost was not a significant issue. The relatively short days in the period leading up to flowering that these varieties experienced resulted in a reduction in the number of grains/m^2. The early maturity group had, on average, a 330 kg/ha yield penalty from the 30th April sow date compared to the 16th May sow date (Figure 2).

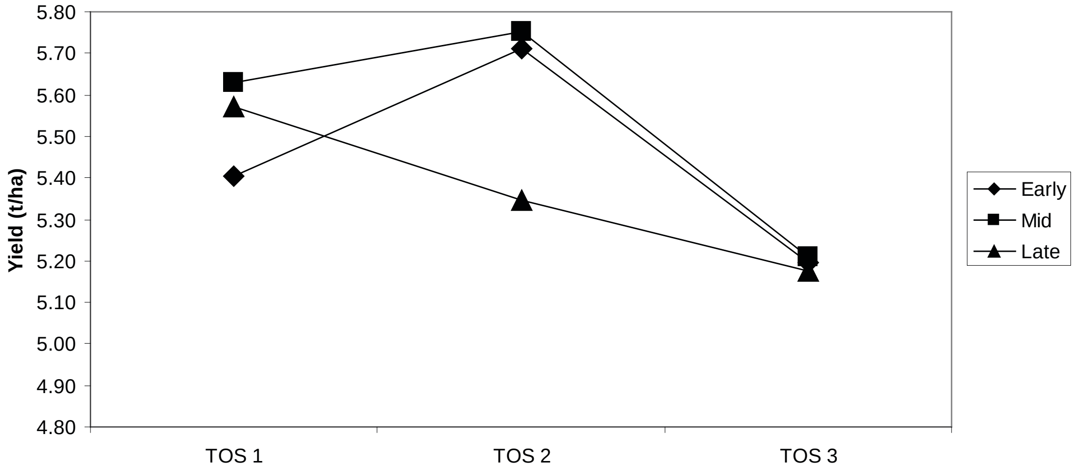

Figure 2. Grain yield comparison of late maturity, early maturity and mid-maturity varieties sown at three dates – Trangie 2011

Acknowledgements

This project is funded by NSW DPI and GRDC under the Variety Specific Agronomy Package Project (DAN00129). Thanks to Trangie staff Jayne Jenkins and Rob Pither for technical assistance and Gavin Melville for statistical analysis.

Chickpea time of sowing trial – Trangie 2011

Leigh Jenkins[1] and Rohan Brill[2]

[1] NSW DPI, Warren
[2] NSW DPI, Coonamble

Introduction

The two major constraints to chickpea production in the northern cropping region are disease and frost damage. In both cases, sowing date can be used as a strategy to influence yield through avoidance of cold temperatures during flowering, and to reduce the effects of disease.

Chickpea time of sowing trials (TOS) were conducted in 2010 and 2011 by NSW DPI at Trangie Agricultural Research Centre, to evaluate the impact of sowing date on phenology and yield of current and potential release cultivars. The 2010 trial succumbed to in-crop waterlogging and wet weather at harvest and was not harvested. This paper reports on the results of the 2011 trial.

2011 Site details

Location:	Trangie Agricultural Research Centre
Soil type:	grey vertosol (pH_{Ca} 7.5)
Previous crop:	wheat
Fertiliser:	100 kg/ha Granulock 12Z
Plant Available Water:	180 mm at sowing to a depth of 1.5 m
In crop rainfall:	230 mm of rain from May–October

2011 Trial treatments

Sowing dates:

1. TOS 1: 5 May
2. TOS 2: 18 May
3. TOS 3: 9 June
4. TOS 4: 27 June

Varieties:

1. CICA 0511 (since released as PBA Boundary⟨PBR⟩, Jimbour⟨PBR⟩ maturity)
2. CICA 0912 (potential release, Jimbour⟨PBR⟩ maturity)
3. Genesis™ 425 (long season maturity, kabuli type)
4. Flipper⟨PBR⟩ (long season maturity, ascochyta tolerance)
5. PBA HatTrick⟨PBR⟩ (Jimbour⟨PBR⟩ maturity, ascochyta tolerance)
6. Sonali⟨PBR⟩ (short season variety released in WA for chilling tolerance)

Results

Impact of time of sowing on phenology

Table 1 (below) provides a summary of mean phenology data grouped for all varieties at each of the four times of sowing. As a general summation of all six chickpea varieties:

- date of first flower (or length of vegetative phase) was progressively delayed as sowing was delayed.
- date of first pod was delayed between TOS 1 and TOS 2, similar between TOS 2 and TOS 3, but further delayed between TOS 3 and TOS 4.
- the length of time between date of first flower and date of first pod shortened as sowing was delayed, especially for TOS 3, then lengthened again for TOS 4.

Table 1. Mean phenology data of six chickpea varieties sown on four dates at Trangie ARC, 2011

	Date sown (2011)	Mean date of first flower	Mean number of days from sowing to first flower	Mean date of first pod	Mean number of days from first flower to first pod
TOS 1	5 May	23 Aug	110	12 Sept	20
TOS 2	18 May	6 Sept	111	23 Sept	17
TOS 3	9 June	13 Sept	96	26 Sept	14
TOS 4	27 June	19 Sept	85	4 Oct	15

Impact of time of sowing on grain yield

There were significant grain yield differences between varieties and also between the four times of sowing. However the relative ranking of varieties across sow times was not significantly different (Figure 1).

General response to sowing time

- TOS 1 (5 May) proved to be too early for the six varieties in this trial, with a mean yield penalty of 400–500 kg/ha compared with TOS 2 and TOS 3.
- There was no significant yield difference between TOS 2 (18 May) and TOS 3 (9 June). In this trial yield was optimal at either of these sowing times.
- TOS 4 (27 June) was too late with an associated yield penalty for all varieties when compared to TOS 2 and TOS 3 (mean yield 300 kg less), but still yielded higher (mean yield 170 kg/ha more) than TOS 1.

These differences could be explained by the climatic conditions post-sowing for each time of sowing. Chickpea sown on the 5 May into warmer soils had emerged within 10 days, but at about the two-leaf stage there was heavy rainfall (41 mm) on 23 May. This rainfall event was conducive to the development of Phytophthora root rot (PRR) (*Kevin Moore, pers. comm.*). TOS 2 had only just been sown on 18 May and although PRR was evident, it did not have the same impact on grain yield as TOS 1. The June sowings TOS 3 and TOS 4, although sown into good moisture, had minimal post-sowing rainfall events through June and July, with their first major rainfall event (28 mm) not until 18 August. There was less development of PRR in TOS 3 and TOS 4 than the two earlier sowings. The dry period of June–July, in combination with a preventative fungicide strategy prior to predicted rainfall events, meant that there was no obvious development of the foliar diseases Ascochyta and Botrytis Grey Mould in any of the four sowing times.

The differences could also be explained in relation to temperatures during the early part of flowering and pod development. Whilst plants sown at TOS 1 flowered earlier and set pod earlier (mean date 12 September), there was a week of low temperatures from 8 September culminating in two frost events on 13 and 14 September. Any flowers/pods up to this point would have been aborted (with the exception perhaps of Sonali⁽ᴰ. This effect would be reduced with subsequent sowing dates, to the point where plants sown at TOS 4 did not begin to flower until 19 September (mean date) after those particular frost events had occurred.

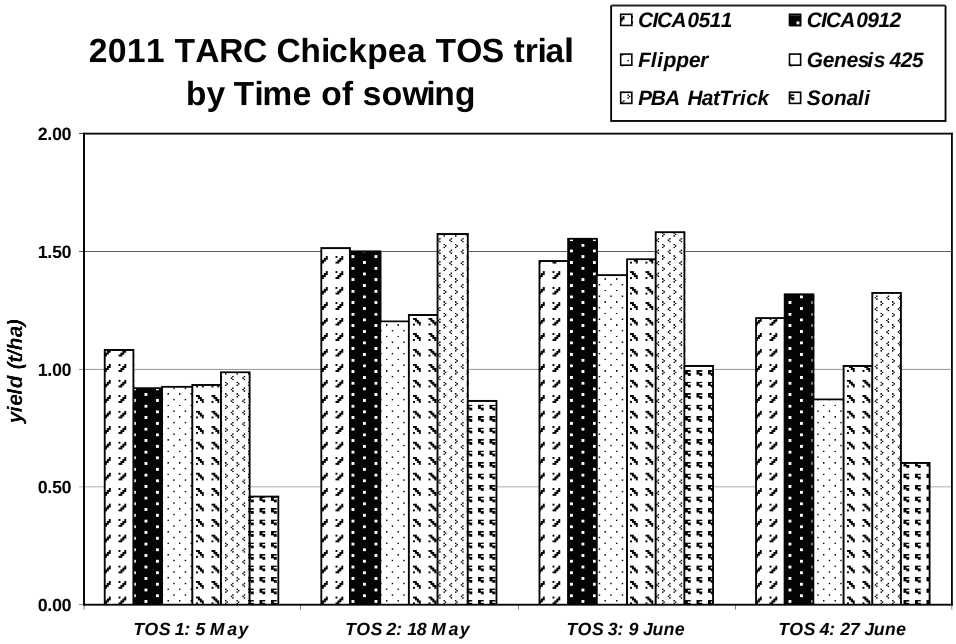

Figure 1. Yield response of six chickpea varieties sown on four dates at Trangie ARC, 2011 (average variety l.s.d. = 0.124; average TOS l.s.d. = 0.116).

General response of varieties

- PBA HatTrick$^{\text{⟨b⟩}}$ was the highest overall yielding variety (mean yield 1.37 t/ha), with significant yield differences to Flipper$^{\text{⟨b⟩}}$, Genesis™ 425 and Sonali$^{\text{⟨b⟩}}$, but not to CICA 0511 (PBA Boundary$^{\text{⟨b⟩}}$) or CICA 0912.
- There was no significant difference between the yields of CICA 0511 (since released as PBA Boundary$^{\text{⟨b⟩}}$) and CICA 0912.
- There was no significant difference between any of the varieties sown at TOS 3, with the exception of Sonali$^{\text{⟨b⟩}}$.
- The early flowering habit of Sonali$^{\text{⟨b⟩}}$ did not translate into increased yield and was significantly lower yielding (360–630 kg/ha less) than all other varieties.

Summary

The development and release of new chickpea varieties has led to the belief that early sowing (early May) would be the key to optimising water use through the development of increased biomass and earlier flowering. This trial has shown that earlier flowering does not necessarily translate into higher yield, due to the impact of lower temperatures during early flowering and a greater potential risk of disease. Conversely there is also a yield penalty from later sowing (late June) but chickpea plants are able to compensate to some effect through shortening their vegetative phase and flowering at temperatures more conducive to subsequent pod development.

The results from this trial are from one season (2011) only and results may vary depending on different seasonal conditions and locations.

Acknowledgements

This trial was funded by NSW DPI and GRDC through the Northern Pulse Agronomy Project in 2011.

Thanks to Jayne Jenkins and Robert Pither (technical assistance), Gavin Melville and Kelvin Appleyard (NSW DPI, Trangie) and Andrew Verrell (NSW DPI, Tamworth). Thanks also to Jeremy Brown (Agrigrain, Narromine) for supply of PBA HatTrick$^{\text{⟨b⟩}}$ seed for all chickpea trials.

Response of barley to row spacing – Moree, Walgett and Bellata 2011

Matthew Gardner and Guy McMullen
NSW DPI, Tamworth

Introduction

There has been a trend to wider row spacing's in recent years. Likely benefits include:

- an ability to sow into higher levels of retained stubble
- a reduction in fuel costs during sowing and/or increased sowing speed
- ability to inter-row sow subsequent crops
- reduced soil disturbance, and
- lower cost of sowing equipment.

However, potential costs from wider spacing's include:

- lower yields with wider row spacing, particularly under higher yielding conditions, and
- reduced weed competition.
- Unlike wheat varieties there can be large differences in plant type between barley varieties. For example Hindmarsh⊕ is a short erect type that does not produce large amounts of biomass compared to Commander⊕, which is more competitive with a more prostrate growth habit and production of large quantities of biomass early in the season. It is hypothesised that these differences in plant types may allow some barley varieties to perform better at wider row spacing's in comparison to others.

Site details

Location:	"Boggy Creek", Bellata,	"Oodnadatta", Moree,	"Sefton Park", Walgett
Co-operator:	Brian Lowe	Hugh Ball	Dave Denyer
Sown:	7th June 2011	19th May 2011	8th June 2011

Treatments

There were three row spacing trials conducted in 2011 at Bellata, Moree and Walgett. In the trials there were three barley varieties, Commander⊕, Hindmarsh⊕ and Shepherd⊕ which were planted at three target populations 40, 80 and 120 plants/m^2. The Hindmarsh⊕ treatments at Walgett received severe preferential damage from mice during grain fill and could not be harvested. Mice damage for Commander⊕ and Shepherd⊕ was surprisingly negligible. These differences were due to different maturities of the varieties with Hindmarsh⊕ being the quickest maturing variety. Three row spacing's were used; 300, 400 and 500 mm, and for Commander⊕ twin rows on 500 mm spacing's (500T) were also included.

Results

- At Walgett the 400 and 500 mm row spacing's reduced the establishment by approximately 20 plants/m^2 or 25% compared to the 300 mm row spacing. The 500T (twin row) treatment established similar plant numbers for Commander⊕ as the 300 mm row spacing.
- At Moree plant establishment was very poor being 25 to 65% lower compared to Walgett. A rainfall event immediately following planting caused significant crusting of the soil surface, which may explain the low establishment across the site. The establishment was much lower than anticipated. The 500T treatment still had 39% greater establishment than the 400 and 500 mm row spacing's.

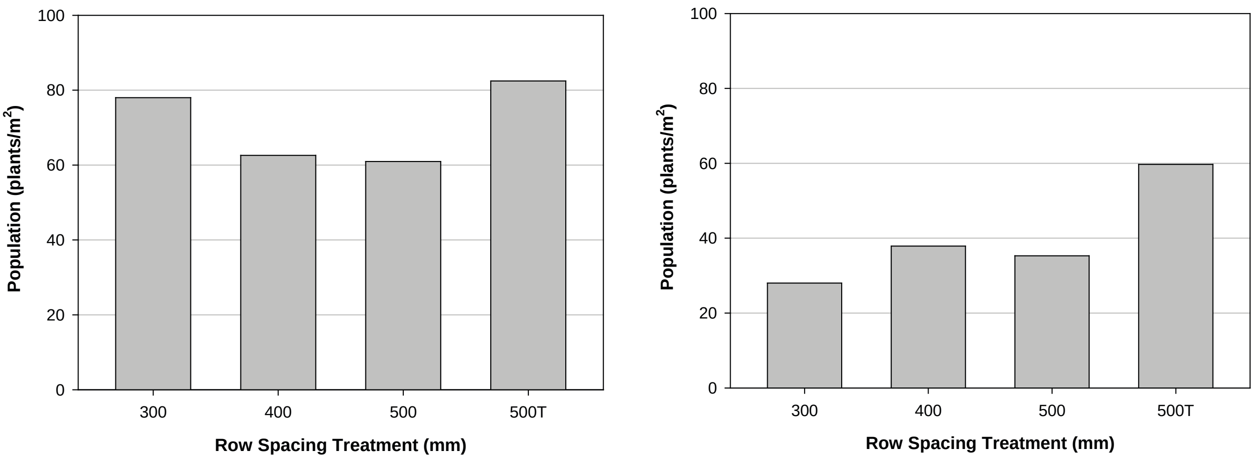

Figure 1. Effect of row spacing treatment on plant establishment at Walgett (a) and Moree (b) in 2011

- There was no significant effect of row spacing on grain yield at Bellata in 2011.
- Similar to Bellata, there was no significant effect of row spacing treatments on the grain yield of Shepherd⦶ at Walgett. The 500 mm row spacing for Commander⦶ yielded significantly lower than the 300 mm row spacing at Walgett.
- The 500T treatment at Walgett yielded similar to the 300 mm row spacing.

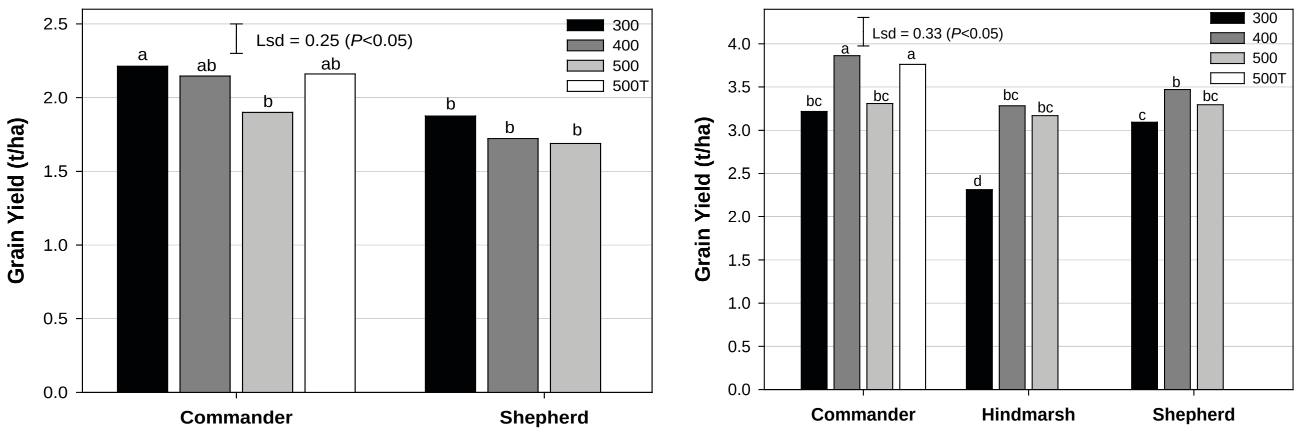

Figure 2. Variety yields at 4 row spacing treatments at Walgett (a) and Moree (b) in 2011.

- The 400 mm and 500T row spacing treatments for Commander⦶ had the greatest number of tillers at Moree. All other treatments had similar tiller numbers except for the 300 mm row spacing treatment for Hindmarsh⦶, which had the lowest tiller numbers.

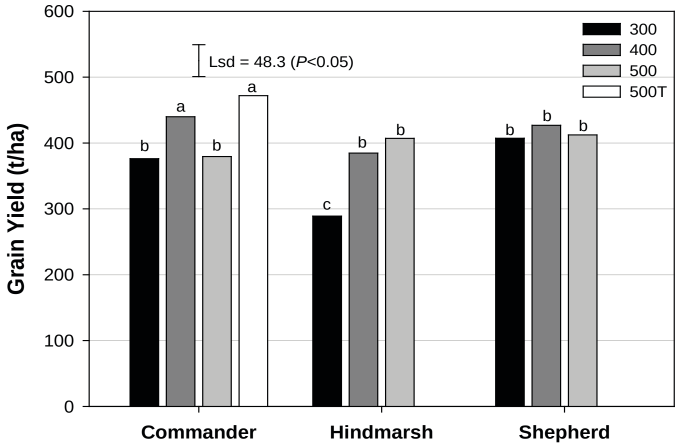

Figure 3. Tiller numbers for CommanderΦ, HindmarshΦ and ShepherdΦ at 4 row spacing treatments at Moree in 2011.

- Plant populations above 80 plants/m^2 had limited effect on the grain yield at Bellata, while increasing from 40 to 80 plants/m^2 increased yield by approximately 0.25 t/ha.

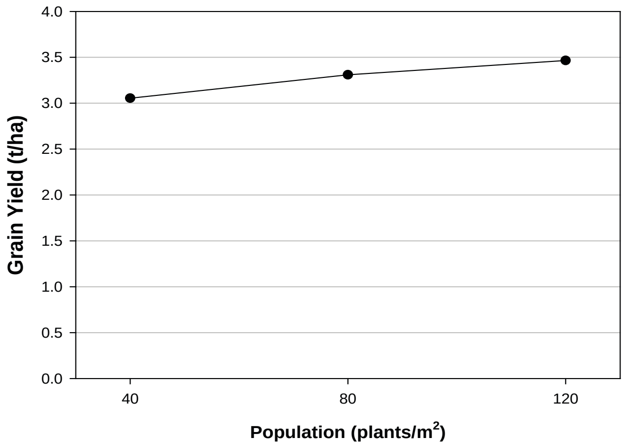

Figure 4. Effect of plant population on grain yield at Bellata in 2011.

Summary

The 500 mm row spacing treatment incurred the greatest yield penalty at Moree and Walgett for CommanderΦ. For ShepherdΦ there was no yield penalty for shifting from 300 to 500 mm row spacing's at Walgett or from 400 to 500 mm row spacing's at Moree. At Moree HindmarshΦ did not have any yield penalty from moving between 400 and 500 mm row spacing's. No yield differences between row spacing treatments were observed at Bellata. The 500T row spacing treatment was shown to be an effective means of improving plant establishment numbers and consequently grain yield at both Walgett and Moree compared to the 500 mm row spacing treatment. The importance of establishment was made evident by the Moree trial where low establishment for the 300 mm row spacing treatment resulted in lower or similar yields to the 500 mm row spacing treatment. The influence of row spacing on grain yield from trials in 2011 does not support results of similar trials in 2010, which showed significant reductions in yield when moving from 330 to 430 mm. It is unclear why significant responses were not observed in 2011 although both trials suffered significant moisture stress up to stem elongation (GS30), but is hoped that when grain quality data becomes available then an explanation may become clear.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131). Trial sites provided by Hugh Ball, "Oodnadatta", Moree, Brian Lowe, "Boggy Creek" and Dave Denyer, "Sefton Park", Walgett, and technical assistance provided by Stephen Morphett, Alan Bowring, Jim Perfrement, Patrick Mortell, Jan Hoskings and Rod Bambach are gratefully acknowledged.

Barley Time of Sowing – Tamworth 2010 and 2011

Matthew Gardner and Guy McMullen

NSW DPI, Tamworth

Introduction

The autumn break in NSW occurs anywhere between March and June, with the reliability of the break being more inconsistent in northern NSW compared to the south. There are a large number of barley varieties available to growers across a wide range of maturities providing the opportunity to plant barley crops from late March until late June and still have the crop flowering when the risks of frost and heat stress are acceptable. Between mid September to the first week in October is the optimum flowering window for cereal crops at Tamworth to avoid excessive frost risk (>10%) and limit exposure to heat stress later in the season. Varieties differ in their ability to achieve high yields from different sowing times. Trials were conducted at Tamworth to determine the yield and quality of a range of barley varieties across three different sowing times. In addition, phenology information was collected throughout the season to aid sowing time recommendations.

Site details

Location: Tamworth Agricultural Institute (TAI)

Treatments

There were 18 varieties with varying maturities and agronomic traits used in the 2011 and 2010 trials, including both commercially available lines and advanced breeder lines. These varieties were sown on three separate occasions 29th April, 21st May and the 25th June in 2010. In 2011 sowing dates were the 6th May, 10th June and the 28th June.

Results 2010

The 2010 growing season provided extremely favourable growing conditions with above average rainfall recorded for the growing season. Rainfall received during July and August was over twice the long term average however, significant rain in November and December also resulted in significant harvest issues. Grain yields were greatest at the TOS 1 and 3, with a 0.5–0.6 t/ha yield penalty associated with the TOS 2.

In the 2010 barley TOS trial Oxford$^{(\phi)}$ and VB0611 were the standout performers ranking in the top 5 yielders at all three TOS's. Again Oxford$^{(\phi)}$ took an additional 5–6 days to reach anthesis compared to each TOS average, whereas, VB0611 a quick maturing breeder line was 2–6 days quicker to reach anthesis compared to each TOS average. With the exception of VB0611 it was the early to mid season varieties such as Fairview$^{(\phi)}$, Oxford$^{(\phi)}$, Urambie$^{(\phi)}$ that yielded best for TOS 1. For TOS 2 mainly mid season varieties performed best, whereas, mid to early season varieties performed best for TOS 3.

Table 1. Grain yield, yield rank and days to anthesis for 18 barley varieties at three sowing times at Tamworth in 2010. Lsd's for TOS and variety were 0.41 t/ha and 0.52 t/ha, respectively (P<0.05).

Variety	Yield (t/ha) and rank within sow time						Days from sowing to anthesis		
	29th Apr		21st May		25th Jun		29th Apr	21st May	25th Jun
Commander⁽ᵇ⁾	4.2	17	4.6	12	5.1	10	130	–	102
Fairview⁽ᵇ⁾	5.8	3	4.2	14	5.7	2	130	–	108
Fitzroy⁽ᵇ⁾	5.7	5	4.1	15	5.6	3	130	–	108
Fleet⁽ᵇ⁾	4.7	14	5.5	1	5.2	9	123	–	98
Gairdner⁽ᵇ⁾	5.2	8	5.0	9	5.2	8	130	–	108
Grout⁽ᵇ⁾	5.0	12	5.1	6	5.1	11	123	–	96
Hindmarsh⁽ᵇ⁾	5.1	10	3.6	17	4.0	18	123	–	91
Oxford⁽ᵇ⁾	6.0	2	5.2	5	5.8	1	130	–	108
Roe	5.0	11	5.0	7	5.3	6	104	–	91
Scope⁽ᵇ⁾	4.6	15	1.8	18	4.3	16	123	–	102
Shepherd⁽ᵇ⁾	4.6	16	4.1	16	4.3	17	123	–	102
Skiff	5.0	13	5.0	8	5.1	12	123	–	98
Urambie⁽ᵇ⁾	5.7	4	4.5	13	5.4	5	130	–	108
VB0601	3.9	18	5.2	4	4.6	15	104	–	98
VB0611	6.2	1	5.2	2	5.5	4	123	–	96
Bass⁽ᵇ⁾ (WABAR2315)	5.1	9	5.2	3	5.0	13	123	–	108
Westminster⁽ᵇ⁾	5.5	7	4.7	11	5.2	7	130	–	108
Navigator⁽ᵇ⁾ (WI4262)	5.7	6	4.7	10	4.8	14	148	–	108
TOS Average	5.2		4.6		5.1		125 (01 Sep)		102 (05 Oct)

The grain yield of the short season variety (Grout⁽ᵇ⁾) was relatively unaffected by TOS. Grain yield for Commander⁽ᵇ⁾ actually increased as sowing date was delayed. Urambie⁽ᵇ⁾ achieved greatest grain yield for TOS 1 and the lowest grain yield for TOS 2. There was almost a 1 t/ha yield increase associated with delaying sowing from TOS 2 to TOS 3.

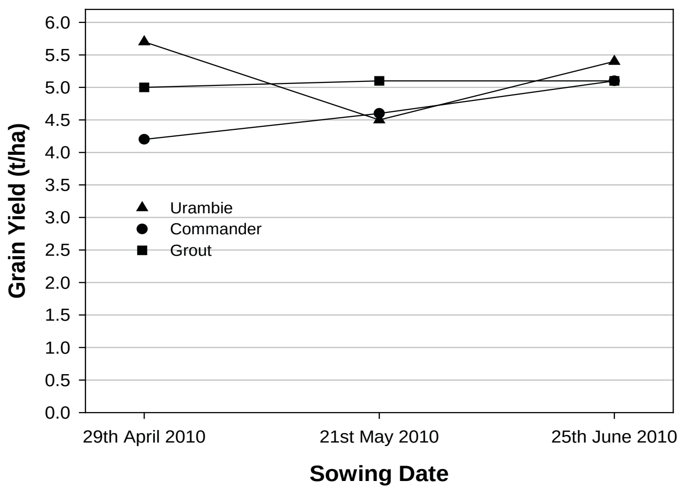

Figure 1. Grain yield at three sowings dates for Urambie⁽ᵇ⁾, Commander⁽ᵇ⁾ and Grout⁽ᵇ⁾ at Tamworth in 2010

Results 2011

The 2011 season started with good subsoil moisture. Very little rain fell during June, July and August after which above average rainfall was received in September, October and November. Late November and early December had uncharacteristically cool temperatures and wet conditions.

Early (5.2 t/ha) and later (5.3 t/ha) TOS resulted in similar yields while the mid season TOS (4.8 t/ha) slightly reduced grain yield, which was similar to what was observed in 2010.

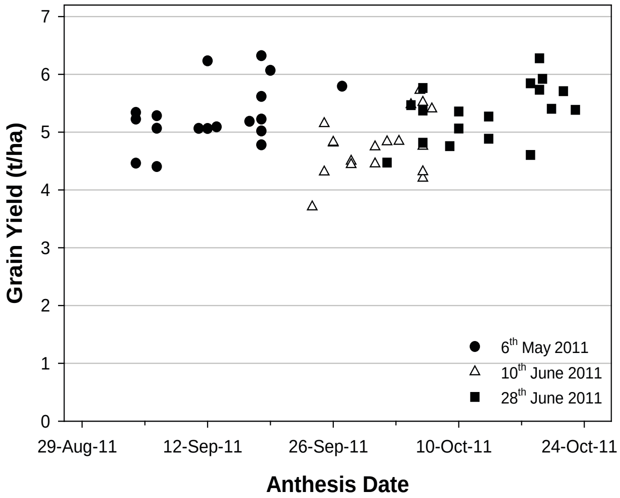

Figure 2. Relationship between grain yield and anthesis date for three sowing dates at Tamworth in 2011

In 2011 barley TOS trials Oxford(b) was the stand out variety, ranking 1st for yield at both TOS 1 and 3 while ranking 2nd yielding for TOS 2. For each TOS Oxford(b) took 5–6 days longer than the TOS average to reach flowering. Overall it was the mid to long season varieties such as Commander(b), Urambie(b), Oxford(b) and Fairview(b) that had the highest yields for TOS 1. For TOS 2 it was mid to short season varieties such as Fitzroy(b), Fairview(b) and Hindmarsh(b) that performed well. The maturity of cultivars didn't appear to have a large bearing on yield performance for TOS 3 with both short and long season varieties ranking in the top 7 yielding varieties. This was a result of the mild conditions that were experienced during the critical grain filling period at this sowing time.

Table 2. Grain yield, yield rank and days to anthesis for 18 barley varieties at three sowing times at Tamworth in 2011. Lsd's for TOS and variety were 0.22 t/ha and 0.62 t/ha, respectively (P<0.05).

Variety	Yield (t/ha) and rank within sow time						Days from sowing to anthesis		
	6th May		10th June		28th June		6th May	10th June	28th June
Commander(b)	6.2	2	4.7	11	5.1	13	127	111	102
Fairview(b)	5.6	5	5.5	3	5.9	2	133	115	111
Fitzroy(b)	5.2	10	**5.7**	**1**	4.6	17	132	116	110
Gairdner(b)	4.8	16	4.2	17	5.4	9	133	116	115
Grout(b)	5.3	7	4.3	16	4.8	15	121	105	98
Hindmarsh(b)	5.3	6	5.1	5	5.5	7	119	105	97
NRB091087	5.1	12	4.5	12	4.8	16	121	108	101
NRB091124	5.1	14	4.5	13	4.9	14	127	111	105
Oxford(b)	**6.3**	**1**	5.5	2	**6.3**	**1**	133	116	111
Shepherd(b)	5.2	9	4.4	14	5.4	11	119	108	102
Urambie(b)	6.1	3	4.8	6	5.7	5	134	113	111
VB0432	5.0	15	5.4	4	5.7	6	133	117	114
VB0611	5.1	13	4.8	9	5.8	4	126	106	98
Bass(b) (WABAR2315)	5.1	11	4.8	7	5.3	12	128	112	105
Westminster(b)	5.2	8	4.8	10	5.8	3	133	116	110
Navigator(b) (WI4262)	5.8	4	4.3	15	5.4	8	142	116	112
Skipper (WI4446)	4.4	18	4.8	8	5.4	10	121	106	98
Fathom (WI4483)	4.5	17	3.7	18	4.5	18	119	104	94
TOS Average	5.2		4.8		5.3		128 (10 Sept)	111 (28 Sept)	105 (10 Oct)

Hindmarsh(h) and breeder line WI4483, recently released as Fathom, were the quickest varieties to reach anthesis at all 3 planting dates, whereas breeder line WI4262 , recently released as Navigator(h), took the longest time to reach anthesis, particularly for the earliest planting time. On average, the time taken to reach flowering was reduced by 17 days between TOS 1 and TOS 2 and a further 6 days by TOS 3.

Taking a closer look at the varieties; Urambie(h) (long season), Commander(h) (mid season) and Hindmarsh(h) (short season); some of the yield and maturity interactions between TOS and variety become clearer. The short season Hindmarsh(h) had similar yields across all three TOS dates and was consistently 5–8 days quicker to reach anthesis than Commander(h). Commander(h) lost approximately 1 t/ha of yield by delaying sowing to either TOS 2 or 3 compared to TOS 1. Urambie(h) lost 1.5 t/ha of yield by delaying sowing from TOS 1 to TOS 2, yet gained approximately 1 t/ha of yield by delaying sowing from TOS 2 to TOS 3. At TOS 3 Urambie(h) took an additional 9 days to reach flowering compared to Commander(h).

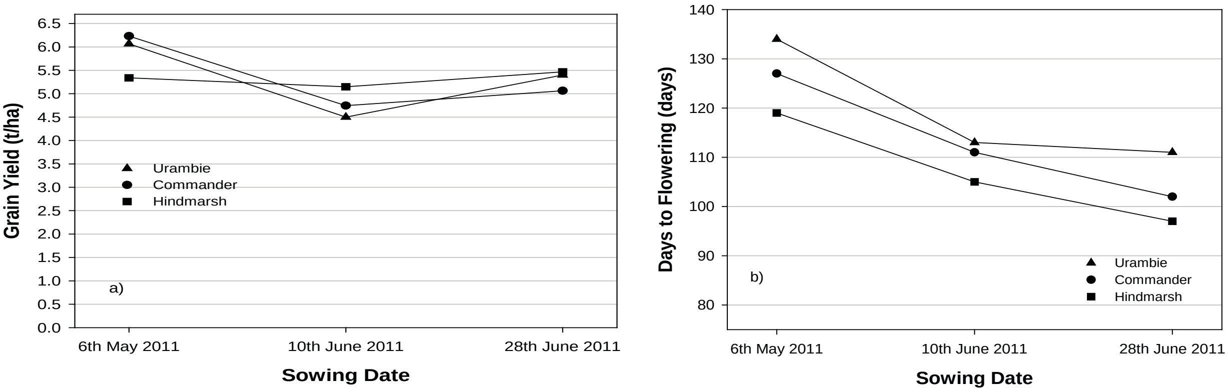

Figure 3. Grain yield (a) and days from sowing to flowering (b) at three sowings dates for Urambie(h), Commander(h) and Hindmarsh(h) at Tamworth in 2011

Summary

Oxford(h) was the top performing variety in both TOS trials, while none of the established malting varieties were consistently high yielding. Between mid September to the first week in October is the optimum flowering window for cereal crops at Tamworth to avoid excessive frost risk (>10%) and limit exposure to heat stress later in the season. In both 2010 and 2011 the first TOS had the highest average yields. However, the average flowering date for TOS 1 in 2010 and 2011 was September 1st and 10th, respectively, which is earlier than the optimum flowering window. There was very little frost pressure in both years meaning that the yield of the first TOS were not penalised with frost damage. The third TOS in both 2010 and 2011 resulted in a slight yield increase compared to the second TOS. The yield increases were primarily associated with mid to longer season varieties such as Oxford(h), Fairview(h) and Urambie(h). Average flowering date for the third TOS was the 5th and 10th of October for 2010 and 2011, respectively, which is on the later end of the optimum flowering window. In both years there was an extremely soft finish to the season with above average rainfall and mild temperatures, which meant that flowering later in the season did not result in yield penalties from heat stress. The lack of heat stress yield penalty meant that longer season varieties that took an additional 6 – 10 days to reach flowering, compared to TOS averages, were able take advantage of favourable conditions compared to shorter season varieties. The atypical conditions experienced during the 2010 and 2011 growing seasons may have given misleading information about TOS dates. This type of research needs to be undertaken across a range of different seasons to understand the sowing time responses more adequately. Based on the long term optimum flowering window, the sowing of barley should occur between mid–late May for longer season varieties such as Gairdner(h), Commander(h), Oxford(h) and early June for shorter season varieties such as Hindmarsh(h) and Grout(h).

Acknowledgements

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131). The technical assistance provided by Stephen Morphett, Jim Perfrement, Patrick Mortell, Alan Bowring, Jan Hoskings, Rod Bambach and Bruce Haigh are gratefully acknowledged.

Grange and Henley – Preliminary evaluation of two potential new malt varieties for the north

Matthew Gardner, Patrick Mortell and Guy McMullen

NSW DPI, Tamworth

Introduction

Grange and Henley are two new barley varieties that are licensed to Seedmark. Both varieties have been developed in Europe along with the recently released variety Oxford⟨PBR⟩ and all have a mid–late maturity. Grange is targeting domestic malt markets while Henley is targeting export malt markets and both have just completed the 1st stage of malt accreditation (a 3 year process). Both varieties have been included in NVT trials over the past 3 years with Grange yielding slightly better than Oxford⟨PBR⟩, while Henley has performed worse than Oxford⟨PBR⟩. Both varieties are either MS or S to spot form net blotch and have better straw strength than Gairdner⟨PBR⟩. These varieties are thought to be soon released into the market place; however, little is know about their agronomy under conditions in north western NSW. In 2011, three trials were conducted using Grange and Henley to look at their performance and agronomic suitability for the region.

Site details

Location:	Breeza	"Hyland", Bithramere	Tamworth
Co-operator:	NSW DPI	Gavin Hombsch	NSW DPI
Sowing Date:	29th June 2011	10th June 2011	28th June 2011

Treatments

Variety by population trials were run at Breeza, Bithramere and Tamworth in 2011. At each site two varieties were used – Grange and Henley. At Breeza plant populations of 60, 100 and 140 plants/m^2 were targeted, whereas at Bithramere and Tamworth the 3 target populations were 60, 80 and 100 plants/m^2. All three trials were co-located with other agronomy trials to give an indication of performance against current commercial varieties.

Results

- Grain yields for Grange, 3.4 and 3.9 t/ha, and Henley, 3.3 and 3.8 t/ha, were similar at Bithramere and Tamworth, respectively. Yields for Gairdner⟨PBR⟩ sown on the same date as these population trials was 3.4 and 4.2 t/ha, for Bithramere and Tamworth, respectively.
- At Breeza, Grange (6.4 t/ha) had significantly greater yields than Henley (5.6 t/ha). Commander⟨PBR⟩ and Gairdner⟨PBR⟩ at the same site yielded 5.6 and 4.5 t/ha, respectively. The Breeza site received a single irrigation at early tillering.
- Minimal or no lodging was observed for Grange and Henley at any of the sites, including Breeza, which had high lodging pressure late in the season.

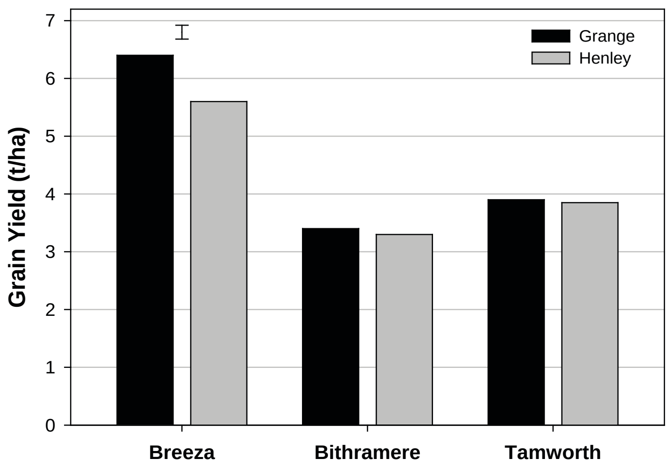

Figure 1. Average grain yield of Grange and Henley at Breeza, Bithramere and Tamworth in 2011.

- At Breeza, increasing plant populations from 60 to 100 plants/m^2 significantly increased grain yields by 0.6 and 0.7 t/ha for Grange and Henley, respectively. No significant yield benefit was observed for increasing plant populations beyond 100 plants/m^2.
- No response to plant population was observed at Bithramere or Tamworth.

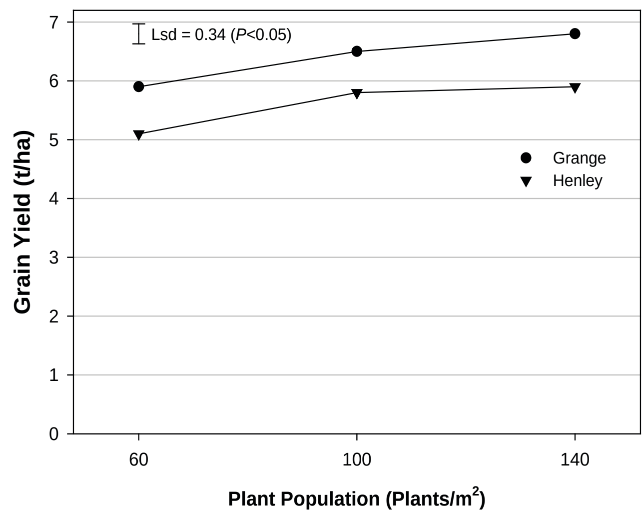

Figure 2. Effect of plant population on grain yield of Grange and Henley at Breeza in 2011

- At Breeza, Grange had significantly lower screenings and protein than Henley (but protein was still in excess of malt specifications), while having significantly greater 1000 grain weight, retention and test weight.

Table 1. Grain quality parameters for Grange and Henley at Breeza. Grain quality for Gairdner$^{\text{(b)}}$ was included for comparison at the same site (not same trial). Values designated with different letters within the same row are significantly different (P<0.05) (Gairdner$^{\text{(b)}}$ not included in analysis).

Quality Parameter	Grange	Henley	Gairdner$^{\text{(b)}}$ (same site)
Protein (%)	14.3b	14.7a	15.9
1000 Grain Weight (g)	48.3a	43.5b	42.5
Retention (%)	93.8a	89.8b	74.8
Screenings (%)	1.9b	2.7a	6.8
Test Weight (kg/hL)	63.8a	60.5b	64.6

Summary

Preliminary results suggest that under favourable conditions such as Breeza both Grange and Henley have comparable or higher yield potential than existing commercial varieties. Under the high yielding conditions of Breeza target plant populations of 100 plants/m^2 were optimal for yield. The grain quality results from Breeza suggests that both varieties would not meet malt specification due to test weight (needs to be >65 kg/hL) and protein as Breeza was a high protein site. Test weights for Grange (63.6 kg/hL) and Henley (62.9 kg/hL) were also low at Tamworth. At both the Breeza and Tamworth the trials received significant rainfall prior to harvest, which may have reduced the test weights. The failure to achieve malt, when a suitable variety has been selected, can result in significant financial penalties when producing barley, hence growers requirement for a reliable malt variety. Therefore, any risk of new varieties not meeting malt specification may limit their uptake by growers. Grange and Henley will be included in further agronomic trials in 2012.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131). Thank you to Gavin Hombsch, “Hyland”, Bithramere, for providing the trial site. The technical assistance provided by Stephen Morphett, Jim Perfrement and Jan Hoskings are gratefully acknowledged.

Grazing wheat and barley – impacts on crop canopy management, lodging and grain yield

Matthew Gardner and Guy McMullen
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Introduction

The grazing of winter cereal crops has been widely adopted, especially in southern NSW. The use of dual purpose cereal crops in mixed farming systems provides supplementary grazing during winter when pasture growth is limited by low temperatures. Well managed dual purpose cereals provide producers with an opportunity for increased profitability and flexibility in mixed farming systems, by enabling increased winter stocking rates and generating income from forage and grain. Typically these crops are earlier sown, longer season varieties that provide greater dry matter production for grazing. Barley with its vigorous early growth generally produces more dry matter for grazing and greater grain yield compared to grazed wheat. Research has shown that to avoid grain yield penalties stock must be removed from cereals before the end of tillering (GS30). However, the timing and intensity of grazing during the season can incur yield penalties, particularly when grazing pressure is high and late in the grazing period. In some circumstances grazing can be beneficial to grain production by reducing lodging or in seasons with dry springs grazing can increase grain yields due to reduced water use in the vegetative stages leaving more soil water for grain fill. The challenge for growers is to find the balance between optimising dry matter (DM) removal without compromising grain production.

The aim of this paper is to collate the results from a number of research trials conducted at Tamworth from 2007 to 2010, with specific focus on what management strategies can be used to manipulate the balance between DM removal and grain production.

Site details

All trials were conducted at the Tamworth Agricultural Institute research station.

Treatments

The 2007 grazing trial compared the performance of 8 barley and 2 wheat varieties that were planted either early (11th May) or during the main sowing window (25th June). The 2009 grazing trial investigated the interaction between variety (3 barley varieties – Urambie⟑, Commander⟑ and Fitzroy⟑) and plant population (100 and 200 plants/m^2). In 2010 two barley varieties (Commander⟑ and VB0611 – an experimental line) and one wheat; EGA Gregory⟑; were grazed either early (at GS25), late (at GS30) or both early and late. All trials were overlayed with plus or minus grazing treatments, where grazing was simulated with the use of a slasher.

Results

Time of sowing

To fully maximise the accumulation of biomass for winter grazing it is important to ensure that cereal crops intended for grazing are sown early (April – 1st week May). Sowing early in the 2007 grazing trial resulted in significantly greater DM yields at GS30 and grain yield for all barley and wheat varieties. On average for barley and wheat there was 40 and 42%, respectively, greater DM production for the early plant compared to the main season plant (6 weeks later). Similarly, there was an average 1.59 t/ha (P<0.05) grain yield penalty across barley and wheat varieties for delaying sowing from the early to the main season plant. The severe grain yield penalty observed from grazing main season planted cereals is associated with grazing delaying maturity, which means flowering occurs later when conditions are hotter and drier. In the 2007 trial grazing delayed flowering of barley and wheat by 6–11 days depending on variety.

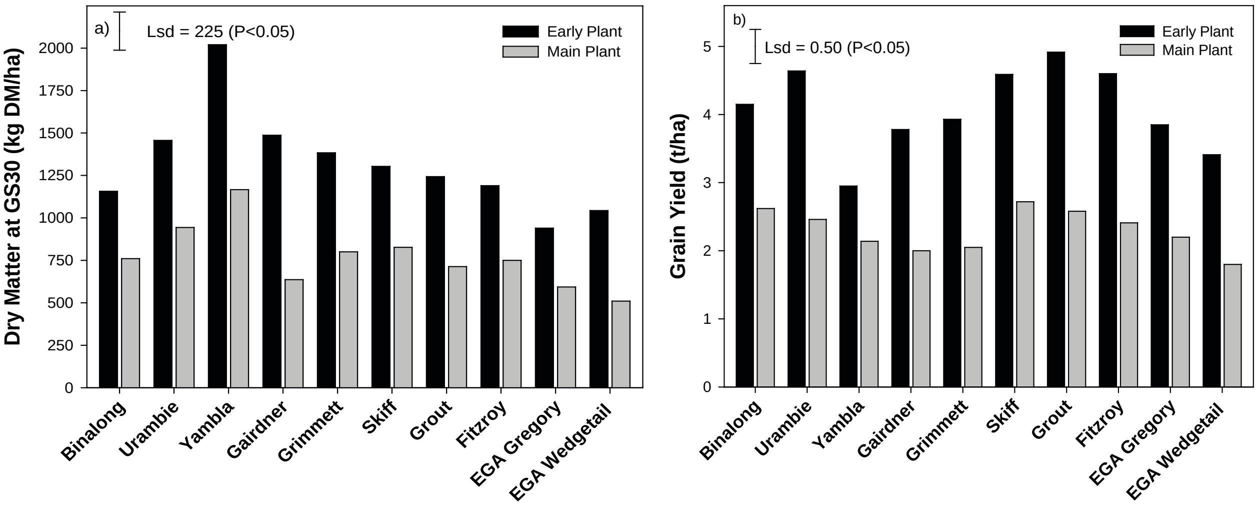

Figure 1. a) Dry matter yield at GS30 and b) grain yield for 8 barley and 2 wheat varieties that were planted either early (11th May) or in the main season window (25th June).

Plant population

Manipulating plant population is a simple management option that can have a significant impact on DM production for grazing and grain yield. Increasing plant populations from 100 to 200 plants/m^2 (doubling sowing rate from 60 to 120 kg/ha) for the three barley varieties Fitzroy$^{\phi}$, Urambie$^{\phi}$ and Commander$^{\phi}$ significantly (P<0.05) increased DM yield by 710, 335 and 407 kg DM/ha, respectively. Two DM cuts were able to be taken from Fitzroy$^{\phi}$ and Urambie$^{\phi}$ treatments compared to only 1 from the Commander$^{\phi}$ treatment, which produced approximately half the DM biomass. Increasing plant population significantly (P<0.05) increased grain yield for Fitzroy$^{\phi}$ and Commander$^{\phi}$ by 0.36 and 0.44 t/ha when no grazing was implemented. Under grazing treatments Urambie$^{\phi}$ was the only variety to have a higher yield (0.33 t/ha) at the higher plant population. At the 200 plants/m^2 population grazing significantly reduced the grain yield of all varieties, whereas, at 100 plants/m^2 population a grain yield penalty was only observed for Urambie$^{\phi}$. Therefore, using higher plant populations to increase DM yield for grazing is achievable but for increasing grain yield may be less reliable.

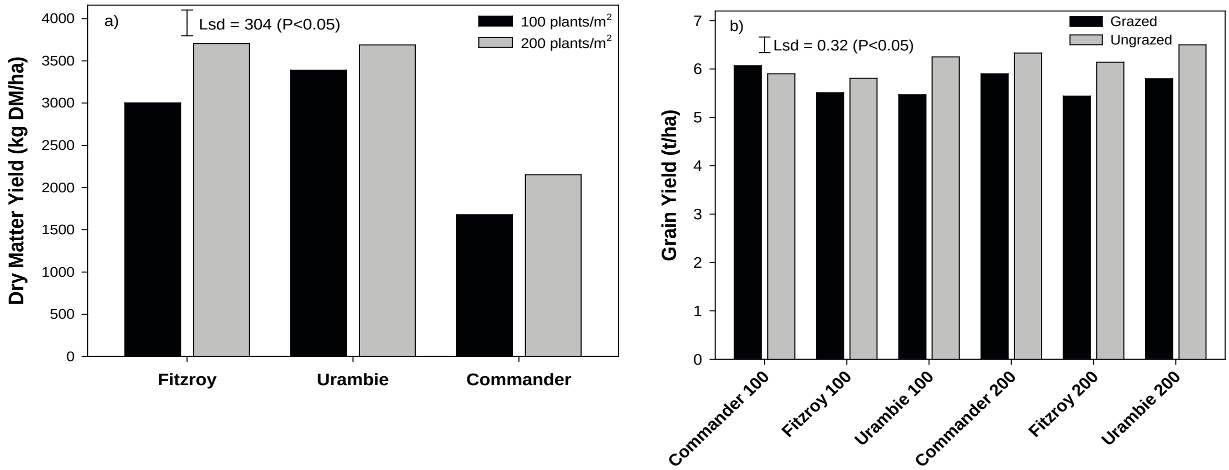

Figure 2. a) Dry matter yield for grazing from 3 barley varieties at either 100 or 200 plants/m^2 and, b) grain yield for 3 barley varieties grown at 100 or 200 plants/m^2 and either grazed or ungrazed.

Timing of grazing

Although removing livestock before GS30 minimises grain yield penalties, the timing of grazing between GS13-GS30 can also have a significant influence on DM yield and grain yield. Across two barley varieties Commander$^{\phi}$ and VB0611 (advanced breeder line) and EGA Gregory$^{\phi}$ grazing early significantly (P<0.05) limited DM yield by 74 and 62% compared to the late and early + late grazing systems, respectively. The early + late grazing system also yielded approximately 750 kg DM/ha less (P <0.05) than the late grazing system. The additional, DM yield achieved under the late and early + late grazing systems came at the expense of grain yield. Grain yield for the late and early + late grazing systems was similar regardless of variety but had approximate reductions of 0.6, 1.0 and 0.4 t/ha of grain for Commander$^{\phi}$, VB0611 and EGA Gregory$^{\phi}$, respectively. The early grazing had no significant effect on grain yield compared to the ungrazed control.

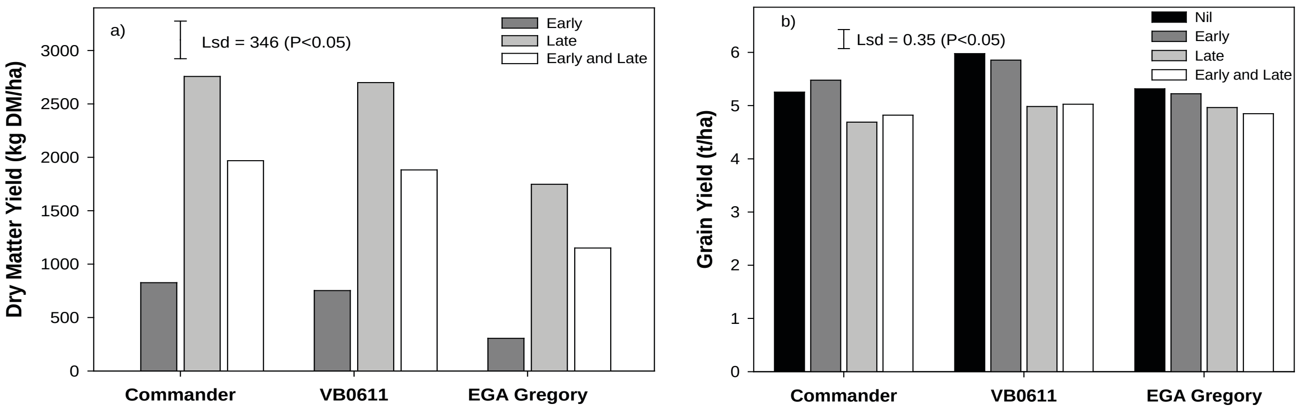

Figure 3. a) Dry matter yield for Commander$^{\Phi}$, VB0611 and EGA Gregory$^{\Phi}$ under either early, late or a combination of early and late grazing systems and b) grain yield for Commander$^{\Phi}$, VB0611 and EGA Gregory$^{\Phi}$ under either ungrazed, early, late or a combination of early and late grazing systems

Lodging

Grazing can be used to limit early canopy growth and therefore is a management tool to reduce the incidence of lodging. Lodging remains a significant problem in barley and has been estimated to cause yield losses of up to 40%. In the 2010 grazing trial it was observed that grazing late had the greatest potential to reduce lodging scores, particularly in the 2 barley varieties. The early + late grazing system reduced lodging to a similar extent to late grazing, whereas early grazing only reduced the lodging scores slightly. These results are directly related to the quantity of DM removed (Figure 3a).

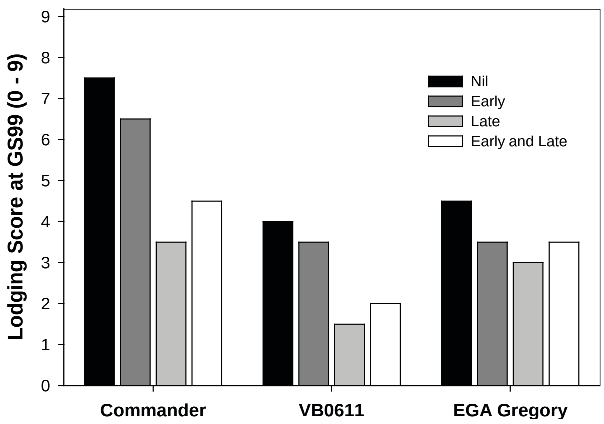

Figure 4. Influence of ungrazed, early, late and early + late grazing systems on lodging scores (0 = standing, 9 = flat)

Conclusion

When trying to optimise the balance between DM production and grain yield for grazing cereals growers have a number of management options available including sowing time, plant population, species/variety and grazing timing, among others. Ensuring that grazing cereal crops are sown early (April – 1st week in May) is pivotal to allow sufficient time for biomass to accumulate for winter grazing and flowering to still occur within the optimum window. Grazing crops planted in the main season sowing window are likely to suffer large yield penalties as flowering will occur later when conditions are hotter and drier. Increasing plant populations is an effective means of increasing DM yield for grazing, however, has limited capacity to increase grain yields after grazing. Increases in DM yield ranged from 335 to 710 kg DM/ha when moving from 100 to 200 plants/m^2. In comparison, the timing of grazing can have a greater influence on DM yield, with late grazing systems offering an additional 74 and 45% DM yield compared to early and early + late grazing systems. Despite the additional DM yield under the late grazing system it has the greatest risk as grazing occurs closer to GS30 and there are greater grain yield penalties. However, late grazing has the potential to reduce lodging severity, particularly in susceptible varieties such as Commander$^{\Phi}$. When considering the farming system as a whole the late grazing system may be the most suitable as it offsets grain yield losses with reduced lodging and increased livestock production from additional DM yield. The emphasis on either DM yield or grain yield will be grower specific and a range of management options may need to be implemented to get the balance right.

Acknowledgments

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131).The technical assistance provided by Stephen Morphett, Jim Perfrement and Patrick Mortell is gratefully acknowledged.

Nitrogen management for malting barley

Matthew Gardner and Guy McMullen

NSW DPI, Tamworth

Introduction

The ability to achieve malt, when a suitable variety has been selected, can result in significant financial advantages when producing barley. Nitrogen (N) management of malting barley can be a large determinant of the capacity to achieve both high yields and grain that meets malting specification\s. To meet malt specifications growers should target proteins of 10.5 – 12% to achieve maximum yield and still meet receival standards. As the rate of N supply is increased, yield will generally increase to a maximum level, whereas protein may continue to increase with further N application. Drier or wetter than expected seasonal conditions can significantly change yield potential mid season, which consequently changes N requirements to meet target protein contents. Therefore, the flexibility of delaying N application can be a risk management strategy for growers to adapt to changing seasonal conditions. When considering in crop N applications it is critical to know what soil N levels are available at the start of the season. Many paddocks may have high starting soil N levels well in excess of what is required to achieve realistic target yields and maintaining proteins suitable for the production of malting barley. Previous studies have demonstrated large variations in genotype responses to different levels of N nutrition. Gairdner(b) barley when it was first released was recognised as a low protein achiever, particularly under favourable grain-filling conditions but had issues with small grain size for malting. Many of the recently released malting lines, most notably Commander(b) in the northern region, have shown improved capacity to meet malting specifications with low protein and suitable grain size.

Three trials were conducted across the northern grains region to determine the effect of N timing and rate on the capacity of the two main malt barley varieties, Gairdner(b) and Commander(b), to meet the malt specifications. At the time of publication grain quality data was not available for the Moree trial site.

Site details

Location:	Breeza	“Hyland”, Bithramere	“Oodnadatta”, Moree
Co operator:	NSW DPI	Gavin Hombsch	Hugh Ball
Sowing Date:	29th June 2011	10th June 2011	19th May 2011
Available soil N (kg N/ha) (0–100 cm):	109	41	42

Treatments

Commander(b) and Gairdner(b), two malting barley varieties, were grown at plant populations of 60 and 120 plants/m^2 in three trials in 2011. In each trial four rates of N were applied at sowing including 0, 20, 40 and 80 kg N/ha. Two additional N treatments were included, 40 kg N/ha applied at growth stage 31 (GS31 – stem elongation) and a split application treatment where 20 kg N/ha was applied at sowing with a further 20 kg N/ha applied at GS31.

Results

Commander(b) had significantly greater yields than Gairdner(b) at Breeza and Moree, while there was no difference between the variety yields at Bithramere. Similarly, at Moree and Breeza increasing plant population from 60 to 120 plants/m^2 significantly increased yields by 0.15 and 0.50 t/ha, respectively (data not shown).

Table 1. Grain yields (t/ha) for Commander(b) and Gairdner(b) at Bithramere, Breeza and Moree in 2011

Location	Commander(b)	Gairdner(b)
Bithramere	3.65	3.71
Breeza**	5.74	4.50
Moree**	3.99	3.55

** Represents a significant (P<0.05) variety response at trial site

Bithramere was the only site where a significant yield response to N rates was observed (Figure 1). The application of 20 or 40 kg N/ha resulted in similar grain yields as the control (0 kg N/ha) treatment (Figure 1). Applying 80 kg N/ha or a 20 + 20 split application resulted in similar yields that were greater than the control. The delayed application of 40 kg N/ha achieved the highest yields of 4.1 t/ha (Figure 1).

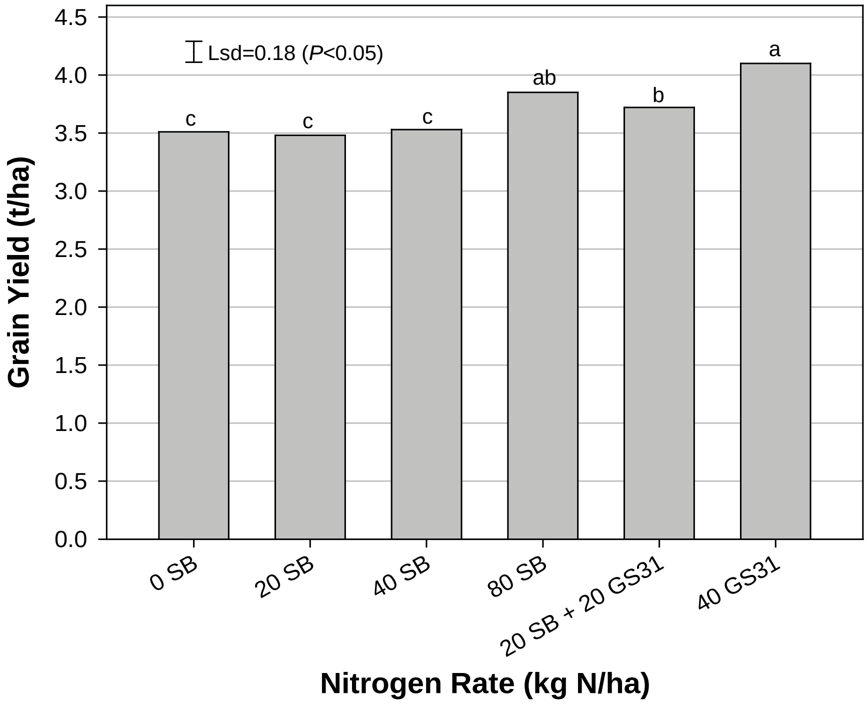

Figure 1. Effect of rate, either applied at sowing (SB) or growth stage 31 (GS31), on grain yield (t/ha) at Bithramere in 2011

The protein response of Gairdner$^{(D}$ to applied N was generally greater than Commander$^{(D}$, particularly when applied N was greater than 40 kg N/ha at both Breeza and Bithramere (Figure 2a and b). The delayed or split application treatments resulted in similar grain proteins to the 40 kg N/ha applied at sowing at both sites. The Breeza site had very high grain protein results (well in excess of malting requirements) and showed that Gairdner$^{(D}$ had significantly greater protein than Commander$^{(D}$ for all N treatments including the control. Grain protein results from Bithramere also showed that when high N rates were applied to the crop, 80 kg N/ha, Commander$^{(D}$ was still able to achieve malt specifications while Gairdner$^{(D}$ grain protein levels were greater than grain receival standards.

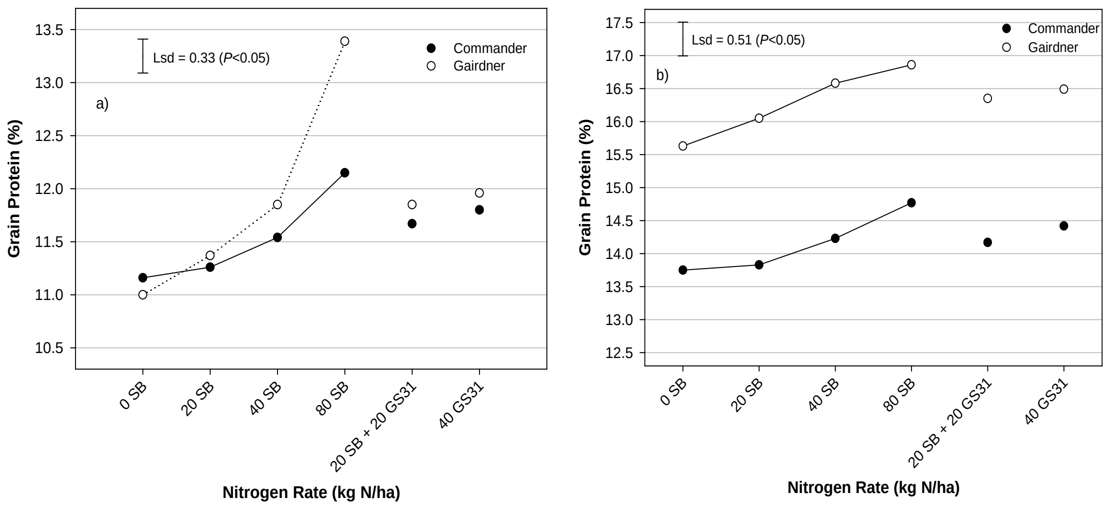

Figure 2. Effect of rate, either applied at sowing (SB) or growth stage 31 (GS31), on grain protein (%) for Commander$^{(D}$ and Gairdner$^{(D}$ at Bithramere (a) and Breeza (b) in 2011.

Gairdner$^{(D}$ had on average 0.8% more screenings than Commander$^{(D}$ across all N treatments (Figure 3a) although all levels were below the 5% level at which grain receival grade would be affected. The 80 kg N/ha treatment for Gairdner$^{(D}$ resulted in significantly higher screenings than all other treatments but was still <5% (Figure 3a). All other N treatments either had no impact or only slightly increased screenings compared to the respective control treatments for Commander$^{(D}$ and Gairdner$^{(D}$ (Figure 3a).

Retention for Gairdner$^{(D}$ was 4.5 to 9% lower than Commander$^{(D}$ and significantly declined when N rates exceeded 40 kg N/ha compared to the control (Figure 3b). In comparison, retention for Commander$^{(D}$ was relative stable with 40 kg N/ha applied at GS31 being the only treatment that significantly reduced retention compared to the control but was still >90% (Figure 3b). The split application and delayed N treatments for both varieties resulted in similar retentions to the 40 kg N/ha applied at sowing (Figure 3b).

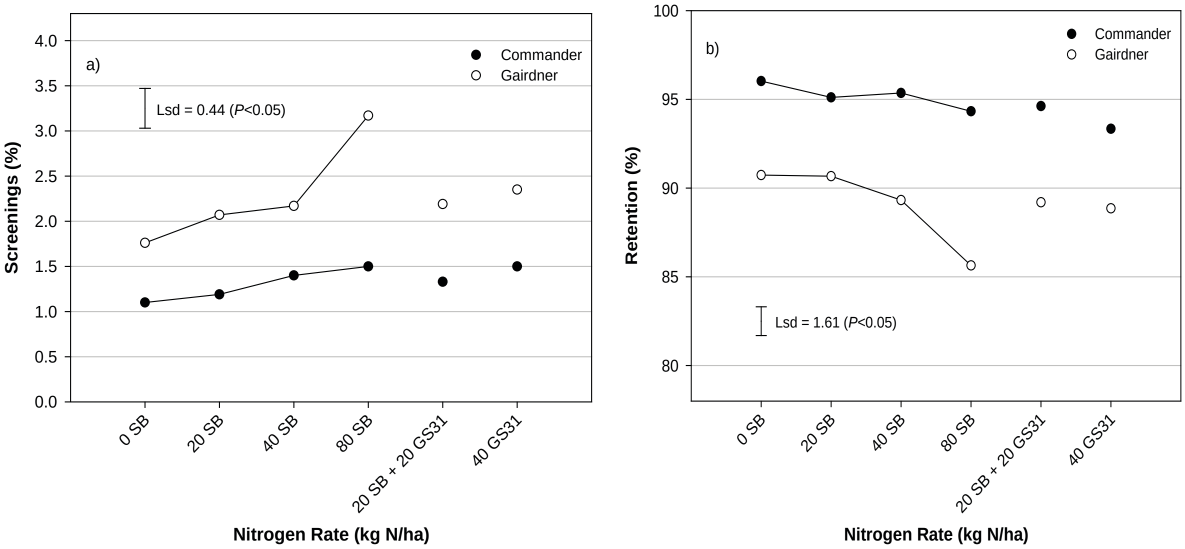

Figure 3. Effect of N rate, either applied at sowing (SB) or growth stage 31 (GS31), on screenings (%) (a) and retention (%) (b) for Commander$^{\text{(b}}$ and Gairdner$^{\text{(b}}$ at Bithramere in 2011.

In contrast to other grain quality parameters, the test weight for Gairdner$^{\text{(b}}$ was relatively stable across N treatments, whereas Commander$^{\text{(b}}$ had increasing test weights with increasing N rate (Figure 4). The split application, delayed N and 80 kg N/ha treatments slightly increased test weights for Gairdner$^{\text{(b}}$ compared to the control (Figure 4). With each increase in N rate from 0 to 80 kg N/ha there was a significant increase in test weight for Commander$^{\text{(b}}$ (Figure 4).

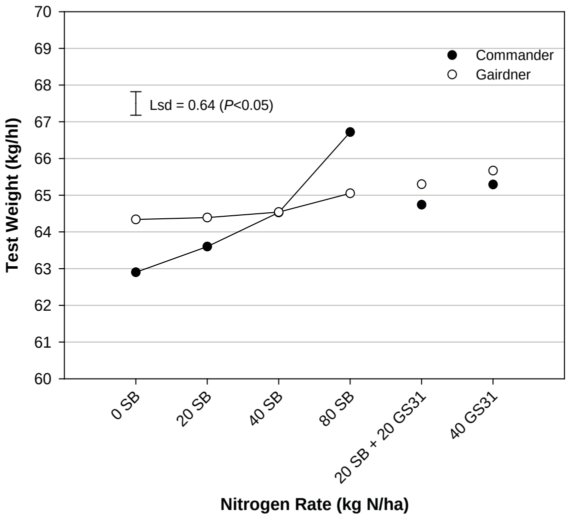

Figure 4. Effect of rate, either applied at sowing (SB) or growth stage 31 (GS31), on test weight (kg/hL) for Commander$^{\text{(b}}$ and Gairdner$^{\text{(b}}$ at Bithramere in 2011.

Summary

Yield responses in barley to N applications can be variable, which was evident in the 2011 trials with only one site showing a significant yield response to applied N. Despite the limited yield responses the Breeza and Bithramere trials showed that variety selection and N management can influence grain quality parameters and the chances of achieving malt quality grain. Commander$^{\text{(b}}$ provided more stable grain quality across N treatments and also had a positive test weight response to applied N.

Overall, Gairdner$^{\text{(b}}$ had higher protein, screenings and lower retentions and these characteristics were more responsive to N treatments than Commander$^{\text{(b}}$. The split application or delaying of N resulted in similar or improvements in grain quality over the up front application. In these trials the delayed application of N did not significantly increase protein compared to the up front application, however, delayed applications after GS31 could be expected to have a greater impact on protein.

Based on the results from Breeza and Bithramere, Commander(b) barley is more likely to achieve malt quality specifications than Gairdner(b) when grown under a higher level of N nutrition. In fact, a higher level of N nutrition may assist Commander(b) in meeting test weight specification. However, it is critical to note that Commander(b) is a variety that is very susceptible to lodging and a high level of N nutrition, especially at sowing, would only exacerbate this issue. Reducing plant populations or the use of plant growth regulators may be management options to reduce the severity of lodging. Commander(b) has also demonstrated an ability to maintain lower grain protein levels compared to the main industry malting variety, Gairdner(b). Based on this and the higher yield potential of Commander(b), Gairdner(b) would be more suited to paddocks with low soil residual N, whereas Commander(b) will be more likely to achieve malt specifications from paddocks with higher residual soil N but lodging management must be considered in these situations.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Prject (DAN00131). Thanks to Gavin Hombsch, “Hyland”, Bithramere, and Hugh Ball, “Oodnadatta”, Moree, for providing the trial sites. The technical assistance provided by Stephen Morphett, Jim Perfrement, Patrick Mortell, Alan Bowring, Jan Hoskings, Rod Bambach and Bruce Haigh are gratefully acknowledged.

Does N management need to differ between commercial wheat varieties?

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[3] University of New England and NSW DPI, Condobolin

Introduction

Efficient use of nitrogen (N) is crucial to economic wheat production, with the risk and reward balance of applied N being marginal for more western regions. Excessive application of N may increase susceptibility of the crop to disease and increase water use early in the growing season whereas insufficient application may limit grain yield, grain protein and subsequent profitability. Within a given season in a cereal crop, fertiliser rate and timing are the major tactical tools used for N management. Applications of N at sowing or up to the start of stem elongation drive greater crop biomass and grain yield response in comparison to late applications (around anthesis or GS61) which have little influence on grain yield but can drive a significant protein response.

Nitrogen management for protein has become a prevalent issue, particularly in the past two seasons with large premiums being paid for wheat with greater than 13% protein (APH2, APH1 and H1). In 2011, premiums of approximately $60–80/tonne above H2 levels were paid for wheat above 13% protein.

It is generally considered that there are only minor differences among commercial varieties in regard to grain protein accumulation. However, there have been suggestions from growers and agronomists that, relative to other varieties, EGA Gregory[Φ] has a lower grain protein concentration. It must be noted though that EGA Gregory[Φ] has demonstrated wide adaptation across grain growing regions in New South Wales with high relative yields, good resistance to stripe rust, high level of tolerance to root lesion nematode (*Pratylenchus thornei)*, flexibility with sowing date and classification as an AH or APH variety depending on the region.

Results from the NVT trial network support observations made by growers and agronomists. Of 103 NVT trials (since 2008) that contained the varieties EGA Gregory[Φ], LongReach Spitfire[Φ] and Sunvale[Φ], EGA Gregory[Φ] was the highest yielding variety, with Sunvale[Φ] being the lowest. However, EGA Gregory[Φ] had the lowest grain protein concentration, while LongReach Spitfire[Φ] had the highest grain protein concentration. A regression analysis of grain yield and grain protein concentration has shown that grain protein concentration at a given yield level significantly (P<0.001) varied between varieties. For a given yield LongReach Spitfire[Φ] had 1.5% and 0.6% greater protein concentration than EGA Gregory[Φ] and Sunvale[Φ], respectively.

As part of the GRDC funded VSAP project, three nitrogen use efficiency (NUE) trials were conducted in 2011 at Trangie, Coonamble and Spring Ridge, as well as a time of sowing (TOS) trial at Trangie. The results of these trials have been used in this paper to assess the grain yield, grain protein concentration and protein yield/ha of EGA Gregory[Φ], Livingston[Φ], LongReach Spitfire[Φ] and Sunvale[Φ] and whether N management strategies need to differ between varieties.

Site details

Location:	Trangie NUE	Trangie TOS	"Magomadine", Coonamble	"Yarooga", Spring Ridge
Co-operator:	NSW DPI	NSW DPI	Ray Williams	Angus Murchison
Sowing Date:	29th June 2011	April – June 2011	10th June 2011	19th May 2011

Results

Yield

In the Trangie NUE and TOS trials, EGA Gregory[Φ] achieved 14 and 7%, respectively, greater (P<0.05) yield than all other varieties (Figure 1). At the Spring Ridge and Coonamble sites EGA Gregory[Φ] was among the higher yielding varieties but had similar yields to Livingston[Φ] at Spring Ridge and LongReach Spitfire[Φ], Livingston[Φ] and Sunvale[Φ] at Coonamble (Figure 1). In the Trangie NUE trial Livingston[Φ] had a significantly greater yield than LongReach Spitfire[Φ], which had the lowest yield. Similarly at Spring Ridge LongReach Spitfire[Φ] (4.8 t/ha) had lower yields than Livingston[Φ] but was greater than Sunvale[Φ] (Figure 1). Sunvale[Φ] also had significantly lower yields than LongReach Spitfire[Φ] in the Trangie TOS trial and at the Coonamble site (Figure 1).

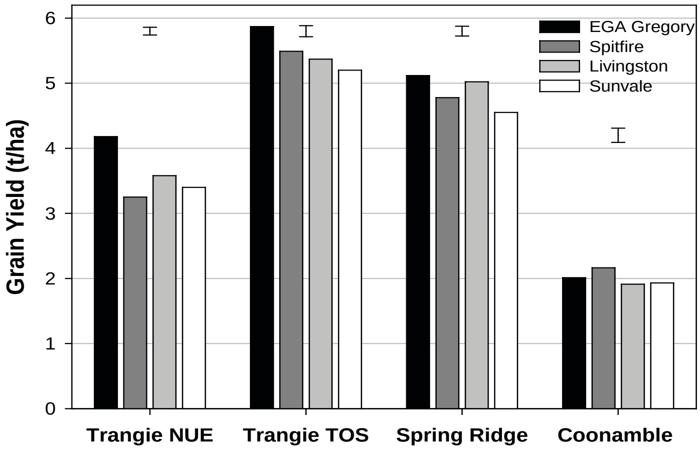

Figure 1. Grain yields for EGA Gregory⟨PBR⟩, LongReach Spitfire⟨PBR⟩, Livingston⟨PBR⟩ and Sunvale⟨PBR⟩ in four trials conducted in 2011 at Trangie (NUE and TOS), Spring Ridge and Coonamble. Lsd bars indicate significant differences (P<0.05) between varieties at the different trial sites.

Protein

EGA Gregory⟨PBR⟩ had significantly lower protein contents in all trials, having on average 1.9, 1.3 and 1.3% lower protein than LongReach Spitfire⟨PBR⟩, Livingston⟨PBR⟩ and Sunvale⟨PBR⟩, respectively (Figure 2). LongReach Spitfire⟨PBR⟩ had the highest protein in the Trangie NUE, TOS and Coonamble trials and was greater than Livingston⟨PBR⟩ but similar to Sunvale⟨PBR⟩ at Spring Ridge (Figure 2). Livingston⟨PBR⟩ had similar protein contents to Sunvale⟨PBR⟩ in the Spring Ridge and Trangie TOS trials, however, was significantly lower and higher in the Trangie NUE and Coonamble trials, respectively (Figure 2).

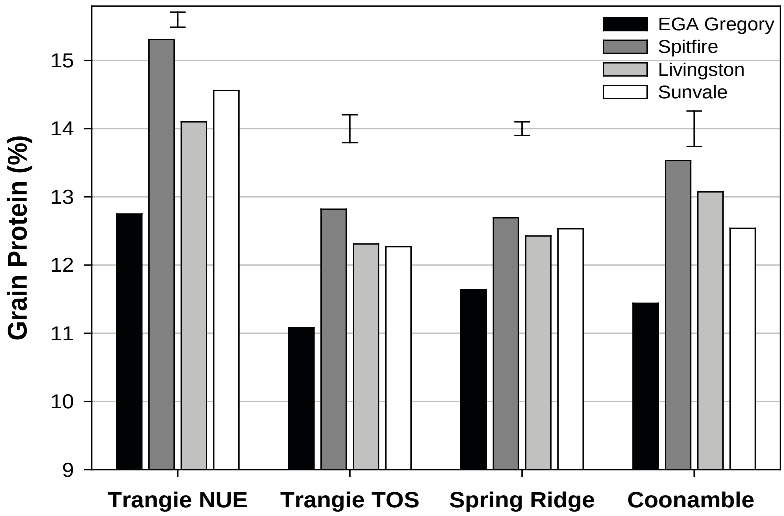

Figure 2. Grain protein for EGA Gregory⟨PBR⟩, LongReach Spitfire⟨PBR⟩, Livingston⟨PBR⟩ and Sunvale⟨PBR⟩ in four trials conducted in 2011 at Trangie (NUE and TOS), Spring Ridge and Coonamble. Lsd bars indicate significant differences (P<0.05) between varieties at the different trial sites.

Grain Protein Yield

The grain protein yield gives an indication of NUE, and is effectively the total amount of protein removed from a given area. For example, a crop with a grain yield of 4 t/ha with 10% protein has a grain protein yield of 400 kg protein/ha. LongReach Spitfire⟨PBR⟩ had significantly greater grain protein yields than all other varieties in the Coonamble and Trangie TOS trial (Figure 3). In all trials EGA Gregory⟨PBR⟩ had similar grain protein yields to Livingston⟨PBR⟩ and Sunvale⟨PBR⟩ in the Coonamble and Trangie TOS trials. There was no significant difference in grain protein yield at Spring Ridge and in the Trangie NUE trial (Figure 3).

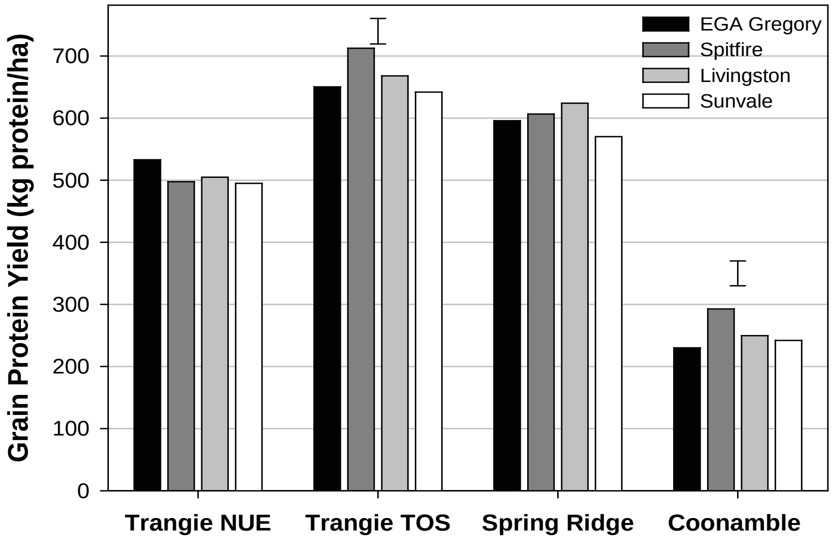

Figure 3. Grain protein for EGA Gregory⌽, LongReach Spitfire⌽, Livingston⌽ and Sunvale⌽ in four trials conducted in 2011 at Trangie (NUE and TOS), Spring Ridge and Coonamble. Lsd bars indicate significant differences (P<0.05) between varieties at the different trial sites.

Manipulating protein through N management

At the Spring Ridge and Coonamble sites there was a split application of N included in addition to the up front application N at sowing. At Spring Ridge either 80 or 160 kg N/ha were applied at sowing or as a split application where 40 kg N/ha was applied at sowing and a further 40 kg N/ha at GS31 (stem elongation). At Coonamble the N rates varied with either 60 or 120 kg N/ha applied at sowing or the split application where 30 kg N/ha was applied at sowing and a further 30 kg N/ha applied at GS61 (anthesis).

Using a 40+40 split application of N resulted in similar protein to applying 80 kg N/ha at sowing for both EGA Gregory⌽ and LongReach Spitfire⌽ at Spring Ridge (Figure 4a). In comparison, the later split application of N (sowing and GS61) achieved similar grain protein to applying 120 kg N/ha at sowing for both EGA Gregory⌽ and LongReach Spitfire⌽ (Figure 4b). The results indicate that using a late application of N can be an effective means of increasing grain protein for both EGA Gregory⌽ and LongReach Spitfire⌽.

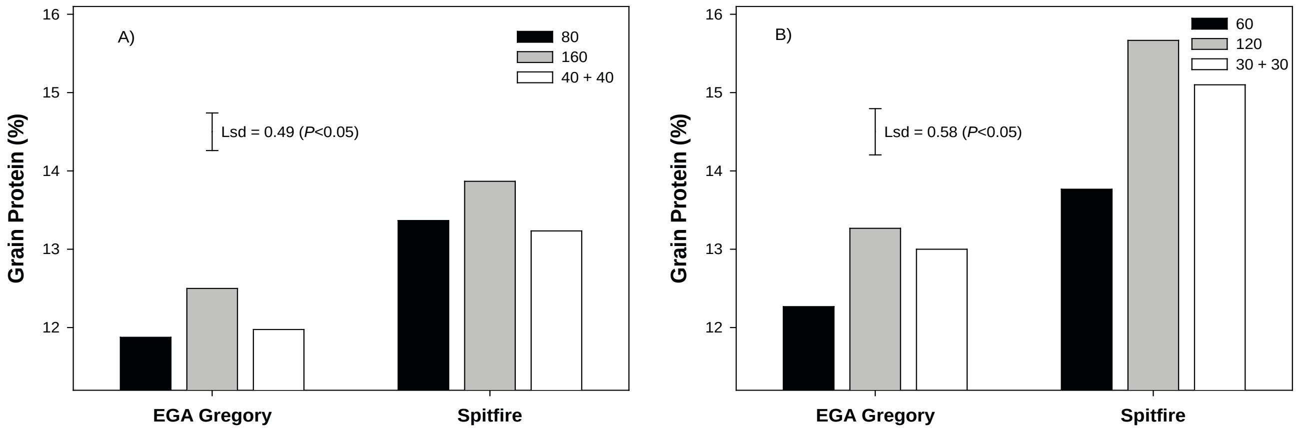

Figure 4. Grain protein at A) Spring Ridge and B) Coonamble for EGA Gregory⌽ and LongReach Spitfire⌽ at three different N management strategies. At Spring Ridge N management was either 80 or 160 kg N/ha were applied at sowing or a split application where 40 kg N/ha was applied at sowing and a further 40 kg N/ha at GS31 (stem elongation). At Coonamble the N rates varied with either 60 or 120 kg N/ha applied at sowing or the split application where 30 kg N/ha was applied at sowing and a further 30 kg N/ha applied at GS61 (anthesis).

Conclusion

EGA Gregory was the highest or among the highest yielding varieties in VSAP trials conducted throughout the 2011 season, which supports the results of NVT trials. Furthermore, EGA Gregory had the lowest grain protein in all trials compared to LongReach Spitfire, Livingston and Sunvale, which also supports findings from NVT trials since 2008 and the observations of growers and agronomists. Despite the consistently lower proteins in EGA Gregory, its equally consistent higher yields means that it achieves similar protein yields (kg protein/ha) to other varieties. Therefore, EGA Gregory has a similar capacity to remove N on a per hectare basis as Sunvale, Livingston and in some cases LongReach Spitfire. LongReach Spitfire appears unique in the fact that, unlike EGA Gregory, even when it achieves high yields it is still able to maintain protein concentration, giving it the potential to have a higher protein yield. Given the large premiums currently being paid for protein, EGA Gregory may need specific N management targeting protein, whereas LongReach Spitfire may need N management with a greater emphasis that maximises yield. An effective N management strategy for EGA Gregory that targets protein with in-crop applications of N after GS31 may be profitable as higher protein grades can be achieved without significantly limiting yield. The N management of LongReach Spitfire appears to be in direct contrast to EGA Gregory, which is focussed on achieving yield with either N application at sowing or in-crop prior to GS31.

Acknowledgements

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Row spacing responses of wheat varieties – Spring Ridge and Coonamble 2011

Matthew Gardner[1], Guy McMullen[1] and Rohan Brill[2]

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[2] NSW DPI, Coonamble

Introduction

There has been a trend to wider row spacing's in recent years. Likely benefits include:

- an ability to sow into higher levels of retained stubble
- a reduction in fuel costs during sowing and/or increased sowing speed
- ability to inter-row sow subsequent crops
- reduced soil disturbance, and
- lower cost of sowing equipment.

However, potential costs from wider spacing's include:

- lower yields with wider row spacing, particularly under higher yielding conditions, and
- reduced weed competition.

There are a number of studies currently examining the responses of cereal and broadleaf crops to row spacing, and also the interaction with plant population. In targeting a desired population, the likely establishment percentage has to be selected. In practice establishment rates rarely exceed 90% and can fall as low as 30% depending on sowing conditions and seed quality. Germination tests do not necessarily give a good indication that germinated seed will be able to establish a viable plant.

Site details

Location:	"Yarooga", Spring Ridge	"Woolingar", Coonamble
Co-operator:	Angus Murchison	Jason Peters

Treatments

Spring Ridge	Coonamble
Sowing date – 26th June	Two sowing dates – 20th May and 21st June
Four varieties – EGA Gregory⟨PVR⟩, Livingston⟨PVR⟩, LongReach Spitfire⟨PVR⟩ and Sunvale⟨PVR⟩	Four varieties – EGA Gregory⟨PVR⟩, Livingston⟨PVR⟩, LongReach Spitfire⟨PVR⟩ and Sunvale⟨PVR⟩
Three row spacings – 30, 40 and 50 cm	Three row spacings – 30, 40 and 50 cm
Three populations – 60, 120 and 180 plants/m^2	Three populations – 40, 80 and 160 plants/m^2

Results – Spring Ridge

- No significant yield loss was observed by moving from 30 cm to 40 cm row spacing, however sowing at the 50 cm row spacing reduced yield by an average of approx. 300 and 400 kg/ha, compared with the 30 cm and 40 cm row spacing's, respectively.
- There was no significant effect of increasing plant population beyond 120 plants/m^2 on yield at any of the row spacing's, but plant populations of 60 plants/m^2 significantly limited yield.

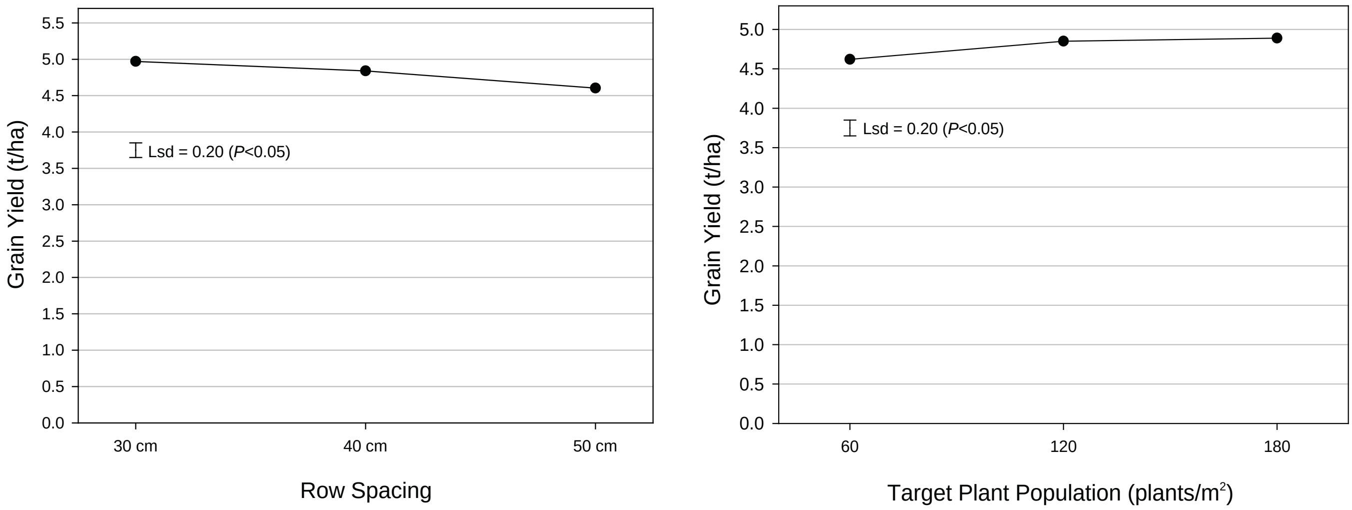

Figure 1. Effect of row spacing (a) and plant population (b) on grain yield at Spring Ridge in 2011.

- Livingston⏀ and EGA Gregory⏀ achieved similar yields across all row spacing's suggesting that these varieties may be better able to compensate for the wider row spacing's compared to LongReach Spitfire⏀, which experienced significant yield reductions as row spacing widened.

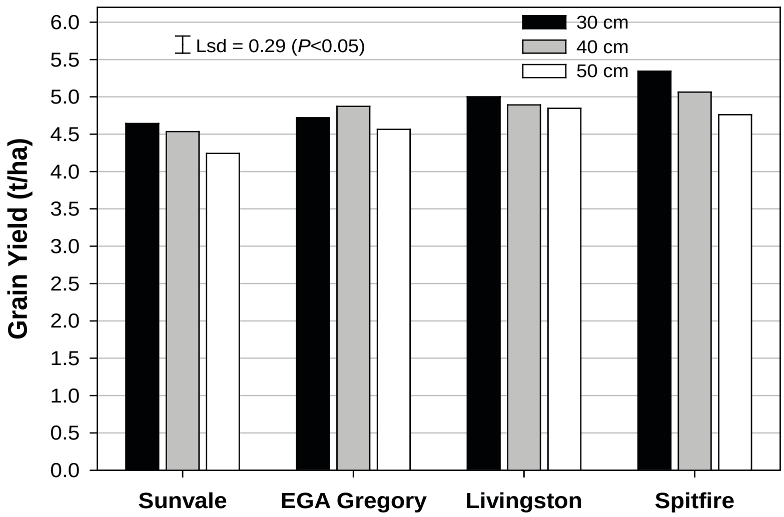

Figure 2. Variety yields at three row spacing's at Spring Ridge in 2011.

Results – Coonamble

- The yield penalty for delayed sowing (10th May to 6th June) was on average 1.25 t/ha across all row spacing's.
- For TOS 1 the 30 and 40 cm row spacing's achieved similar yields that were significantly greater than the 50 cm row spacing. In contrast, for TOS 2 the 30 cm row spacing had significantly higher yields than the 40 and 50 cm row spacing's, which had similar yields.

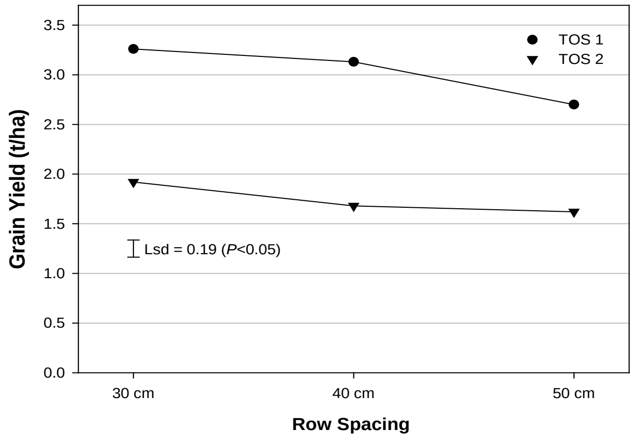

Figure 3. Effect of row spacing and TOS on grain yield at Coonamble in 2011.

- LongReach Spitfire⟨PBR⟩ had a significant reduction in yield for each increase in row spacing from 30 to 50 cm. For Sunvale⟨PBR⟩ and EGA Gregory⟨PBR⟩ the reductions in yield at wider row spacing's were not significant between the 30 and 40 cm row spacing's.

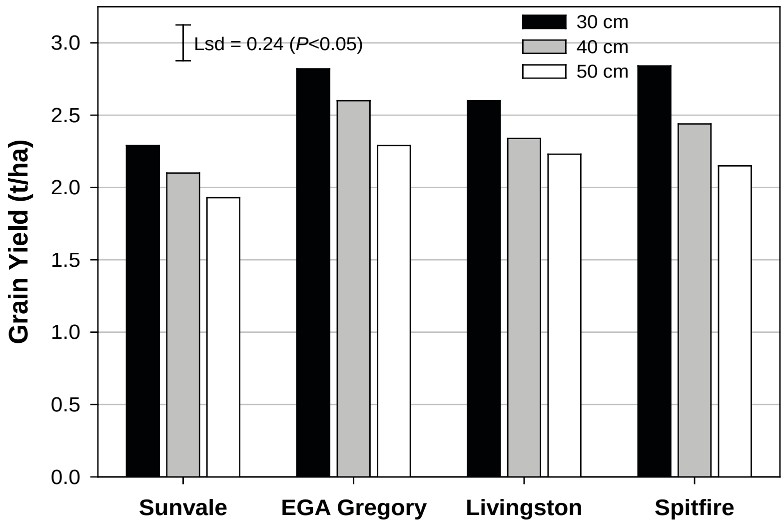

Figure 4. Variety yields at three row spacing's at Coonamble in 2011 (mean of two sowing times).

Summary

The results from the 2011 wheat row spacing trials indicate that shifting from a 30 to 40 cm row spacing did not significantly reduce yields at either Spring Ridge or Coonamble, however, at both sites the 50 cm row spacing's resulted in a significant reduction in yield. These results are in contrast with the 2009 and 2010 results from Coonamble and Kelvin where significant yield reductions were observed at the 40 and 50 cm row spacing's compared to the 30 cm row spacing. The 2011 season was dry and cold prior to August after which above average rainfall and mild temperatures were experienced during anthesis and grain fill. However, the favourable conditions experienced during anthesis and grain fill in 2011 were equally as favourable in the spring of 2010. LongReach Spitfire⟨PBR⟩ appeared to be the most sensitive variety to wider row spacing's, with significant yield reductions at both trial sites for the 40 and 50 cm row spacing's compared to the 30 cm spacing. Between Sunvale⟨PBR⟩, EGA Gregory⟨PBR⟩ and Livingston⟨PBR⟩ there was no difference in the ability of any variety in terms of yield at wider row spacing's. Wider row spacing's have provided yield and quality stability in areas that experience high temperatures and where moisture is often limited after flowering. Quality data from the current trials were still being processed at the time of printing.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Variety Specific Agronomy Package Project (DAN00129). Thanks to Angus Murchison, "Yarooga", Spring Ridge, and Jason Peters, "Woolingar", Coonamble, for providing trial sites. The technical assistance provided by Rod Bambach, Jan Hoskings, Patrick Mortell, Alan Bowring, Stephen Morphett and Jim Perfrement are gratefully acknowledged.

Response of wheat varieties to sowing depth – Coonamble 2011

***Matthew Gardner*[1], *Guy McMullen*[1] and *Rohan Brill*[2]**

[1] NSW DPI, Tamworth

[2] NSW DPI, Coonamble

Introduction

Timely sowing is a key component for optimising grain yield and quality. In some seasons moisture seeking or deep sowing is a tool that growers use to ensure that crops are established in their optimal window. There are a range of factors that determine the ability of seedlings to emerge from depth including seed size, coleoptile length, soil conditions and temperature. Some of the disadvantages associated with deep sowing include delayed emergence, poor establishment, reduced early vigour, increased disease susceptibility and potentially reduced grain yield. Research trials in 2011 investigated the wheat variety response to seeding depth.

Site details

Location: "Woolingar", Coonamble

Co-operator: Jason Peters

Treatments

- Four wheat varieties – EGA Bounty⟨PBR⟩, EGA Gregory⟨PBR⟩, Lincoln, Livingston⟨PBR⟩ and LongReach Spitfire⟨PBR⟩
- Two time of sowing (TOS) – 20th May to 21st June
- Two sowing depths – approximately 3.5 and 10 cm
- An additional EGA Gregory⟨PBR⟩ treatment included had an additional 15 kg P/ha applied

Results

- Across all varieties the establishment was reduced by 48 and 67% for TOS 1 and 2, respectively, for the 10 cm sowing depth compared to the 3.5 cm sowing depth.

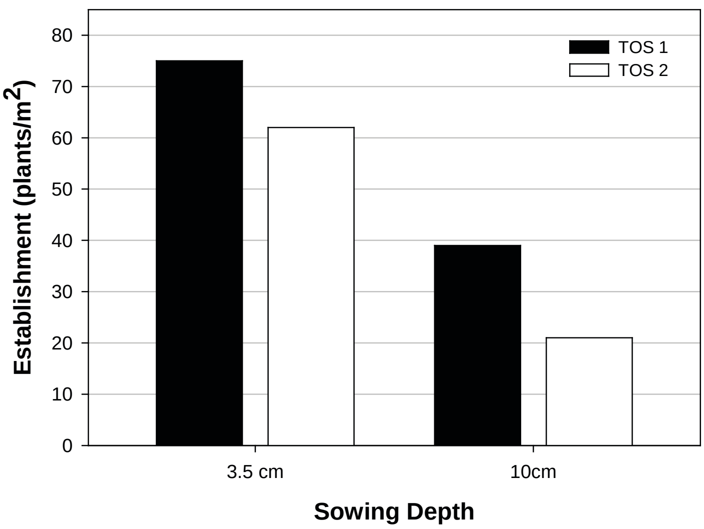

Figure 1. Effect of sowing depth and TOS on establishment at Coonamble in 2011.

- Deep sowing down to 10 cm compared to the 3.5 cm depth reduced yield across all varieties by an average of 1.4 t/ha or 35%.
- There was no significant difference between variety responses to sowing depth at the two different TOS. EGA Gregory⟨PBR⟩ was the highest yielding variety along with LongReach Spitfire⟨PBR⟩ from TOS 1.
- Applying an additional 15 kg P/ha to EGA Gregory⟨PBR⟩ did not have a significant affect on establishment or yield.
- Lincoln was the poorest performing variety. This poor performance is most likely due to the low tolerance to root lesion nematodes as the site had 18,500 *Pratylenchus thornei*/kg soil at sowing.

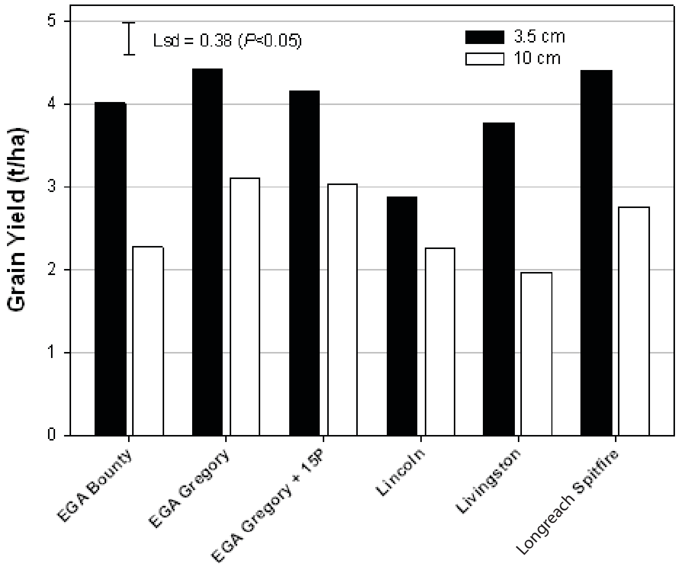

Figure 2. Variety yields for TOS 1 at 2 sowing depths at Coonamble in 2011.

Summary

Deep sowing or moisture seeking can be used to effectively establish varieties in the optimal sowing window. If using the deep sowing method it is essential to use large seed with a high germination capacity. Increases in seeding rates are required to compensate for the reduced emergence of deep sown crops. The use of additional P was not shown to assist deep sown wheat in this study.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Variety Specific Agronomy Package Project (DAN00129). Thanks to Jason Peters, "Woolingar", Coonamble, for providing trial sites. The technical assistance provided by Rod Bambach, Jan Hoskings, Patrick Mortell, Alan Bowring, Stephen Morphett and Jim Perfrement are gratefully acknowledged.

Topdressing EGA Bellaroi⦷ – Timing of application and Liquid vs. Granular

Matthew Gardner, Alan Bowring and Guy McMullen

NSW DPI, Tamworth

Introduction

Nitrogen (N) requirements are determined at the beginning of the season based on available N in the soil, yield potential and target protein content (targeting above 13% to meet DR1 classification). Drier or wetter than expected seasonal conditions can significantly change yield potential mid season, which consequently changes N requirements to meet target protein contents. Therefore, application of all N up front at sowing may over supply N in drier seasons leading to reduced water use efficiency and poorer grain quality, whereas in wetter seasons up front applications of N may result in low N supply, limiting yield and protein potential. Applying all or a proportion of N post sowing (topdressing) can be used by growers to manipulate either or both grain yield and protein, while also acting as a risk mitigation strategy against mid season changes in climate and a method of reducing input costs. Previous studies have established that tactically delaying N can maintain yield or increase yield when split between sowing and up to stem elongation (GS31) compared to when all N is applied at sowing. In contrast, applying N after GS39 resulted in lower grain yields but significantly increased grain proteins.

The 2011 season represented a classic example of where N requirements changed with the onset of wetter conditions as the season progressed. June, July and August received below average rain while the months from September through to December all received above average rainfall and mild temperatures. A trial was conducted at Spring Ridge to investigate topdressing strategies for a crop of EGA Bellaroi⦷, which had low starting soil N levels (25 kg N/ha) and received minimal fertiliser N (25 kg N/ha) at sowing.

Site details

Location:	"Yarooga", Spring Ridge
Co-operator:	Angus Murchison
Sowing date:	22nd June 2011
Available soil N:	25 kg N/ha (0–100 cm)
Applied N at Sowing:	25 kg N/ha (granular urea)

Treatments

There were two main treatments:

1. N product
2. Timing of N application.

The N products used in the trial were either granular urea or liquid UAN. These products were applied as:

1. single applications at growth stages 31, 39 or 61 or
2. as split applications at growth stages:
    a. GS31 + 39,
    b. GS31 + 61,
    c. GS39 + 61 or
    d. GS31 + 39 + 61.

The N rate for all topdressing treatments was 120 kg N/ha (based on the protein target of 13%), therefore, for the split applications the 120 kg N/ha was divided evenly by the number of applications.

Results 2011

Using either granular urea or liquid UAN achieved the same grain yield or protein result. The topdressing of N at any growth stage significantly increased the grain yield compared to where no N was applied. Single or split applications of N at growth stages 31 or 39 increased grain yield to a greater extent than the single application of N at growth stage 61. Splitting N applications three ways increased grain yield by a further 0.22–0.36 t/ha compared to the 2 way split applications, however, had similar yields to the single application at growth stage 31 or 39.

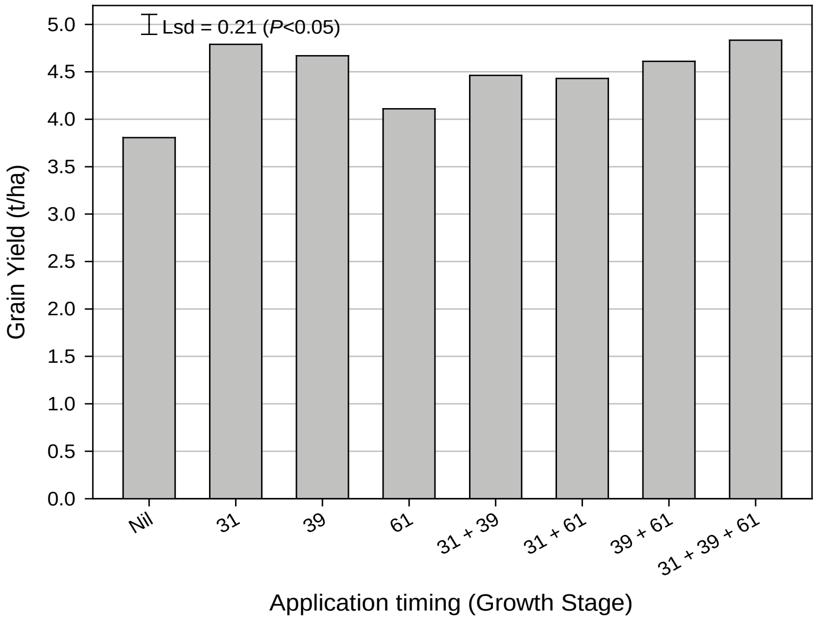

Figure 1. Effect of timing of N topdressing on the grain yield of EGA Bellaroi⟃ at Spring Ridge in 2011

The grain proteins achieved in this trial all exceeded the target of 13%. Although the grain yields were 0.5 t/ha lower than the estimated yields the high proteins suggests that the crop was either accessing additional N not included in the budget or utilising more of the nitrogen for protein than yield. The soil test depth of (100 cm), likely to be shallower then the potential crop rooting depth, means it is feasible that additional N may have been accessed below this point or higher N mineralisation rates could have occurred due to the wet season.

The topdressing of N at any growth stage significantly increased grain protein by 2–3.1% compared to no topdressing of N. A single topdressing application of N at growth stage 31 achieved a grain protein concentration of 15.6%, which was significantly lower than all other topdressing treatments. There was no significant difference in grain protein between any topdressing treatments that were applied in a single application after growth stage 39 or any split applications, which had an average protein concentration of 16.6%.

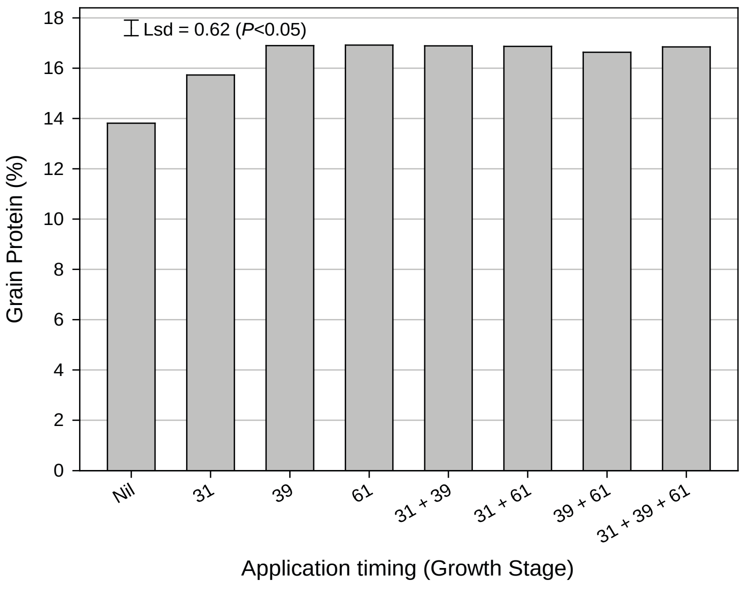

Figure 2. Effect of timing of N topdressing on the grain protein of EGA Bellaroi⟃ at Spring Ridge in 2011

Topdressing N at GS61 achieved similar tiller numbers as not topdressing N at all, a function of maximum tiller number being finalised prior to this growth stage, hence the additional yield in this treatment over the nil treatment likely came from increased grain number per head or larger grain size. Splitting the topdressing of N three ways or single topdressing of N at growth stage 31 had on average an additional 54 tillers/m^2 compared to other two way split topdressing treatments.

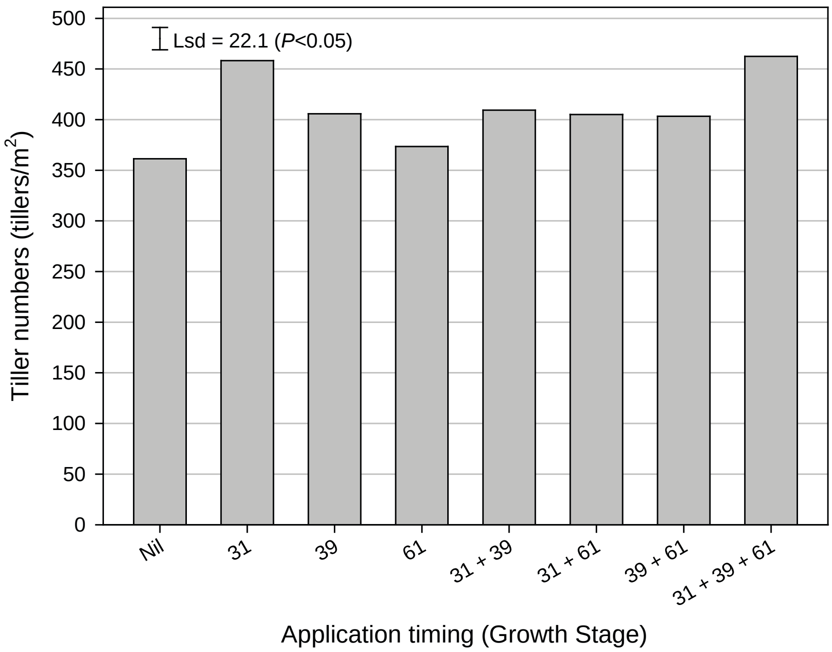

Figure 3. Effect of timing of N topdressing on the tiller numbers of EGA Bellaroi⁽ᴾ⁾ at Spring Ridge in 2011

Summary

There was no difference in the responses between N products. Topdressing with either liquid UAN or granular urea achieved the same end result for both yield and protein. The liquid UAN product does offer some grower benefits with ease of application and even distribution of N. Under the trial conditions, an even distribution of urea was achieved by hand spreading; however under field conditions it is far more difficult to achieve even application with fertiliser spreaders. In support of previous work (McMullen et al. 2009) the topdressing of N at GS31 increased grain yield, whereas late topdressing (GS61) had lower yield but equivalent protein. Topdressing at GS39 achieved a balance between yield and protein benefit from N application. Splitting N topdressing across 3 growth stages resulted in higher yield, protein and tiller numbers. The higher yield for the 3 way split topdressing is most likely associated with the higher tiller numbers, however, it is not understood why similar tiller numbers were achieved to the single application at growth stage 31 as only 1/3 of the N was applied early in the season. Although having multiple topdressing applications optimises N use efficiency by reducing the opportunity for large quantities to be available for loss, it is unlikely to be a cost effective N strategy when application costs are considered. For this trial there was only a small quantity of N applied at sowing, which meant a large application rate of 120 kg N/ha applied in crop. It is not expected that commercially growers would be trying to apply this quantity of in crop N.

Acknowledgements

Thanks to Angus Murchison “Yarooga”, Spring Ridge for providing the trial site. The technical assistance provided by Bruce Haigh, Patrick Mortell and Mick Dal Santo are gratefully acknowledged.

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Wheat Time of Sowing – Tamworth 2010 and 2011

Matthew Gardner and Guy McMullen

NSW DPI, Tamworth

Introduction

The autumn break in NSW occurs anywhere between March and June, with the reliability of the break being more inconsistent in northern NSW compared to the south. Wheat varieties available to growers provide the opportunity to plant from late March until late June and still have the crop flowering when the risks of frost and heat stress are acceptable. Between mid September to the first week in October is the optimum flowering window for cereal crops at Tamworth to avoid excessive frost risk (>10%) and limit exposure to heat stress later in the season. Trials were conducted at Tamworth to determine the yield and quality of a range of wheat varieties across three different sowing times. In addition, phenology information was collected throughout the season to aid sowing time recommendations.

Site details

Location: Tamworth Agricultural Institute (TAI)

Treatments

There were 18 varieties with varying maturities and agronomic traits used in the trials in 2010 and 2011, including both commercially available varieties and advanced breeder lines. These varieties were sown on three separate occasions 29th April, 21st May and the 25th June in 2010 and the 6th May, 10th June and the 28th June in 2011.

Results 2010

The 2010 growing season provided extremely favourable growing conditions with above average rainfall recorded for the growing season. Rainfall received during July and August was over twice the long term average. Significant rain in November and December resulted in significant harvest issues. The relationship between yield and anthesis date was negative; with the greatest yields being observed at the earlier flowering dates, with the exception of Jandaroi⏀.

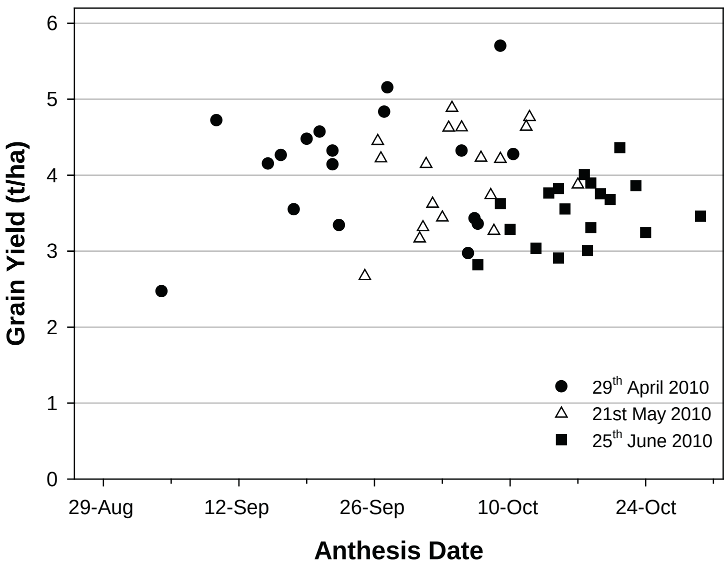

Figure 1. Relationship between grain yield and anthesis date for three sowing dates at Tamworth in 2010

The standout yielding variety for 2010 was Hyperno⏀, which was either the highest or second highest yielder for all three TOS's. Hyperno⏀ took an additional 4 – 14 days to reach flowering compared to the average for each TOS. The durum varieties yielded highest at TOS 1 (Hyperno⏀ and EGA Bellaroi⏀), TOS 2 (Hyperno⏀ and Jandaroi⏀) and TOS 3 (Hyperno⏀, Caparoi⏀ and EGA Bellaroi⏀), which are all considered quick maturing. EGA Gregory⏀ and Livingston⏀ were among the better performing bread wheat varieties. Average days to anthesis for TOS 1, 2 and 3 was 148, 136 and 113 days, respectively. EGA Eaglehawk⏀ took the longest to reach anthesis.

Table 1. Grain yield, yield rank and days to anthesis for 18 wheat varieties at 3 sowing times at Tamworth in 2010. Lsd's for TOS and variety were 0.42 t/ha and 0.39 t/ha, respectively (P<0.05).

Variety	Yield (t/ha) and rank within TOS						Days from sowing to anthesis		
	29th Apr		21st May		25th Jun		29th Apr	21st May	25th Jun
EGA Bellaroi$^{\text{(b)}}$	5.2	2	4.2	7	3.9	4	150	138	119
Caparoi$^{\text{(b)}}$	3.4	15	4.2	9	4.0	2	160	140	114
LongReach Crusader$^{\text{(b)}}$	4.2	11	3.7	12	3.3	13	138	139	106
EGA Eaglehawk$^{\text{(b)}}$	4.3	9	3.9	11	3.5	11	163	148	126
EGA Gregory$^{\text{(b)}}$	4.6	5	4.1	10	3.9	3	143	132	114
EGA Wylie$^{\text{(b)}}$	3.3	16	3.3	15	2.9	17	145	132	111
Hyperno$^{\text{(b)}}$	5.7	1	4.8	2	4.4	1	162	143	117
Jandaroi$^{\text{(b)}}$	3.0	17	4.6	3	3.8	7	159	143	115
Livingston$^{\text{(b)}}$	4.7	4	4.4	6	3.6	9	133	127	105
LPB05-2148 (LongReach Spitfire$^{\text{(b)}}$)	4.5	6	4.6	5	3.6	10	142	135	112
Strzelecki$^{\text{(b)}}$	4.3	8	3.6	13	3.7	8	145	133	116
Sunvale$^{\text{(b)}}$	3.6	13	3.4	14	3.3	12	141	134	114
Sunvex$^{\text{(b)}}$	4.1	12	3.2	17	3.0	16	145	132	114
Sunzell$^{\text{(b)}}$	4.8	3	3.3	16	3.2	14	150	139	120
Ventura$^{\text{(b)}}$	4.3	10	4.2	8	3.0	15	139	128	109
WID801 (Tjilkuri)	4.3	7	4.6	4	3.8	5	158	136	111
234194 (Durum)	3.4	14	4.9	1	3.8	6	159	135	110
TOS Average	4.2		4.0		3.5		148 (23 Sep)	136 (3 Oct)	113 (16 Oct)

There was little separation between the grain yield for late (EGA Eaglehawk$^{\text{(b)}}$), mid (EGA Gregory$^{\text{(b)}}$) and quick (LongReach Crusader$^{\text{(b)}}$) maturing varieties across the each TOS, however, EGA Eaglehawk$^{\text{(b)}}$ took nearly an additional 20 days to flower at each TOS.

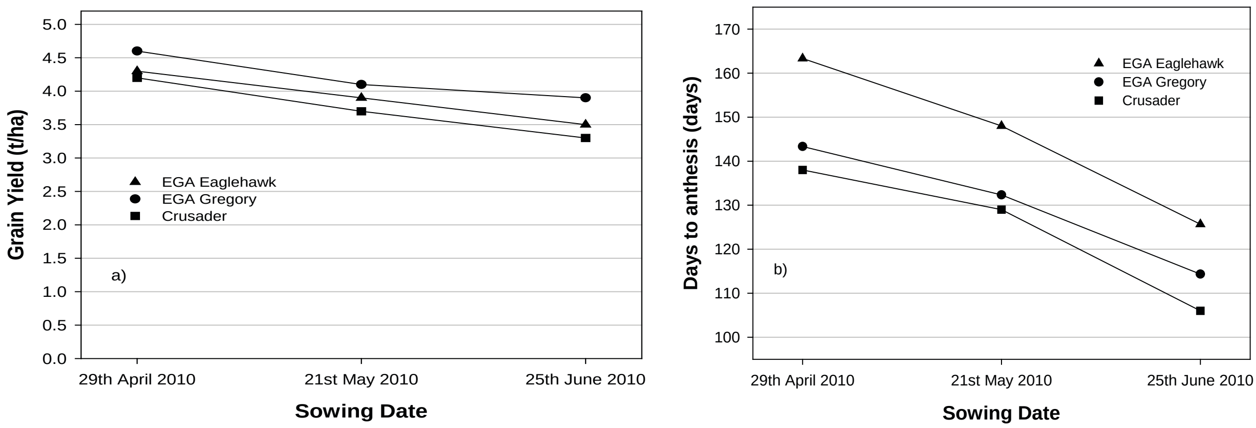

Figure 2. Grain yield (a) and days from sowing to flowering (b) at 3 sowings dates for EGA Eaglehawk$^{\text{(b)}}$, EGA Gregory and LongReach Crusader$^{\text{(b)}}$ at Tamworth in 2010

Results 2011

The 2011 season started with good subsoil moisture. Very little rain fell during June, July and August after which above average rainfall was received in September, October, November and December. Late November and early December had uncharacteristically cool temperatures. The relationship between grain yield and anthesis date revealed that earlier flowering times were generally associated with higher yields.

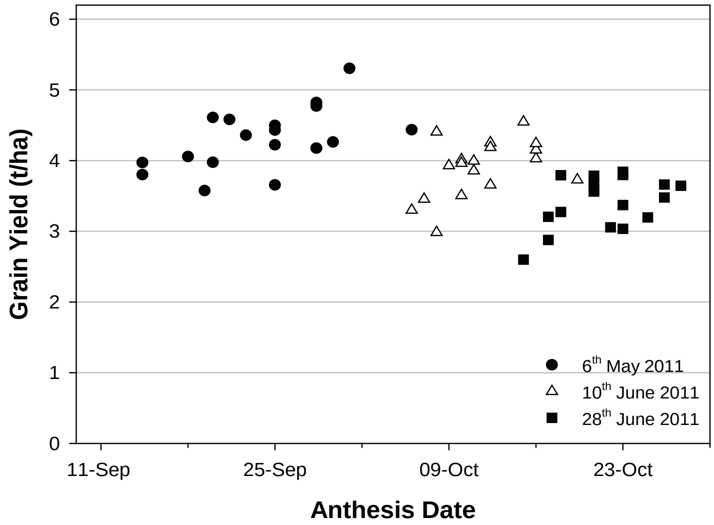

Figure 3. Relationship between grain yield and anthesis date for three sowing dates at Tamworth in 2011

Grain yield significantly declined for each delay in sowing time with average yields for TOS 1, 2 and 3 being 4.2, 3.9 and 3.4 t/ha, respectively. EGA Bounty⟃ (mid maturity) was the standout performer in 2011 having the greatest yield for TOS 1 and 2 while being the 6th highest yielder for TOS 3. Hyperno⟃ was the highest yielding durum variety at all 3 sowing dates. Mid maturity varieties such as EGA Gregory⟃, EGA Bounty⟃, and Zulu generally yielded best for TOS 1. Quicker maturing durum varieties were highest yielding at TOS 2. The advanced breeder line SUN595B achieved the highest yields along with Hyperno⟃ and Zulu at TOS 3, which are quicker maturing varieties.

LongReach Crusader⟃ and LongReach Spitfire⟃ were the quickest varieties to reach anthesis, taking 5–10 less days to reach anthesis compared to the TOS average, whereas, EGA Eaglehawk⟃ took an additional 4 to 12 days to reach anthesis compared to the TOS average. Time taken to reach anthesis was reduced on average by 17 and 8 days from delaying sowing to TOS 2 and 3, respectively.

Table 2. Grain yield, yield rank and days to anthesis for 18 wheat varieties at three sowing times at Tamworth in 2011. Lsd's for TOS and variety were 0.22 t/ha and 0.62 t/ha, respectively (P<0.05).

Variety	Yield (t/ha) and rank within TOS						Days from sowing to anthesis		
	6th May		10th June		28th June		6th May	10th June	28th June
EGA Bellaroi⟃	4.2	11	4.3	3	3.4	11	141	123	116
Caparoi⟃	4.2	12	3.9	12	3.6	9	144	122	114
LongReach Crusader⟃	3.8	16	3.3	17	3.2	13	130	117	110
EGA Bounty⟃	5.3	1	4.5	1	3.7	6	147	126	119
EGA Eaglehawk⟃	4.4	7	3.7	13	3.5	10	152	130	119
EGA Gregory⟃	4.8	2	4.0	7	3.2	14	144	127	118
Ellison⟃	4.1	13	4.0	8	3.1	15	134	121	115
Hyperno⟃	4.5	6	4.4	2	3.8	3	141	119	111
Jandaroi⟃	4.0	14	3.5	16	2.6	18	136	118	108
Livingston⟃	3.6	18	3.5	15	3.8	4	135	121	114
LongReach Spitfire⟃	4.0	15	3.0	18	2.9	17	130	119	110
SUN595B	4.4	8	4.2	5	3.8	1	141	123	116
SUN627A	4.6	4	4.0	9	3.6	8	136	122	114
Sunguard⟃	4.6	5	4.0	10	3.0	16	137	121	116
Sunvale⟃	4.3	10	4.2	6	3.6	7	146	127	121
Sunzell⟃	4.4	9	3.7	14	3.7	5	139	123	114
TD1046(Durum)	3.7	17	3.9	11	3.3	12	141	120	111
Zulu	4.8	3	4.2	4	3.8	2	144	127	116
TOS Average	4.2		3.9		3.4		140 (22 Sep)	123 (10 Oct)	115 (20 Oct)

For the mid maturity variety EGA Gregory(b) there was a 1.2 t/ha yield penalty for delaying sowing from TOS 2 to TOS 3. EGA Gregory(b) took a similar time to flower as the late maturing variety EGA Eaglehawk(b) for TOS 2 and 3. EGA Eaglehawk(b) (late maturing) and LongReach Crusader(b) (quick maturity) followed a similar decline in yield across different TOS's, however, LongReach Crusader(b) yielded approximately 0.5 t/ha less at each TOS. LongReach Crusader(b) was 8–13 days to quicker to reach flowering than EGA Eaglehawk(b).

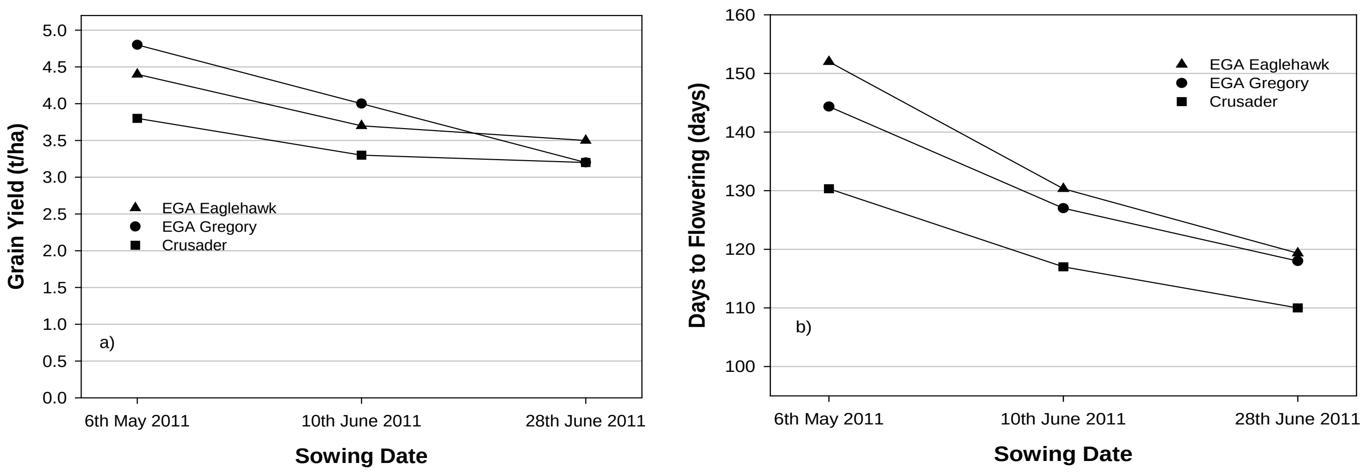

Figure 4. Grain yield (a) and days from sowing to flowering (b) at three sowings dates for EGA Eaglehawk(b), EGA Gregory and LongReach Crusader(b) at Tamworth in 2011

Summary

EGA Bounty(b) and Hyperno(b) consistently had high yields across all 3 TOS's in 2011 and 2010. The earliest sowing time in 2011 was the only TOS with average anthesis date (22nd September) in the optimum flowering window. The average flowering dates for TOS 2 and 3 were 5 and 15 days past the optimum flowering window, which resulted in significant yield penalties. In 2010, TOS 1 and TOS 2 resulted in average anthesis dates of the 23rd September and 3rd October, which both fall in the optimum flowering window and resulted in similar yields. The third TOS had an average anthesis date of the 16th October, which resulted in a significant yield reduction. With the barley TOS trial it was observed that the above average rainfall allowed late maturing varieties to escape yield penalty when flowering approximately 5 days beyond the optimum flowering window. For the wheat TOS 3 flowering occurred 11 to 15 beyond the optimum flowering window and the yield penalty occurred. Therefore, it would be expected that yield penalties would be more severe when hot and drier conditions are experienced during October. While the durum varieties performed very well at the earlier planting times, late April is considered too early to recommend commercially planting durum.

The results contained in this paper must be carefully considered as two mild seasons have been encountered. In a more 'normal' season frost damage would likely be sustained from sowing some varieties at the end of April.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Variety Specific Agronomy Package Project (DAN00129). The technical assistance provided by Stephen Morphett, Jim Perfrement, Patrick Mortell, Alan Bowring, Jan Hoskings, Rod Bambach and Bruce Haigh are gratefully acknowledged.

Lodging management of barley in 2011 – Spring Ridge, Tamworth and Bellata

Matthew Gardner and Guy McMullen

NSW DPI, Tamworth

Introduction

Lodging is a major limitation to the wider use of barley in northern farming systems. Lodged crops can severely limit grain yield and reduce grain quality, not to mention the difficulties associated with harvest. Research into lodging of barley has focussed on both genetic and management solutions. Management options available to growers include variety selection, plant population, defoliation and plant growth regulators (PGRs). Defoliation during tillering (GS25) and up to stem elongation (GS31) has been reported to be an effective means for reducing both the incidence and severity of lodging. Plant Growth Regulators are a widely use management tool for preventing lodging of cereal crops in Europe and New Zealand. The primary PGRs used for lodging management shorten the stem by inhibiting the synthesis of the plant hormone gibberellin. By preventing the synthesis of giberellin at early stem elongation (GS30-32), PGRs have the capacity to shorten the lower internodes (space between nodes) of the stem, therefore, shortening the overall crop height. Crop height reductions can be in the order of 5–20 cm. There is also some evidence that PGR's can induce thickening of the stem wall which reduces lodging.

A trial investigating lodging management options including variety, plant population, defoliation and PGRs was conducted at 3 sites throughout the northern region in 2011. All sites experienced extremely dry conditions during June, July and August. In contrast, above average rainfall was received in September, October and November, which was also accompanied by very mild temperatures.

Site details

Location:	Tamworth	"Yarooga", Spring Ridge	"Boggy Creek", Bellata
Co-operator:	NSW DPI	Angus Murchison	Brian Lowe
Sowing Date:	10th June 2011	21st June 2011	6th June 2011

Treatments

Commander⦶ and Oxford⦶ were the two varieties used for the trial. Commander⦶ is extremely susceptible to lodging while Oxford⦶ has good straw strength. The two varieties were grown at plant populations of 60, 80 or 120 plants/m^2. There were four PGR treatments nil, Cycocel®, Moddus® and a combination of Cycocel® and Moddus®. All treatments had either plus or minus defoliation at GS31.

Results

Yield

There was no significant interaction between treatments for grain yield at any of the 3 sites. Defoliation at stem elongation significantly reduced grain yield by 4.1 and 4.3% at Spring Ridge and Bellata, respectively. At Spring Ridge, Oxford⦶ significantly out yielded Commander⦶ by 0.31 t/ha. The PGR treatments had a significant affect on grain yield at Tamworth (Figure 1). Cycocel® (6.37 t/ha) had a greater grain yield than both Moddus® (6.05 t/ha) and the Nil treatment (5.94 t/ha) (Figure 1).

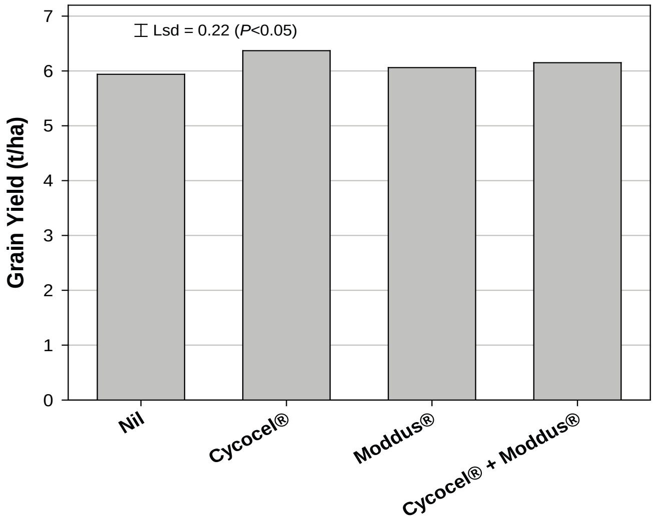

Figure 1. Grain yield at Tamworth for Nil, Cycocel®, Moddus® and Cycocel® + Moddus® PGR treatments.

Lodging

Bellata had minimal to no lodging pressure compared to Tamworth and Spring Ridge. Although the Tamworth site had lower lodging compared to Spring Ridge the trends were similar (Table 1). Commander⁽ᵈ⁾ is a more susceptible variety to lodging compared to Oxford⁽ᵈ⁾, which has strong straw strength (Table 1). At both the Tamworth and Spring Ridge sites lodging severity for Commander⁽ᵈ⁾ was approximately 3 times what was observed for Oxford⁽ᵈ⁾ (Table 1). Defoliation at stem elongation reduced lodging severity regardless of variety or PGR treatment (Table 1). The combination of Cycocel® and Moddus® was the most effective PGR treatment to reduce lodging severity compared to the control treatment (Nil PGR and – defoliation) (Table 1).

Table 1. Lodging scores (Scale 0-9, where 0 is standing and 9 is flat on the ground) at harvest for the Spring Ridge and Tamworth sites.

PGR	Spring Ridge				Tamworth			
	Commander⁽ᵈ⁾		Oxford⁽ᵈ⁾		Commander⁽ᵈ⁾		Oxford⁽ᵈ⁾	
	– defoliation	+ defoliation	– defoliation	+ defoliation	– defoliation	+ defoliation	– defoliation	+ defoliation
Nil	7.2	5.2	3.0	1.9	3.0	2.3	1.0	1.0
Cycocel®	6.2	5.3	1.8	1.6	2.0	1.7	0.2	0.7
Moddus®	5.3	4.9	1.8	1.6	2.0	1.3	0.0	0.0
Cycocel® + Moddus®	4.6	4.3	1.9	0.9	1.8	1.4	0.0	0.0

Plant Height

The ability of PGRs to reduce the severity of lodging appears to be related to the capacity to restrict plant height (Figure 2). The nil PGR treatments had the greatest plant heights while Cycocel® + Moddus® was the most effective treatment at restricting plant height (approximately 4–5 cm) (Figure 2). Moddus® restricted plant height to a greater extent than Cycocel® (Figure 2). Again similar trends were observed at Tamworth, where Moddus® + Cycocel® significantly restricted plant height by 3 – 4 cm compared to the nil treatment (Figure 2).

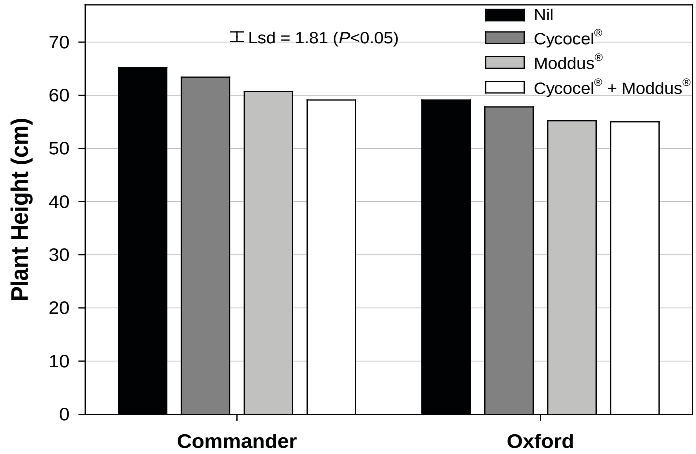

Figure 2. The effect of four PGR treatments on plant height of Commander and Oxford⟨D⟩ at Spring Ridge 2011.

Dry Matter (DM) Yield

Restricting the size of the crop canopy or DM production, like restricting plant height, is another effective means of reducing the severity of lodging. Defoliation and plant population were the most effective management strategies for restricting the DM production at Anthesis (GS61) and maturity (GS99). On average across sites defoliation reduced DM yield at anthesis by 5 – 9%, however, these reductions in DM yield by maturity were negligible. In contrast, the 60 and 80 plants/m^2 populations maintained a significantly lower DM yields than 120 plants/m^2 population at both anthesis and maturity (Figure 3).

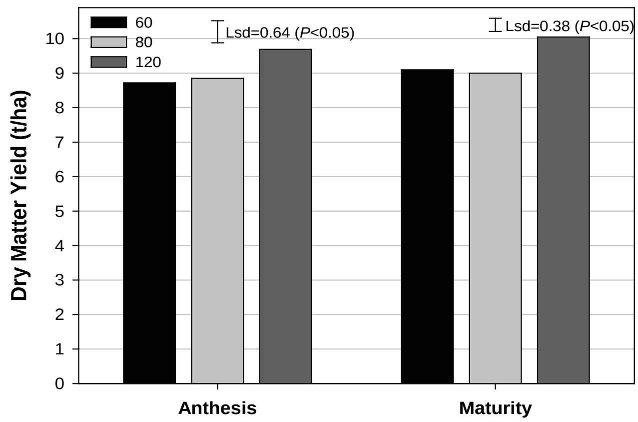

Figure 3. Dry Matter yield for the 60, 80 and 120 plants/m^2 populations at anthesis and maturity.

Summary

Choosing a variety that is less susceptible to lodging is the most effective management option for reducing the losses from and severity of lodging. Where a susceptible variety to lodging such as Commander⟨D⟩ is grown defoliation prior to stem elongation can reduce the severity to lodging and limit the canopy size at anthesis. It is essential that defoliation **does not** occur beyond stem elongation (GS31) as significant yield penalties could be expected. Maintaining plant populations at approximately 80 plants/m^2 enabled DM yield to be restricted throughout the growing season, without significantly limiting yield. Of the PGR treatments the combination of Cycocel® and Moddus® reduced the severity of lodging to the greatest degree. It is important to note that Moddus® is not currently registered for use on cereals in Australia although it is widely used throughout New Zealand and Europe. Applying both Cycocel® and Moddus® blocks the synthesis of Giberellin in 2 places as opposed to 1 if a single product is applied, this may explain why this treatment was most effective at reducing. Responses to the application of PGR products have been highly variable between trial sites and between seasons. The mechanism that influences the efficacy of PGR products is not well understood under Australian conditions and requires further investigation.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131). Trial sites provided by Angus Murchison, "Yarooga" and Brian Lowe, "Boggy Creek and technical assistance provided by Stephen Morphett, Alan Bowring, Jim Perfrement, Patrick Mortell, Jan Hoskings and Rod Bambach are gratefully acknowledged.

The yield and quality penalty of a wet harvest – barley

Matthew Gardner and Guy McMullen
NSW DPI, Tamworth

Introduction

The 2010–11 seasons have had above average rainfall during the grain fill period and particularly during the harvest period. Wet weather can and has caused significant delays in harvest, either from paddocks too wet for machinery traffic or high grain moisture. Delaying harvest and weather occurring during the delay can have a significant affect on grain yield and harvest. A trial was conducted in 2011 to investigate the impact of delaying harvest due to wet weather conditions on grain yield and quality of 12 barley varieties.

Site details

Location: Tamworth Agricultural Institute

Cooperator: NSW DPI

Sowing Date: 10th June 2011

Treatments

There were 11 commercially available barley varieties and 1 advanced breeder line used in the trial including Roe, Commander⁽ᵈ, Vlamingh⁽ᵈ, Grout⁽ᵈ, Hindmarsh⁽ᵈ, Gairdner⁽ᵈ, Mackay⁽ᵈ, Fleet⁽ᵈ, Fitzroy⁽ᵈ, Buloke⁽ᵈ, Shepherd⁽ᵈ and VB0611. The barley varieties were harvested on 4 separate occasions with 4 replicates. Harvest 1 (11th November) occurred when the crop had reached maturity and had not received any rainfall near harvest. Harvest 2 (18th November) occurred 7 days later after 34 mm of rainfall had fallen, while harvest 3 (28th November) occurred 10 days after harvest 2 and received an additional 109 mm of rainfall. The final harvest (7th December) occurred 10 days after harvest 3 and received a further 72 mm of rainfall. Between harvest 1, which was regarded as optimal time for harvest, and harvest 4 there was 215 mm rain and a delay of 26 days.

Results

- Delays in harvest from harvest 1 to harvests 2, 3 and 4 resulted in significant losses in average yields from 12 barley varieties of 0.38, 0.44 and 0.42 t/ha, respectively.

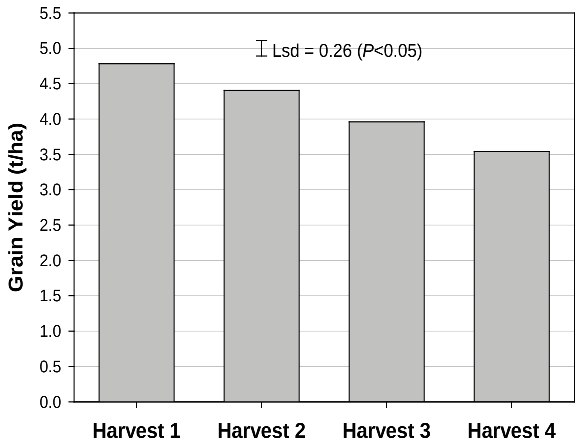

Figure 1. Effect of harvest time on grain yield at Tamworth in 2011

- The yield penalty from delaying harvest from harvest 1 to 4 significantly varied between varieties. Fitzroy⁽ᵈ and Buloke⁽ᵈ incurred the greatest yield losses (2.2 and 2.1 t/ha, respectively) of the 12 varieties, whereas, Roe, Vlamingh⁽ᵈ and Grout⁽ᵈ (0.5, 0.7 and 0.7 t/ha, respectively) had the smallest losses. Commander⁽ᵈ, Gairdner⁽ᵈ, Hindmarsh⁽ᵈ and Shepherd⁽ᵈ all had similar yield losses (average 1.2 t/ha) from delaying harvest at Tamworth by 26 days.

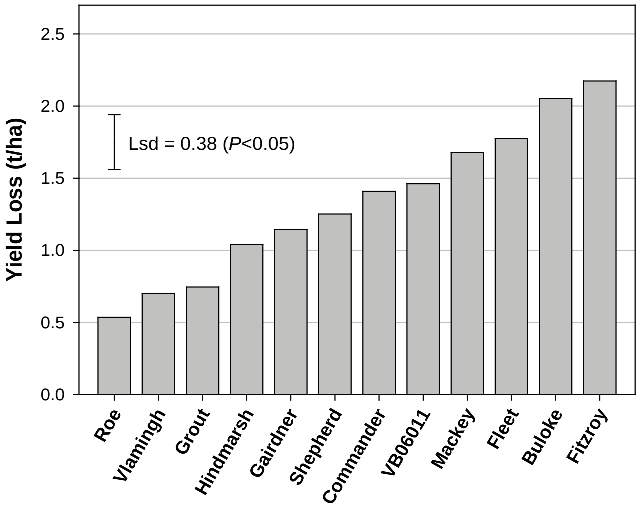

Figure 2. Yield losses (Harvest 1 – Harvest 4) for 11 barley varieties at Tamworth in 2011.

Delaying harvest had a significant effect on all grain quality attributes (Table. 1). Protein increased by almost 1% between harvests 2 and 3. The 1000 grain weight was similar for harvests 1 and 2, which were significantly higher (1.9 g) than both harvests 3 and 4 that were also similar. Retention significantly increased from harvests 1 and 2 to harvest 3 (96.2%) before another significant increase for harvest 4 (97.0%). Screenings were negligible across the four harvest times but did significantly decline from 1.5% for harvest 1 to 0.7% for harvest 4. Test weight significantly declined by 3.1 kg/hL between harvest 1 and 2 before declining a further 2.7 kg/hL for harvests 3 and 4, which were similar.

Table 1. The effect of harvest time on grain quality traits, protein,1000 grain weight, retention, screenings and test weight across 11 barley varieties at Tamworth in 2011. Any values designated with different letters within a column are significantly different (P<0.05).

Harvest Time	Protein (%)	1000 Grain Weight (g)	Retention (%)	Screenings (%)	Test Weight (kg/hL)
Harvest 1	11.5b	51.7a	95.2c	1.5a	72.0a
Harvest 2	11.6b	51.7a	95.5c	1.0b	68.9b
Harvest 3	12.4a	49.6b	96.2b	0.9b	66.1c
Harvest 4	12.4a	49.9b	97.0a	0.7c	66.3c
Lsd (*P*<0.05)	0.2	1.7	0.4	0.1	0.4

Summary

The 2010 – 11 seasons represented wet harvests that resulted in significant downgrades in grain quality and price received for grain at the silo. The present study showed that delaying harvest from what was considered the optimum date by as little as 7 days reduced yield by 0.4 t/ha, while delays up to 26 days reduced yields up to 2.2 t/ha in the worst affected varieties. The decline in yield appeared to be more related to the time delay rather than amount of rainfall, as the yield penalty was reasonably constant (approximately 0.4 t/ha) between each harvest day (approximately 7–10 days), while rainfall between harvest dates ranged between 34 and 109 mm. This average 0.4 t/ha yield penalty equates to approximately $60–80/ha (depending of grade) in the 2011 season, which suggests it may be economical to actually harvest grain at a slightly higher moisture content and dry it down. The yield penalty associated with delayed harvest varied significantly between varieties from 0.5–0.7 t/ha (Roe, Grout[ⓟ] and Vlamingh[ⓟ]) to 2.1–2.2 t/ha (Buloke[ⓟ] and Fitzroy[ⓟ]). The effects of delayed harvest on grain quality were significant with protein concentration and retention increasing, while decreases in 1000 grain weight, screening and test weight were observed. There appeared to be a significant change between harvests 2 and 3 for protein, 1000 grain weight and retention, which suggests that maybe these traits are more affected by rain as between these two harvests 109 mm of rain was received. It was surprising how well grain quality stood up for harvest 4, for instance Gairdner[ⓟ] would have been still eligible to meet malt 1 specification based on the measured quality parameters in this trial. However, the visible signs of weather damage were evident between harvests 1 and 4, which may result in downgrades due to split or cleaved grain or shot and sprung grain. This trial has given an indication of what the penalties are for weather delayed harvest in barley and the differences that exist between varieties. However, in reality growers have little choice in the matter and would harvest if conditions, paddock or grain, would permit.

Acknowledgements

This project is funded by NSW DPI and GRDC under the Northern Barley Agronomy Project (DAN00131). The technical assistance provided by Stephen Morphett, Jim Perfrement, Patrick Mortell, Alan Bowring, Jan Hoskings, Rod Bambach and Bruce Haigh are gratefully acknowledged.

‘Managing legume and fertiliser N for northern grains cropping’ – a manual about N

David Herridge

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Introduction

This 88-page manual summarises current information on fertiliser and legume nitrogen (N) for broad-acre cropping in Australia’s northern grains region, with particular emphasis on the legume N (Figure 1). The manual also contains instructions, underpinning technical information and background science for ‘NBudget’ – the Excel based calculator for estimating the fertiliser N requirements of both summer and winter cereal and oilseed crops and dinitrogen (N_2) fixation by legumes (see accompanying paper). The calculator is attached to the manual as a CD.

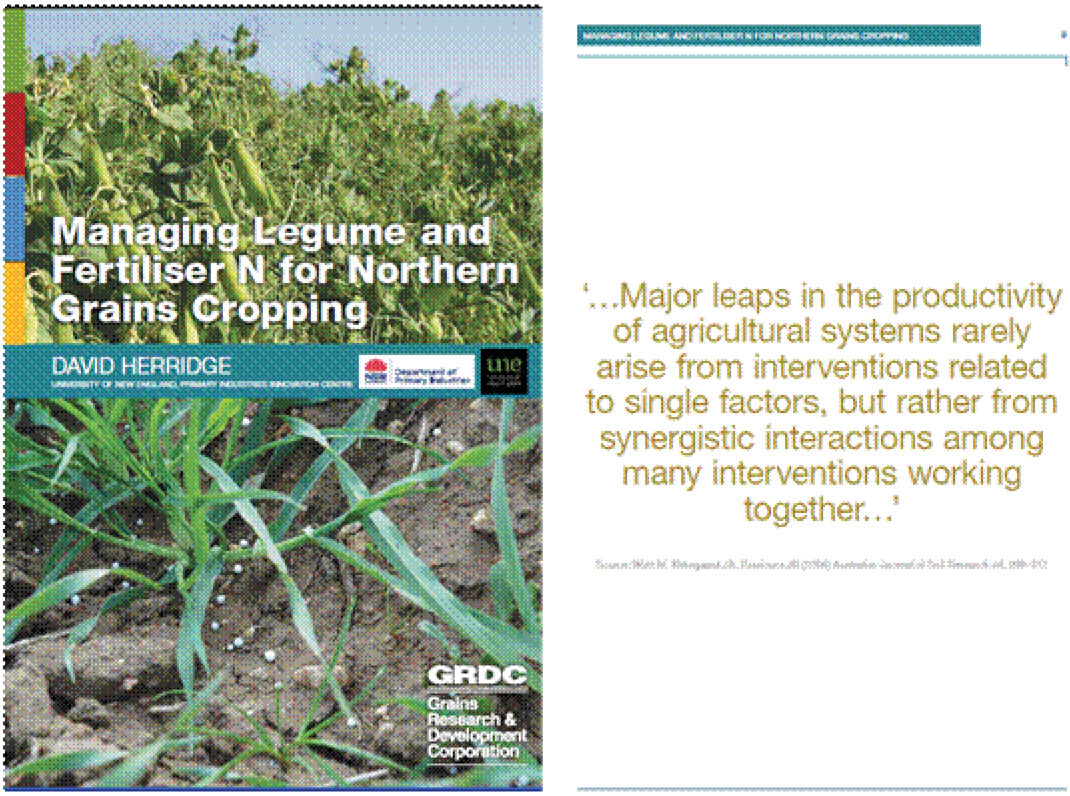

Figure 1. Manual cover and inside cover

Data and concepts that underpin the manual and calculator were sourced from the many published and unpublished experiments conducted primarily by the farming systems and plant nutrition programs of the NSW and Qld government agencies during the past 30 years. The manual interprets and reports not only the data but also the knowledge and insight of the Australian and international scientists who have worked and published in the fields of soil and plant N. Special mention should be made here of the contributions of the late Harry Marcellos, Warwick Felton, David Doyle, Ian Holford and Graeme Schwenke of the NSW DPI (Department of Agriculture) and Wayne Strong, Ram Dalal, David Freebairn and Greg Thomas of the former Queensland Department of Primary Industries.

Why focus on N?

Plant-available (mineral) N is a major driver of agricultural productivity and profitability. Nitrogen is a component of chlorophyll, the green pigment found in almost all plants and responsible for photosynthesis in which carbon from carbon dioxide in the atmosphere is fixed by the plant into sugars in the presence of sunlight. Photosynthesis is the source of almost all of the energy for animal and human life. When plants are N-deficient, they lack chlorophyll (termed chlorotic), appear yellow and are unthrifty. For grain crops, N deficiency means reduced yield and low grain proteins.

Mineral N in the soil is also required for the formation of humus (stable soil organic matter), necessary for soil health and land sustainability. Nitrogen in one of its gaseous forms, nitrous oxide (N_2O), is a potent greenhouse gas and N as nitrate is potentially dangerous to human health when leached into in groundwater that is used for drinking. The challenge facing farmers is that they need to supply sufficient N to their plant-soil systems to optimise yields, profitability and soil health, whilst at the same time minimising the environmental risks associated with greenhouse gas emissions and nitrate pollution of water tables.

Structure of the manual

There are six chapters plus appendices and references in the manual. Each chapter is self contained although written in such a way that one chapter leads logically into the next.

Chapter 1 provides a brief overview of grain cropping in Australian agriculture. The northern grains region is introduced to be followed by an outline of research on N in the region that commenced in the 1960s and which led to the development of N management tools and programs for farmers and their advisors during the 1990s. The N cycle in agricultural systems is examined in terms of how N is added to the soil, how it is moved around and stored in the soil, how it is lost from the soil and, finally, how the soil biology make it all happen.

Chapter 2 defines the problem of declining soil organic matter in grain cropping soils in the region. Variations in nitrate-N concentrations in the root zone are described to provide a sense of how much they vary with cropping and during the post-crop fallow. Potential loss mechanisms – leaching and denitrification – are introduced with brief discussion on their relative significance.

Chapter 3 explores legume N_2 fixation and the farming practices that affect it. Rhizobial inoculants and the inoculation of legumes are also covered. The chapter examines the rotational benefits of legumes, defined by their ability to fix N, improve the mineral and organic N contents of soils in which they grow and to act as a break for soil- and stubble-borne diseases of cereals.

Chapter 4 examines mineral and organic fertilisers, particularly related to the efficiency with which the N is utilised by the target crop. The chapter also examines the fate of fertiliser N as it is processed in the soil to a plant-available form and is either taken up by the growing crop, left unused in the soil, lost from the soil or immobilised into the soil organic matter.

Chapter 5 provides a brief overview of 'NBudget' and how it would be used for specific paddocks. Examples are provided of the accuracy with which the tool predicted soil nitrate levels, i.e. validation.

Chapter 6 considers the science that underpins 'NBudget', covering key issues such as the accumulation of nitrate in the soil resulting from mineralisation of native soil organic matter and fresh crop residues, the efficiency with which water is stored in the soil during the pre-crop fallow to the development of the functions describing legume N_2 fixation.

The appendices contain graphs and tables relevant to 'NBudget'. The cited references (235 in all) constitute the final section of the manual.

Where to get a (free) copy?

You can use one of several methods:

Phone: 1800 11 00 44

Fax: 1800 00 99 88 (Please use the order form by going to the GRDC web site (http://www.grdc.com.au/director/events/bookshop) and following the instructions for downloading the order form)

E-mail: ground-cover-direct@canprint.com.au

Post: Ground Cover Direct, PO Box 7456, Canberra MC ACT 2610 (Please use the order form by going to the GRDC web site (http://www.grdc.com.au/director/events/bookshop) and following the instructions for downloading the order form).

Acknowledgements

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Tracking nitrate levels in Liverpool Plains cropping soils: measured values and 'NBudget' simulations

David Herridge[1] and Bill Manning[2]

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Introduction

Each year, farmers in the northern grains region make decisions about the amount of fertiliser nitrogen (N) they are going to apply to approximately 4 million ha of land intended for cropping. These are challenging decisions, with substantial economic and environmental consequences if they get it wrong. Decision support (DS) tools to help farmers and their advisers make decisions about fertiliser N inputs have been developed and promoted during the past 15 years, from the relatively simple paper-based 'Nitrogen in 95/96', 'NITROGEN IN 96' and 'Nitrogen budgeting for winter cereals' to the more complex computer-based APSIM, WhopperCropper and Yield Prophet®. All rely on a budgeting approach in which the supply of plant-available N for a paddock is determined prior to sowing together with the N demand, i.e. amount of N required to grow the crop. The difference between N supply and demand is the shortfall that is met by fertiliser N inputs.

Farmers use various approaches to determine N supply including deep coring for nitrate or mineral N, calculating on the basis of soil organic carbon levels and back-calculating on the basis of previous yield and protein outputs, i.e. N replacement. Nitrate testing is the most direct method and should provide the basis for good decisions about fertiliser N requirements. The proviso is that sampling is well done, i.e. adequate number of cores/paddock, and the samples are quickly transported to the testing laboratory. The problem is that only a minority of paddocks are deep cored for nitrate each year, probably less than 10%. The vast majority of paddocks will not have any testing, leaving farmers to make the N budgeting decisions with little of the required information. In response to this reality, an excel-based decision-support (DS) tool, 'NBudget', has been developed that aims to help farmers/advisers in Australia's northern grains region set target yields and determine fertiliser N requirements for winter and summer cereals and oilseeds without the need for soil testing (Figure 1).

In this paper, we provide brief details of 'NBudget'. We then compare values for soil nitrate for two paddocks in the Gunnedah region, measured from deep cores during more than 3 years of sampling, with values calculated using 'NBudget'.

'NBudget' – a tool for estimating pre-crop soil water and nitrate levels, crop yields and fertiliser N requirements

There are 16 stations (locations) in the program, from Roma and St George in Qld to Dubbo in the central-west of NSW. The program contains rule-of-thumb values and algorithms for estimating the net release or immobilisation of nitrate-N in the soil, water storage during the fallow, grain yields based on water-use efficiencies and N_2 fixation by legumes if included in the rotation sequence. Input data to generate the rule-of-thumb values and algorithms were derived from published and unpublished experiments conducted principally by the farming systems and plant (N) nutrition programs of the NSW and Qld agricultural agencies during the past 30 years. Input data required to run 'NBudget' includes – location and description of the paddock as very low, low-medium, medium or high fertility, tillage practice, yield and protein level (for cereals) of the previous crop, fertiliser N applied to previous crop, simple assessment of crown rot risk (for winter cereals) and fallow rainfall or depth of wet soil.

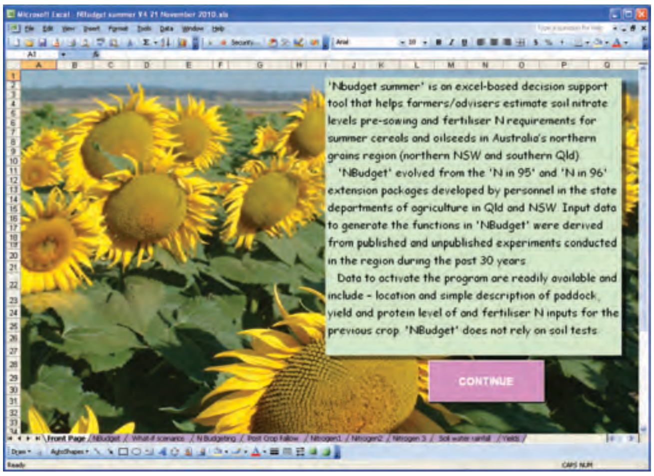

Figure 1. The front page of 'NBudget' for winter crops. The winter crops version includes bread wheat, durum, barley, canola, chickpea and fababean. The summer crop version (image not shown) includes sorghum, sunflower, mungbean and soybean.

There are six steps to work through in 'NBudget' for winter crops and five in 'NBudget' for summer crops to estimate yields and fertiliser N requirements (steps for the winter crop version as follows):

1. Site details – The station is selected from a drop-down list of 16 and property and paddock names inserted. Also selected from drop-down lists are the fertility status of the paddock (very low, low-medium, medium or high, according to the short description of each), soil type and tillage practice. The vast majority of paddocks will be in the low-medium or medium categories.
2. Two seasons prior to last season's sowing – The user selects from the list the crop grown in the paddock the season before last. A rule-of-thumb estimate of soil nitrate at the start of last season, aggregated from published and unpublished data, is then shown. In the example in Figure 2, the soil nitrate value at the start of last season following a N-fertilised cereal crop two seasons ago is 72 kg N/ha.
3. Last season's crop – The user selects from a drop-down list the crop that was last grown in the paddock and inserts the yield, protein and amount of fertiliser N applied. In the Figure 2 example, barley yielding 1.8 t/ha @ 12% grain protein and fertilised at the rate of 6 kg N/ha was grown.
4. The program then provides an estimate of post-fallow soil nitrate, i.e. soil nitrate at the time that the farmer or adviser is making a decision about fertiliser N inputs for the coming cropping season. 'NBudget' estimated 69 kg N/ha. The other key value is post-fallow soil water, determined using either fallow rainfall records, depth of wet soil (push probe) or by other means (estimate of 124 mm). Both soil water and soil nitrate values are for soil depths of 1.2 m.
5. Crown rot assessment for bread wheat, durum and barley for current season (only in the winter cropping version) – The expected level of crown rot, low, medium or high, is selected from the list. The yield loss for the three cereals is then calculated using default data from the NSW DPI Grain Pathology research program, Tamworth (S. Simpfendorfer, personal communication).
6. Targeting grain yields and proteins, fertiliser N – Expected grain yields for the coming season are calculated automatically using default water use efficiency (WUE) values after the user inserts the target grain proteins for the average season for bread wheat, durum and barley. The default protein values are 11.5% (bread wheat), 13.0% (durum) and 10.0% (barley). Grain proteins for canola, chickpea and fababean are at set values that do not require changing. The fertiliser N requirements for bread wheat, durum, barley and canola and the amounts of N fixed by chickpea and fababean are then calculated together with residual (post-fallow) nitrate levels.

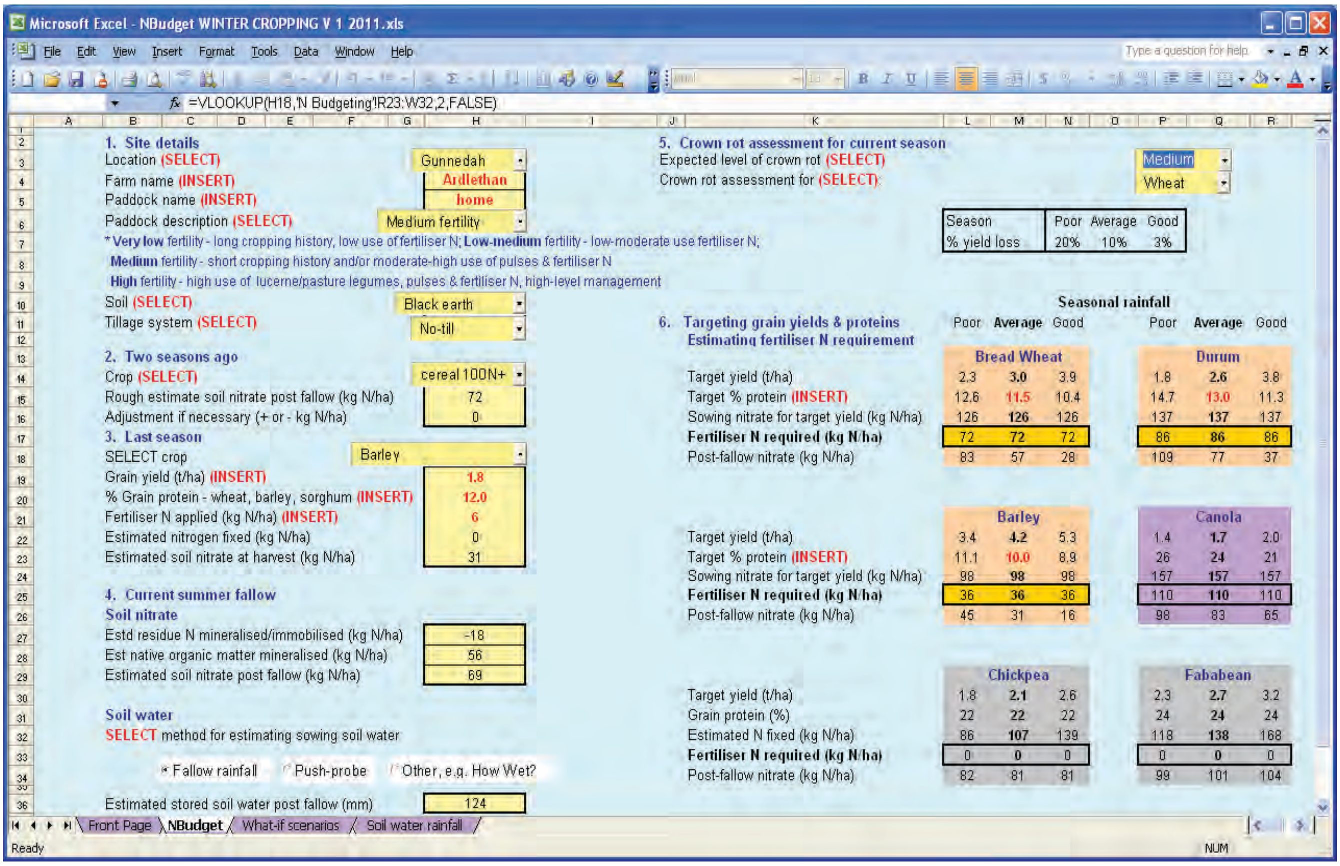

Figure 2. Output page of 'NBudget' for winter crops showing the 6 steps to estimate crop yields for the different crops and fertiliser N requirements for bread wheat, durum, barley and canola.

Site details of monitored paddocks in the Gunnedah region

Two paddocks, designated Site 1 and Site 2, at "Rossmar Park", Caroona NSW, were monitored for soil nitrate levels over several years, Site 1 from October 2008 at sowing of a sorghum crop and Site 2 from January 2008 after a barley crop in 2007. Monitoring at both sites has continued to the present and is ongoing. Each site is a commercial no-till cropping paddock; soil type is a heavy Vertosol with salinity increasing with depth (up to a 1000 mg/kg Chloride at 100 cm). Crop choice and fertiliser decisions are made by the grower based on normal agronomic and economic considerations.

Cropping history for Site 1 – 2004 (wheaten hay); 2005 (barley 3.3 t/ha, N fertiliser 105 kg N/ha); 2006 (barley 1.8 t/ha @ 12% protein, N fertiliser 6 kg N/ha); 2007 (barley 2.9 t/ha @ 13.5% protein, N fertiliser 80 kg N/ha); 2008/09 (sorghum 6.3 t/ha, N fertiliser 100 kg N/ha); 2010 (wheat 5.3 t/ha @ 10.8% protein, N fertiliser 100 kg N/ha); 2011/12 corn, N fertiliser 122 kg N/ha). Assumed grain protein of 10% for the 2005 barley crop and 8% grain protein for the 2008–09 sorghum crop. For the 'NBudget' calculations, the paddock was assumed to be of medium fertility.

Cropping history for Site 2 – 2003 (barley 3.0 t/ha @ 12.5% protein, N fertiliser 56 kg N/ha); 2004 (barley 5.5 t/ha @ 10.8% protein, N fertiliser 50 kg N/ha); 2005/06 (sunflower 1.0 t/ha, N fertiliser 73 kg N/ha); 2007 (barley 4.9 t/ha @ 11.2% protein, N fertiliser 75 kg N/ha); 2008 (barley 3.3 t/ha @ 11.0% protein, N fertiliser 100 kg N/ha); 2009/10 (sunflower 2.2 t/ha, N fertiliser 85 kg N/ha); 2010/11 cotton (3.5 bales/ha, N fertiliser 100 kg N/ha). Assumed grain protein of 18% for the 2005–06 and 2009–10 sunflower crops. For the 'NBudget' calculations, the paddock was assumed to be of low–medium fertility.

Soil sampling of monitored paddocks

The soil at each site was deep cored on 6 occasions during 2008–11. Sampling consisted of 15 cores taken across each of the sites. The GPS co-ordinates of each core hole were recorded and subsequent cores taken as close as possible to the previous core holes. The 50 cm diameter cores were sectioned into 0–10, 10–30, 30–60, 60–90, 90–120 and 120–150 cm depths, and then bulked for each depth across the 15 holes, thoroughly mixed and sub-sampled. The sub-samples were dried at 40°C and analysed for nitrate levels at the NSW DPI laboratory, Wollongbar.

Comparing measured soil nitrates with estimates generated using 'NBudget'

Soil nitrate levels were predicted using the 'NBudget What-if scenarios' worksheet and the crop and fertiliser N data above, then compared with the measured values.

Agreement between measured and predicted soil nitrate values was good, particularly at Site 2 (Figures 3 and 4). In some instances, the values were almost identical. In others, such as in July 2010 at Site 1, the measured value was substantially higher than the predicted value (value encircled in Figure 3). In this instance, coring was done soon after the application of fertiliser N and the very high measured value of 297 kg N/ha may have reflected sampling in hot spots of the fertiliser. Agreement was much better in the post-crop sampling in February 2011. Overall, however, the good agreement between the two would suggest that soil nitrate values predicted using 'NBudget' could be used with some confidence by farmers and advisers in making decisions about fertiliser N requirements.

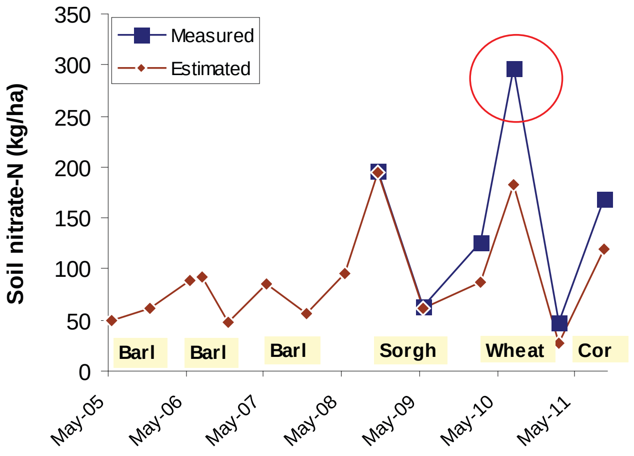

Figure 3. Site 1 –measured (0–1.5 m) and predicted (0–1.2 m) soil nitrate levels

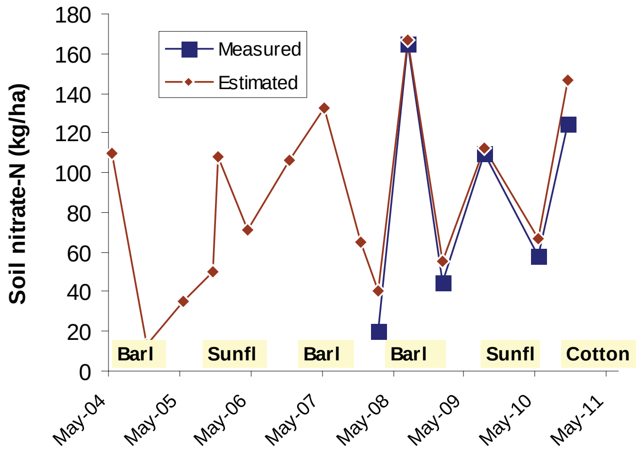

Figure 4. Site 2 – measured (0–1.5 m) and predicted (0–1.2 m) soil nitrate levels

Summary

'NBudget' can assist growers and advisors to fine tune N management decisions provided they have adequate records, i.e. prior grain yields and proteins and fertiliser N inputs for the particular paddock. High fertiliser N prices provide the current incentive for optimising N management. In the future, that could be bolstered by stricter requirements for environmental management, including greenhouse gas mitigation and accounting. The 'NBudget' program needs more validation and, for the foreseeable future, should be used in conjunction with other methods of decision making such as deep coring, advice from agronomists and past experience.

Note that 'NBudget' currently does not deal with cotton. Depending on the level of interest, it may be possible to add cotton to the current four summer crops, i.e. sorghum, sunflower, soybean and mungbean, currently included.

Where to get a copy of 'NBudget' and support for its use?

Currently, 'NBudget' is available as a CD attached to the just-published manual 'Managing legume and fertiliser N for northern grains cropping'. You can use one of several methods to obtain a copy of the manual and CD. See the previous paper for details.

Ongoing support for 'NBudget' will be provided by NSW DPI agronomists Bill Manning, Gunnedah, (william.manning@dpi.nsw.gov.au) and Col McMaster, Forbes, (colin.mcmaster@dpi.nsw.gov.au). It is also intended that 'NBudget' is included as a stand alone tool on the NSW DPI CropMate web site by the middle of 2012.

Acknowledgements

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Validating 'NBudget' simulations of soil nitrate and crop yields of sorghum with measured values

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Introduction

The prime motivation in developing 'NBudget' was to enhance the accuracy and capabilities of the simple paper-based N-budgeting tools, produced in the 1990s for northern grains belt cropping. The major purpose of 'NBudget' remains the same as that of the originals, i.e. to estimate the fertiliser N requirements for crops for the coming season. Deficiencies in 1990s tools were also addressed, such as accounting for the effects of legumes on cereal diseases and soil nitrate levels and modifying the efficiency with which soil nitrate is converted into cereal grain protein as the relative supplies of water and N vary. Additional features of 'NBudget' that were not in the originals are functions for estimating N_2 fixation by legume crops and rules-of-thumb values and linked algorithms for estimating soil nitrate and water, thereby negating the need for deep soil core testing.

Considerable effort went into structuring the calculator in a logical way to make it simple to use. An experienced user can run through a paddock scenario in less than a minute, provided the basic input information is on hand. Considerable effort also went into making sure that the functions and values in the tool were accurate and robust. At the end of the day however, the value of 'NBudget' will largely be determined by the level of use by farmers and advisors as they make decisions about fertiliser N inputs and general N management. The risk is that if farmers and advisers are not confident with the 'NBudget' output, they will not use it and continue with their own methods for determining fertiliser N rates and general N management.

In ongoing research to ground-truth 'NBudget', we monitored three sorghum paddocks in the Quirindi–Gunnedah region during the 2010–11 summer to compare measured soil and crop values with predicted values using 'NBudget'.

Site details and sampling of monitored paddocks

Data was collected as part of a CSIRO project to validate the use of the Agricultural Production Systems Simulator (APSIM) with high yielding sorghum crops on the Liverpool Plains of NSW. Soil nitrates, grain yields and grain proteins were monitored on 3 paddocks, located at Blackville (Site 1, near Quirindi), Willow Tree (Site 2), and Kelvin (Site 3, near Gunnedah). Each site was a commercial no-till cropping paddock with a black Vertosol soil type.

Paddocks were soil cored in late 2010, two paddocks after N application and before planting and one paddock before N application and planting. For the paddocks that were cored after N application, care was taken to sample between the N fertiliser rows. Six cores were taken across each paddock and divided into 0–10, 10–30, 30–60, 60–90 and 90–120 cm segments. Segments from corresponding depths at the six different sampling points were bulked, dried at 40°C and sent to the NSW DPI laboratory, Wollongbar, for nitrate analysis. Information on fertiliser N application, cropping history (including yield and protein where possible) and fertiliser N and grain yields from the 2010/11 sorghum crops were collected from co-operating growers. Sorghum grain samples from each crop were collected and tested for grain protein. Crops experienced mild temperatures and wet conditions during late 2010 and hot dry conditions in early 2011. Yields were average to slightly above average. Following grain harvest each paddock was sampled for nitrate again using the above sampling protocols.

Cropping history for Site 1 – 2008/9 (sorghum 7.0 t/ha, 140 kg fertiliser N/ha); 2009 (wheat 3.5 t/ha @ 13.2% grain protein, 140 kg fertiliser N/ha). For the 'NBudget' calculations, the paddock was assumed to be of medium fertility.

Cropping history for Site 2 – 2007/8 (sunflower); 2009 (wheat 4.0 t/ha, 44 kg fertiliser N/ha). For the 'NBudget' calculations, the grain protein of the 2009 wheat was assumed to be 10% and the paddock to be of low-medium fertility.

Cropping history for Site 3 – 2007/8 (sorghum 8.0 t/ha, 80 kg fertiliser N/ha); 2009 (wheat 3.5 t/ha, 80 kg fertiliser N/ha). For the 'NBudget' calculations, the grain protein of the 2009 wheat was assumed to be 10% and the paddock to be of low-medium fertility.

Comparing measured soil nitrate, yield, grain protein and applied fertiliser N with 'NBudget' predictions

The output page from 'NBudget' for Site 1 is presented as Figure 1. The input details are as detailed above in Cropping history for Site 1. Predicted values for sowing (H29) and post-crop soil nitrates (M18), sorghum grain yield (M14), protein (M15) and fertiliser N requirements (M17) are shown. Also shown are predicted yields, proteins and fertiliser N requirements for sunflower and yields and N_2 fixation for the legumes, mungbean and soybean.

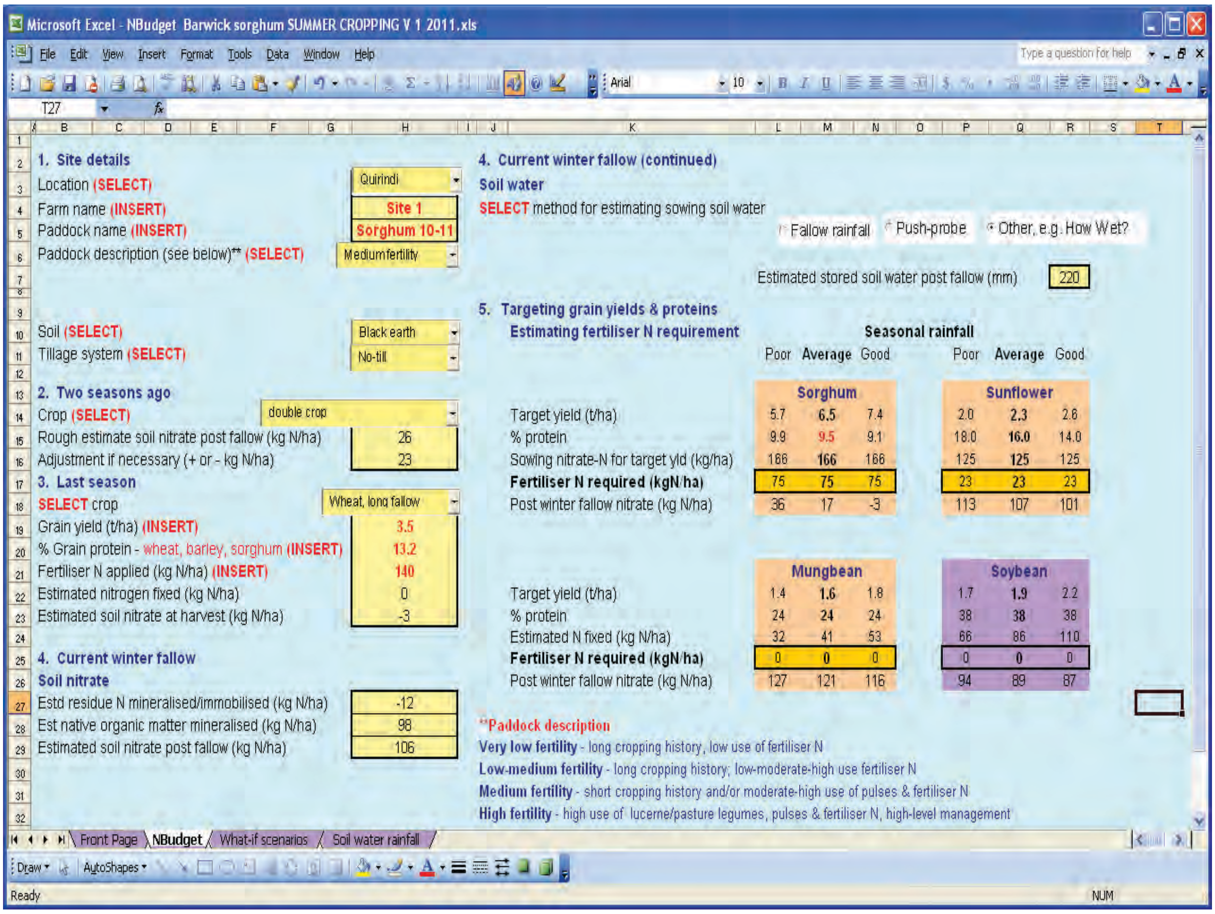

Figure 1. Output page of 'NBudget' for the Site 1 paddock for the 2010–11 season.

We have taken the values for an average season from Figure 1 into the table below to compare with measured data. Data for Sites 2 and 3 are also included in the table below ("NBudget' output pages not shown for these sites).

Agreement between measured and predicted soil nitrates at sowing was generally good, *viz.* 118 *vs* 106 kg N/ha (Site 1), 60 *vs* 67 kg N/ha (Site 2) and 80 *vs* 60 kg N/ha (Site 3). 'NBudget' also did a reasonable job in predicting the sorghum yields, proteins and fertiliser N requirements at the three sites. Predicted post-crop soil nitrates were consistently lower than the measured amounts.

Paddock and farm rainfall records for the pre-sorghum fallow period were not available so, an estimate of sowing soil moisture using 'NBudget' was not completed. Instead, we used the measured values of 167–230 mm.

Parameter	Measured	Predicted using 'NBudget'
Site 1		
Sowing soil water (mm)	220	*
Sowing soil nitrate (kg N/ha)	118	106
Grain yield (t/ha)	6.3	6.5
Grain protein (%)	8.5	9.5
Fertiliser N (kg/ha)	100	75
Post-crop soil nitrate (kg N/ha)	47	17
Site 2		
Sowing soil water (mm)	230	*
Sowing soil nitrate (kg N/ha)	60	67
Grain yield (t/ha)	8.8	6.7
Grain protein (%)	6.6	9.5
Fertiliser N (kg/ha)	75	129
Post-crop soil nitrate (kg N/ha)	19	0
Site 3		
Sowing soil water (mm)	167	*
Sowing soil nitrate (kg N/ha)	80	60
Grain yield (t/ha)	4.4	5.4
Grain protein (%)	9.3	9.5
Fertiliser N (kg/ha)	94	96
Post-crop soil nitrate (kg N/ha)	26	0

Summary

'NBudget' provided good approximations of measured soil nitrates, grain yields and grain proteins for three commercial sorghum paddocks, grown in the Gunnedah–Quirindi area of northern NSW during the 2010/11 summer. Actual rates of fertiliser N applied to the three crops were 100, 75 and 94 kg N/ha, compared with the 'NBudget' predicted rates of 75, 129 and 96 kg N/ha. We will continue to validate the outputs from 'NBudget' to ensure its accuracy and validity.

Acknowledgements

This project was funded by NSW DPI, UNE and GRDC (UNE00014). Thanks to Keith Perrett, Neil Barwick and Joe Fleming for provision of sites. Thanks also to Allan Peake (CSIRO), Peter Formann (NSW DPI) and Jim Hunt, Hunt Ag Solutions for assistance with this work.

Row spacing response of wheat and durum varieties – Gunnedah 2010

Guy McMullen[1], Bill Manning[2] and Rod Bambach[1]

[1] NSW DPI, Tamworth
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Introduction

There has been a trend to wider row spacing's in wheat in recent years. Likely benefits have included:

- an ability to sow into higher levels of retained stubble.
- a reduction in fuel costs during sowing and/or increased sowing speed.
- ability to inter-row sow subsequent crops.
- reduced soil disturbance, and.
- lower cost of sowing equipment.

However, potential costs from wider spacing's include:

- lower yields with wider row spacing, particularly under higher yielding conditions, and
- increased competition from weeds.

There are a number of studies currently examining the responses of cereal and broadleaf crops to row spacing, and also the interaction with plant population. In targeting a desired population, the likely establishment percentage has to be selected. In practice establishment rates rarely exceed 90% and can fall as low as 30% depending on sowing conditions and seed quality. Germination tests do not necessarily give a good indication that germinated seed will be able to establish a viable plant.

Site details

Location:	Kelvin, Gunnedah
Co-operator:	Keith Perrett
Sowing date:	18th May 2010
Harvest date:	26th November 2010

Treatments

- One durum wheat and 3 bread wheat varieties
- Three row spacing's – 30 cm, 40 cm and 50 cm
- Three target populations – 60, 120 and 180 plants/m^2

Results 2010

- The yield loss when moving from 30–40 cm was 6% while from 30 to 50 cm it was 19%. This equates to a 30 kg/cm/ha reduction when row spacing goes from 30 to 40 cm and 60 kg grain/cm/ha when row spacing widens to 50 cm (Figure 1).
- Yield was greatest at the 120 and 180 plants/m^2 across all varieties and row spacing's (Figure 2).

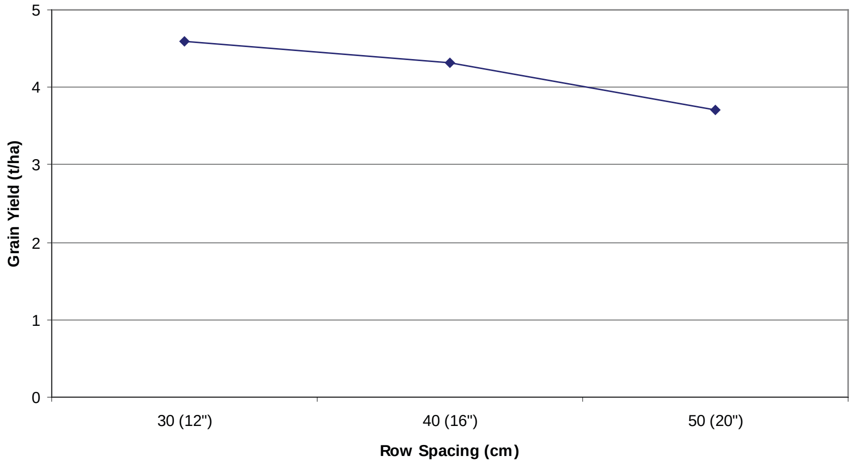

Figure 1. Grain yield and row spacing at Gunnedah (average of all varieties).

- Of the varieties Caparoi(b) durum was the highest yielding while there was no significant difference between any of the other varieties (data not shown).

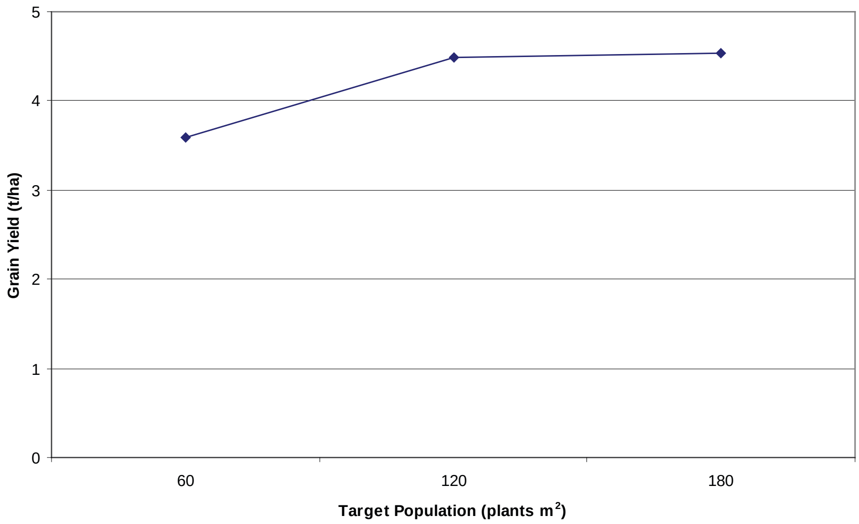

Figure 2. Effect of plant population at Kelvin 2010 (average of all varieties).

Summary

Wider row spacing's have provided yield and quality stability in areas that experience high temperature and limited moisture after flowering. However, there are significant yield penalties at wider row spacing's under higher yielding conditions. There is no evidence from this site that any of the varieties trialled are more suited to wider row spacing's or that plant population responses vary according to variety. Variety choice should consider a range of factors including maturity, disease reactions, grain quality and yield performance across a number of seasons.

Acknowledgements

This project is funded by NSW DPI and GRDC (DAN00129). Thanks to Amy Alston, Dougal Pottie and Peter Formann for technical assistance.

Effect of plant density on grain yield of chickpea varieties at a fixed row space (0.6 m)

Andrew Verrell[1] and Rohan Brill[2]

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[2] NSW DPI, Coonamble

Introduction

The wet harvest conditions in 2010 led to substantial and wide spread damage to harvested chickpea seed. Germination and tests of plant establishment percentages were low across a range of varieties. This meant that in order to attain target field populations in 2011, sowing rates would have to increase substantially.

Our current target populations (20–45 plants/m^2) and row spacing limits, where yield loss is negligible (<75 cm), were derived from research by Brinsmead *et al.* (1996) and Felton *et al.* (1996), respectively. This work used Amethyst (erect) as its principal chickpea cultivar which has long been superseded.

As the 2011 crop season approached, questions were being asked about how cultivars would perform across a range of plant densities. The aim of this trial was to examine the yield performance of PBA HatTrick⍉ and PBA Boundary⍉, across a range of densities, compared to an unreleased desi line (CICA912) from the National Chickpea Breeding Program.

Site details

Location: Coonamble

Soil type: Grey vertosol

Treatments

Treatment	Description
Varieties	PBA HatTrick⍉, PBA Boundary⍉, CICA 912
Densities	5, 10, 15, 20, 30, 45 plants/m^2
Row Space	Fixed at 64 cm
Fertiliser	Granulock 12 Zn, sown at 60 kg/ha
Inoculum	Furrow injected at sowing

Sown with Janke coulter-tyne-presswheel parallelograms on the 8th of June 2011.

Results

- Target densities were achieved with the 30 and 45 plants/m^2 populations just starting to trend below the 1:1 line (Figure 1).
- At harvest, varieties were observed to be 'leaning' at different plant densities. This was scored on a 1–9 scale (1 = erect, 9 = flat on ground). There was a very strong interaction between variety and plant density with CICA 912 tending to stand up better as densities increased compared to the other two varieties (Figure 2).
- In terms of grain yield there was NO interaction between variety and plant density.
- In regards to grain yield, averaged across plant densities, PBA Boundary⍉ (3.47 t/ha) and CICA 912 (3.38 t/ha), out yielded PBA HatTrick⍉ (3.24 t/ha).
- Under these seasonal conditions and row spacing, there was no difference in yield for plant densities ranging from 15 to 45 plants/m^2, across varieties (Figure 3). However, the 5 and 10 plants/m^2 densities yielded much lower which was partly due to excessive branch breakage.

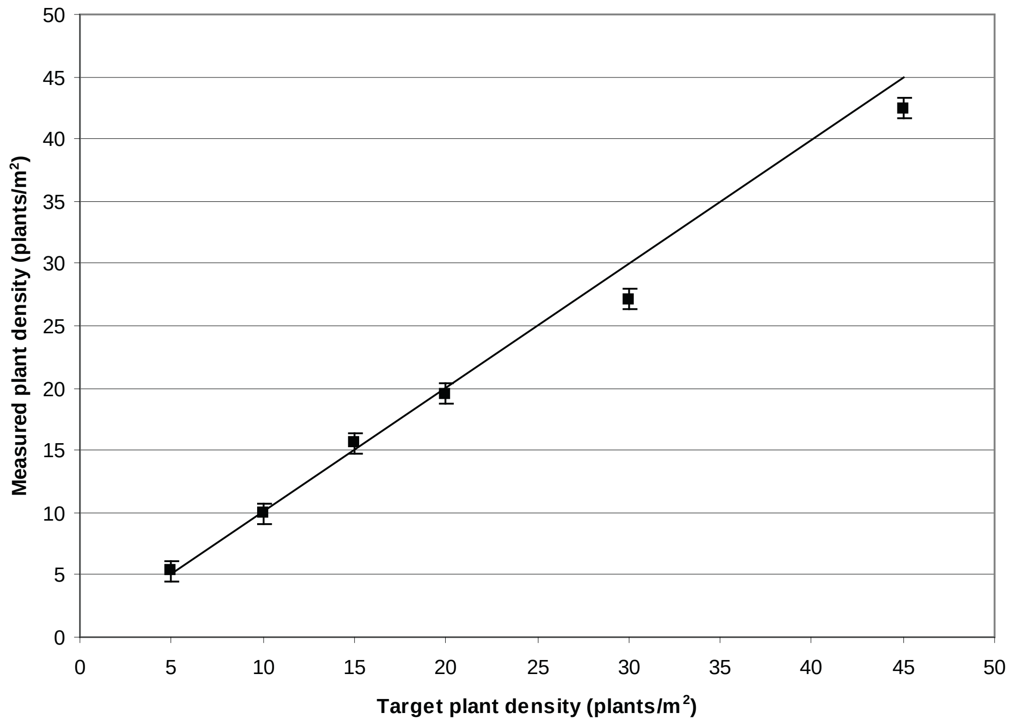

Figure 1. The relationship between target and measured plant densities (plants/m²).

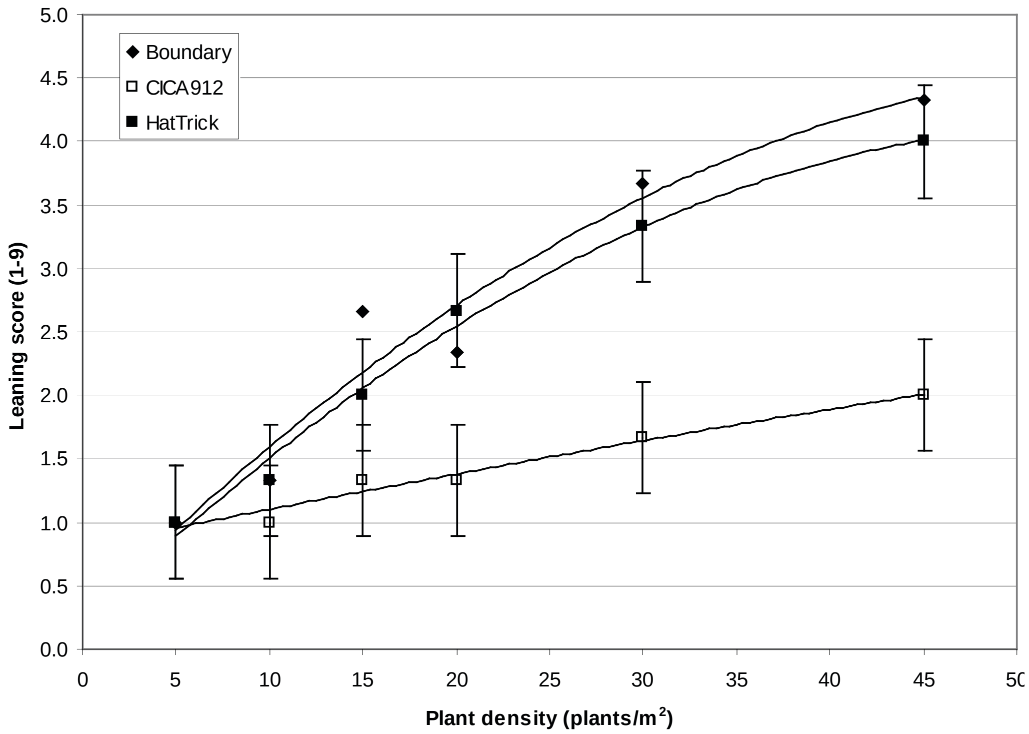

Figure 2. The interaction between varieties and plant densities on the degree of crop leaning.

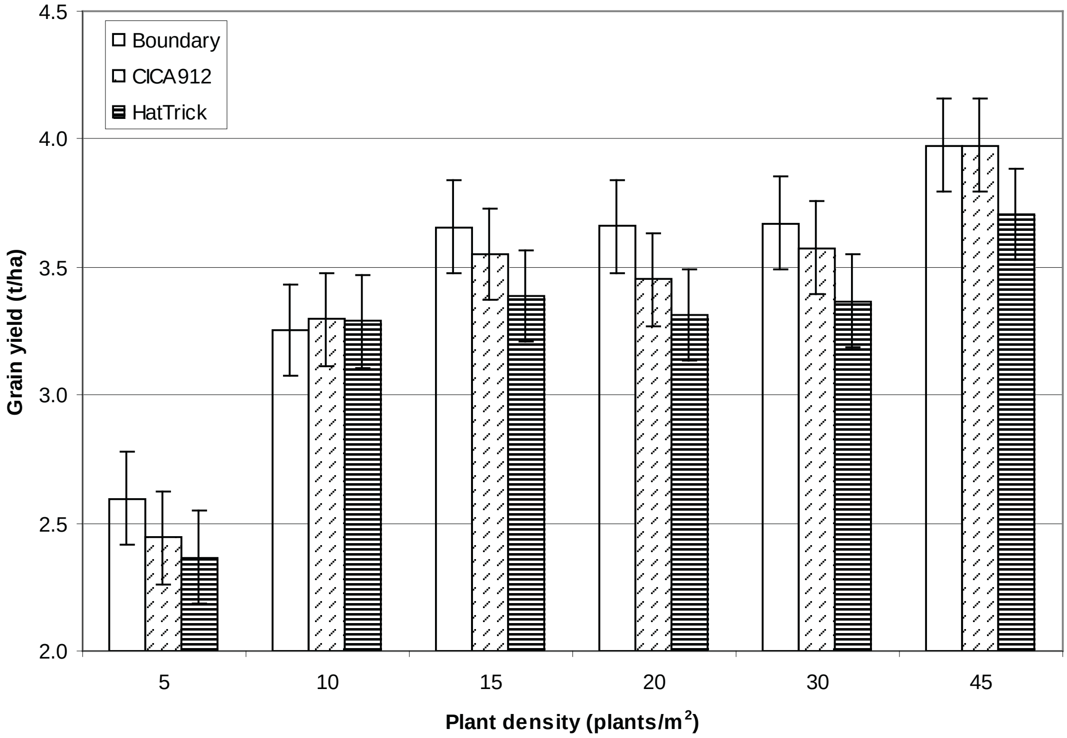

Figure 3. The effect of variety and plant density on grain yield.

Summary

The two new lines, CICA 0912 and PBA Boundary[Ⓟ], performed better than PBA HatTrick[Ⓟ] across a range of plant densities. The targeted populations for all three lines were achieved with a slight trend below the target line for very high populations (45 plants/m^2).

Importantly at this row spacing (64 cm) which is not uncommon in northern and central NSW for pulse crops, grain yields were not adversely affected by targeting plant densities as low as 15 plants/m^2. In fact yield was relatively stable across densities from 15–45 plants/m^2. Densities below 15 plants/m^2 will result in substantially lower yields.

Further work is planned to look at the variety x row space x plant density interactions for a range of new varieties emanating from the National Chickpea Breeding Program.

Acknowledgements

This project was funded by NSW DPI and GRDC under the Northern NSW Pulse Agronomy Project. Thanks to Jayne Jenkins for technical assistance.

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Effect of row spacing and row placement on grain yield in a sorghum/wheat sequence under high rainfall

Andrew Verrell
NSW DPI, Tamworth

Introduction

Sorghum is an important summer crop component of the northern farming system. Traditionally it is grown on a long fallow following wheat then long fallowed out to a durum or bread wheat crop. It can provide a good break to cereal disease and allow problem weeds to be controlled. Row spacing in sorghum varies enormously and increases as potential yield declines. High yielding sites (> 4 t/ha) can have row spacing from as low as 40–60 cm while low yielding sites (< 3 t/ha) are generally planted with row configurations > 1 m with skip or double-skip rows as options.

Inter-row sowing has been shown to reduce the impact of crown rot and increase yield in a wheat/wheat sequence (Verrell *et al.* 2005). There was a need to examine whether the effect of row spacing and placement of sorghum and wheat crops would result in differences in grain yield in a four year crop sequence.

Site details

Location:	TAI
Soil type:	Brown vertosol
Av. Summer Rainfall:	400 mm
Av. Winter Rainfall:	280 mm
Plant Available Water:	120 mm to 1.2 m depth

Treatments

Year	Treatments (8 replicates)
2008	Durum wheat sown across site, 40 cm rows, inoculated with crown rot at low level
2009	Fallow – zero-tillage, stubble standing
2009–2010	Sorghum – row spacing: 40 cm, 80 cm, 40 cm double skip-row (1.2 m between paired rows) – row placement: sown on or between wheat rows
2010	Fallow – zero-tillage, stubble standing
2011	Wheat – row spacing 40 cm – row placement: sown on or between 2008 wheat rows

Sown with Janke coulter-tyne-presswheel parallelograms

Sorghum and wheat sown with 100 kg N/ha and 10 kg P/ha.

Results 2009–2010 sorghum crop

- There was NO interaction between row spacing and row placement.
- Narrow rows (40 cm) had significantly (P<0.05) higher yields (5.5 t/ha) than either 80 cm (4.71 t/ha) or 40 cm double skip row (4.76 t/ha) configurations.
- Yields were marginally higher when sorghum was sown directly over the 2008 wheat rows (5.10 t/ha) compared to inter-row sowing (4.87 t/ha) (P<0.05).

Results 2011 wheat crop

- There were twelve (12) treatment combinations tested in 2011 consisting of sorghum row spacing (3) x sorghum row placement (2) x wheat row placement (2).
- There was NO significant 3rd order interaction (sorghum row space x sorghum row placement x wheat row placement).

- Sorghum row spacing exerted the biggest influence on wheat yield with the solid plant (40 cm row) sorghum having the lowest wheat yield compared to 80 cm and double skip row configurations (Figure 1).
- Sowing wheat into the inter-row space, relative to the 2008 crop, resulted in marginally higher wheat yields (4.61 t/ha) compared to sowing on the old row (4.49 t/ha) ($P<0.05$).
- Importantly there was a significant interaction between sorghum row placement and wheat row placement. Sowing sorghum then wheat into the same rows year after year resulted in the lowest wheat yield in 2011 compared to other row placement combinations (Figure 2).

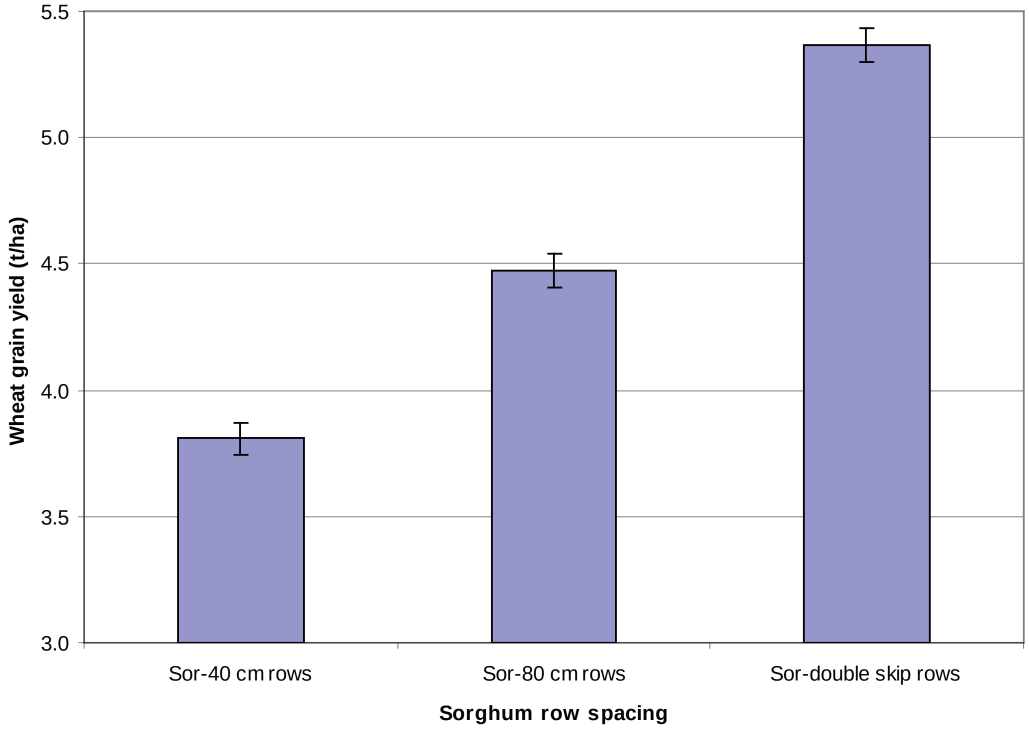

Figure 1. The effect of sorghum row spacing on grain yield of the following wheat crop.

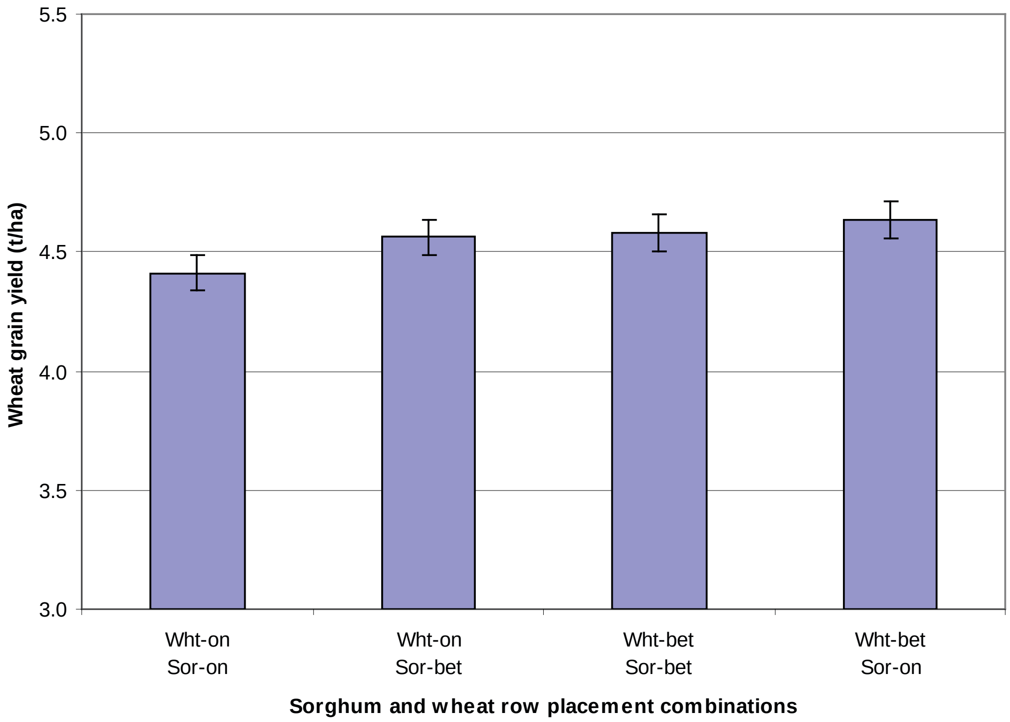

Figure 2. The interaction between sorghum row placement and row placement of the following wheat crop on wheat grain yield.

Summary

In this environment (high yield potential) solid plant sorghum (40 cm) resulted in the highest yield (5.5 t/ha) compared to wider row configurations (av. 4.7 t/ha) in what could be regarded as an above average summer rainfall season in 2009/10. However, the following wheat crop, sown twelve months later after a fallow, showed a reversal in wheat yield trends relative to sorghum row spacing. The highest wheat yield was attained on the double-skip row configuration (5.4 t/ha) with the solid plant sorghum system having a much lower yield (3.8 t/ha). Fallow recharge was adequate with a full profile available at sowing across all sorghum systems. It is speculated that the difference in wheat yield is due to more soil N being available at sowing in the wider row sorghum configurations than in the solid plant.

Row placement resulted in yield differences although much lower than the effect of row spacing. Sorghum performed better by being sown over the previous wheat rows rather than inter-row sown which may be partly due to its higher dependency on VAM and possible residual P. Sowing the 2011 wheat crop into the inter-row space relative to the 2008 crop (sown three years earlier), still resulted in a minor benefit in yield compared to on-row sowing.

The worst wheat yield outcome was attributed to a row placement system that kept sowing over the same row, year after year (4.41 t/ha). The best row placement combination was sowing sorghum over the 2008 wheat rows then sowing the 2011 wheat crop into the inter-row space (4.64 t/ha), meaning this crop was sown into an inter-row space that had not been cropped to wheat for at least three years.

Under high potential sorghum yields, the choice of sorghum row configurations and row placement strategies for both sorghum and the following wheat crop, need to be considered. The decisions made in preceding crops in a sequence can have profound effects on the following crop; the 'knock-on' effect.

Acknowledgements

This project was funded by NSW DPI and GRDC under the project 'Integrated disease management in northern no-tillage systems using precision agriculture' (DAN00116). Thanks to Michael Nowland and Paul Nash for technical assistance.

References

Verrell, A.G., Simpfendorfer S., Nash P. and Moore K. (2005). Inter row planting and stubble management affect crown rot, common root rot and grain yield in durum wheat. Research Update for Growers – Northern Region – Presented at Dubbo, NSW and Goondiwindi, QLD.

Nitrogen volatilisation losses – how much N is lost when applied in different formulations at different times?

***Graeme Schwenke*[1], *Adam Perfrement*[1], *Bill Manning*[2] and *Guy McMullen*[1]**

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Introduction

It is well known that nitrogen fertilisers are 'safer' when incorporated than when surface spread, but pre-season broadcasting and in-season topdressing of wheat crops are practiced by many farmers in the region. Splitting nitrogen application between sowing and in-crop allows growers to lower their financial risk on fertiliser application by letting seasonal conditions drive decisions on how much to spend on nitrogen. Most people try to apply their fertiliser ahead of predicted rain, but what happens if it doesn't rain as predicted? Often, people assume the worst, but is the nitrogen really all lost into the air in a day or two? Worldwide, the research literature lists the range of measured losses from 0 to almost 100%, but there are very few instances of losses greater than about 40% of that applied, with most studies concluding only around 10% loss. This extreme range of possible losses is due to the many factors involved in the process of volatilisation.

In the 2008 and 2009 GRDC advisor updates, we detailed the factors that drive the process of nitrogen volatilisation from fertiliser, along with the results of some laboratory incubation experiments (Schwenke et al. 2008, 2009). Here is a brief summary of the many factors involved;

- Soil pH – more loss at higher pH. Dissolving urea granules creates a high pH zone.
- Temperature – the hotter it is, the greater the potential there is for ammonia loss.
- Soil moisture – wet soil dissolves fertiliser but doesn't move nitrogen (N) into the soil.
- Calcium carbonate – lime in the soil reacts directly with ammonium sulphate increasing loss.
- Soil clay content – clay in soils adsorbs ammonium nitrogen reducing potential for loss.
- Soil buffer capacity – clays in soil absorb changes in soil pH.
- Biological activity – ammonium is converted to nitrate which is safe from volatilisation
- Wind – windy conditions lead to greater loss.
- Rain – rain moves dissolved fertiliser into contact with soil clays, away from wind.
- Depth of fertiliser – ammonia must be at the surface to volatilise. Incorporation reduces loss.
- Crop canopy – some ammonia in air can be re-absorbed by a growing crop canopy.
- Residues/litter – residues can strand fertiliser from soil. Urease enzyme present in residues.
- Fertiliser type – only the ammonium form is lost. Urea converts to ammonium. Nitrate forms are not volatilised.

Our preliminary laboratory work highlighted the importance of some of these soil properties in setting the potential for nitrogen losses. However, actual nitrogen losses in the field are a function not just of risk factors but also process drivers, particularly soil moisture, wind speed, rainfall and temperature. While air movement and temperature effects can also be tested in the lab, field measurements are needed to see the actual amount of N that is lost through volatilisation in our region. Here we report on the first 6-months of measurements made in a two year GRDC and NSW DPI funded project. In 2011 we measured nitrogen volatilisation losses in 3 scenarios; (1) top-dressing wheat, (2) spring fallow broadcasting, and (3) autumn and spring fertiliser application to a grass pasture.

Methodology

Nitrogen fertiliser was applied at locally relevant rates to 50-metre-diameter circular plots using either hand spreading (solid fertilisers) or a quad bike sprayer fitted with streaming-bar nozzles at 10 cm spacing (liquid fertilisers). Each fertiliser type was replicated three times at each paddock (except paddock 7). All plots in a paddock were separated by at least 100 metres to avoid cross contamination. Each paddock also had a background plot 200 metres from the nearest treatment plot, to measure any ammonia already in the air. Three metre tall masts were erected at the centre of each circular plot and fitted with ammonia capture tubes at five heights on the mast. The mast had a wind vane on top and rotated on bearings so that the capture tubes always faced into the wind. This way there was always 25 metres of fertilised plot ahead of the mast no matter which way the wind came from. We changed capture tubes every 3–4 days over a period of a month, measured the ammonia captured inside each, and tallied up the total amount of N lost as ammonia in the atmosphere.

Results

Scenario 1: Topdressing wheat at mid-late tillering

Four fertilisers were trialled on two soil types near Edgeroi in July (Paddocks 1 and 2), and 4 fertilisers on two paddocks near Mullaley in August (Paddocks 3 and 4) 2011. Figures 1 and 2 show that there were only minor volatilisation losses of N from all fertilisers trialled, despite very little rain in the weeks following fertiliser application. Even in paddocks 3 and 4, most rain occurred in the last week of measurement. Volatilisation was likely limited by cool air temperatures, adsorption of ammonium onto soil clays, plant uptake (after rain), and crop canopy protection against wind at the surface. Although the losses were only small, there were differences between some of the products trialled. The liquid urea (normally used at a later growth stage, not on soil) tended to lose a little more than solid urea as it was applied in a dissolved form, whereas the urea particles had to wait for some rainfall to dissolve. However, being applied in liquid form also meant it had immediate contact with the soil particles to aid adsorption of the ammonium once converted from the urea form. The urea ammonium nitrate and ammonium nitrate liquids showed slightly smaller losses, because a portion of these products is already in the nitrate form which does not volatilise. When the products were considered on an ammonium basis the losses per unit ammonium were similar between products. At paddocks 3 and 4, the use of a nitrification inhibitor with urea (Green Urea™) further reduced volatilisation compared to the standard urea.

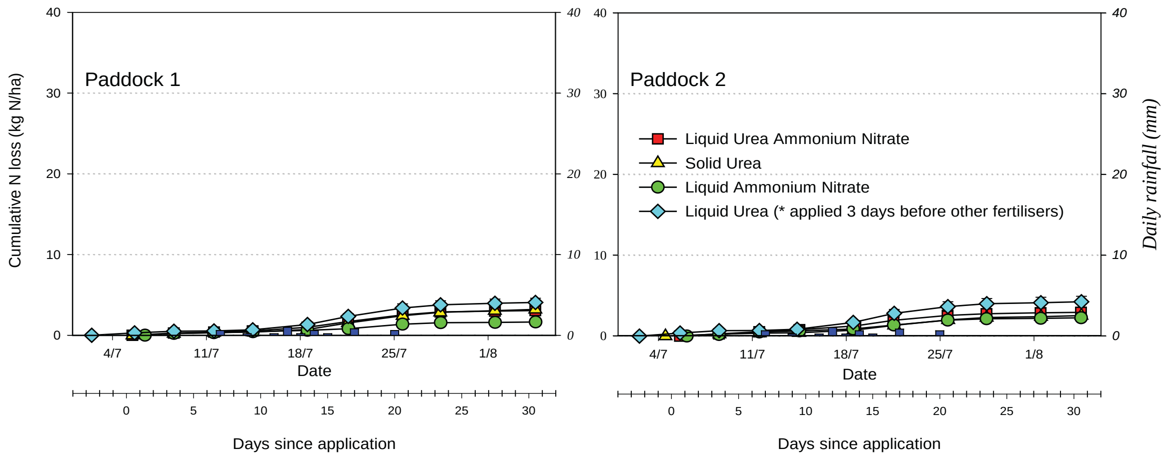

Figure 1. Cumulative nitrogen loss as ammonia after a 60 kg N/ha topdress application into two paddocks near Edgeroi during July 2011. Each point is a mean of 3 replicate plots. Daily rainfall is shown as bars from top of graph.

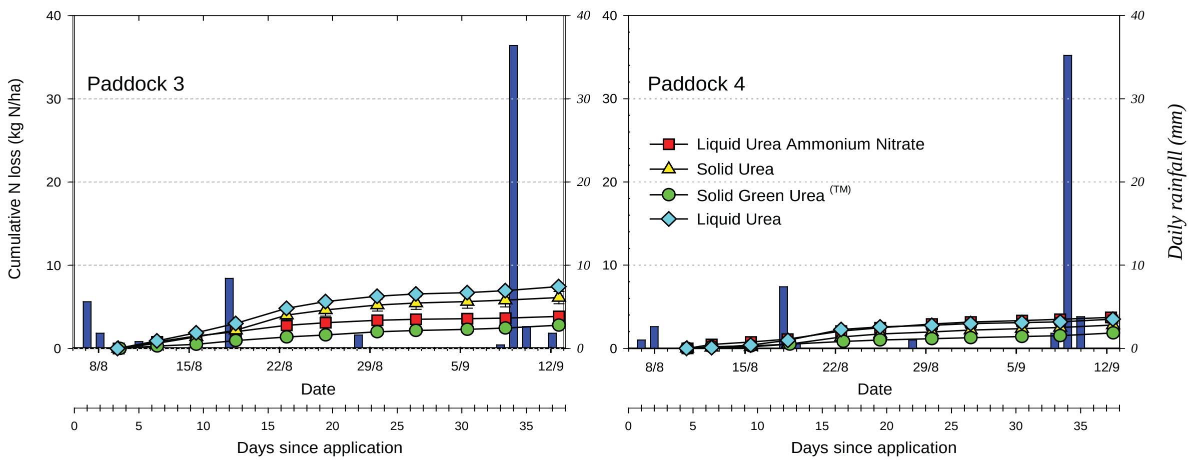

Figure 2. Cumulative nitrogen loss as ammonia after an 80 kg N/ha topdress application into two paddocks near Mullaley during August–September 2011. Each point is a mean of 3 replicate plots. Daily rainfall is shown as bars from top of graph.

Scenario 2: Fertiliser broadcast onto fallowed soil prior to summer cropping

N volatilisation during the spring fallow can be higher as temperatures are warmer, rainfall events are more frequent (though sometimes small) and there is no crop to slow wind blowing across the soil surface. An added factor in paddock 5 was the observed/measured presence of carbonate nodules (8.2%) in the soil surface that can react directly with ammonium sulphate to stimulate greater N losses than would otherwise be the case. In these trials only urea and ammonium sulphate (crystalline by-product) fertilisers were applied as liquids are not used for pre-season nitrogen application. Volatilisation loss from ammonium sulphate was high (>30% of applied nitrogen) at paddock 5, due to the presence of the carbonates. After application of the fertilisers this site had enough rain to just dissolve the products which was followed by a dry period. Urea losses were also higher at this paddock. At paddock 6 the initial rain after spreading was higher and may have helped to get the dissolved nitrogen into better contact with the soil clays.

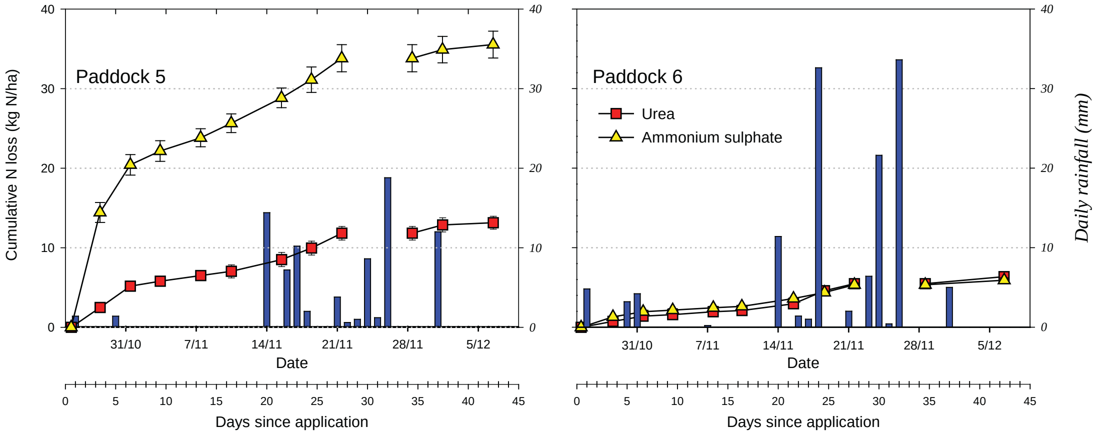

Figure 3. Cumulative nitrogen loss as ammonia after 100 kg N/ha broadcast application at two fallow paddocks near Caroona during November–December 2011. Each point is a mean of 3 replicate plots. Daily rainfall is shown as bars from top of graph. The gap in data collection was due to storm damage.

Scenario 3: Fertiliser broadcast onto tropical grass pasture

We used a grass pasture near Tamworth to trial the method in autumn before the main trials began, and included a tropical grass pasture near Caroona in spring when measuring paddocks 5 and 6. Figure 4 shows that both pasture paddocks lost significant amounts of nitrogen from the urea application, but much less from the ammonium sulphate. In both instances we had little rain in the first two weeks following application, but urea granules soon disappeared from view. Without significant rainfall, the dissolved urea would have been caught in the leaf litter. Conversion of urea to ammonium needs an enzyme called urease, which is abundant on plant residue surfaces. The mulch layer also helps to keep conditions moist.

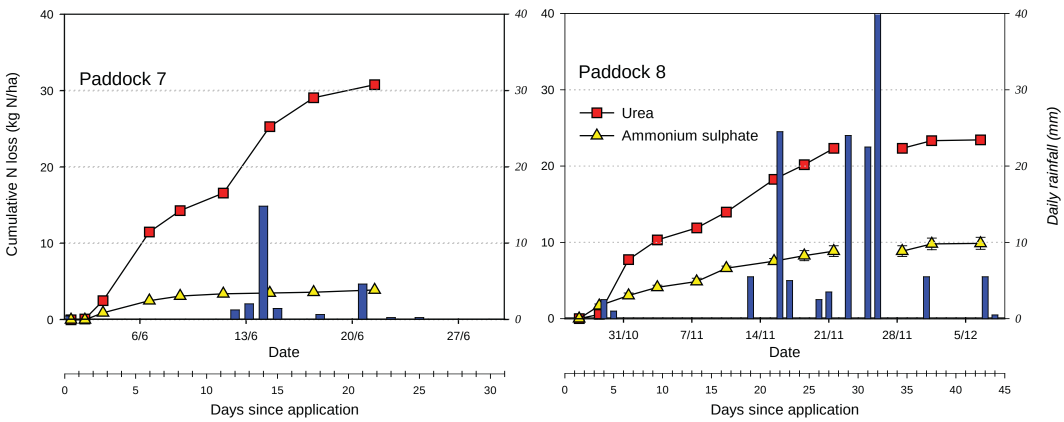

Figure 4. Cumulative nitrogen loss as ammonia after 100 kg N/ha broadcast application at two grass pasture paddocks near Tamworth (paddock 7), and Caroona (paddock 8). Measurements were done during June (paddock 7), and November–December 2011 (paddock 8). There was only one plot of each treatment in paddock 7, but each point in paddock 8 is a mean of 3 replicate plots. Daily rainfall is shown as bars from top of graph. The gap in paddock 8 data is due to storm damage.

These results will be added to over the next 12–18 months from further trials on other farm paddocks, giving a better overall picture of the amount of nitrogen losses likely in the region. So far, it appears that topdressing wheat paddocks during mid-tillering is relatively low risk in terms of volatilisation losses, so most of the applied nitrogen remains in place for crop uptake. Whether the topdressed nitrogen translates through to improved yield or protein will depend on the weather conditions for the remainder of the crop's growing season, as well as other influences such as weeds and diseases. Evaluating the impact of post-sowing nitrogen application was outside the scope of this project, but has been well researched in previous years. Research funded by GRDC and NSW DPI through the Northern Grower Alliance project (NGA0002) showed that delayed N reliably improved grain protein and maintained grain yield with applications up to early stem elongation, irrespective of the N fertiliser that was used.

Our first trials of summer fallow broadcast applications have shown that some losses are to be expected, but are mostly minor (<10%), unless the soil surface has naturally-occurring lime where losses can be much higher. However, in our search for suitable trial sites across the region it appears that naturally occurring lime in the surface soil is fairly rare. If in doubt you can ask for a calcium carbonate test when soil testing – once will generally be sufficient as it is unlikely to change with seasons. However, cultivation can bring up lime from lower in the soil profile.

In general our results so far seem to fit well with the research literature where an average of 10% of applied nitrogen is lost from urea added to arable systems and 20% from urea added to pastures.

Summary

- Fertiliser nitrogen can be lost from the soil surface as ammonia gas via the process of volatilisation. Just how much is lost depends on a range of factors, including; soil moisture, temperature, pH, naturally-occurring lime in the soil, ground cover, wind, soil clay %, and fertiliser type.
- Nitrogen volatilisation losses from four top-dressed mid-tillering wheat crops were minor; <10% loss over a whole month during winter 2011. Fertiliser was applied to dry soil, temperatures were low, and there was little rain after application. There were only small differences between fertiliser types.
- Two fallow paddocks broadcast with urea or ammonium sulphate in spring also had minor losses, except where ammonium sulphate was spread on a paddock with carbonates at the surface when losses were >30% of that added.
- Two grass pasture paddocks broadcast with urea or ammonium sulphate in autumn or spring both had severe losses from urea (23–31% loss), but only minor loss from the ammonium sulphate.
- Don't assume all applied fertiliser is lost if rain doesn't come after topdressing or broadcast spreading.
- Avoid using ammonium sulphate on paddocks with carbonates in the surface soil.
- Incorporation will prevent losses of any nitrogen fertiliser type.
- Ammonium sulphate is less risky for grass pastures than urea if rainfall doesn't come soon after application.

Acknowledgements

This is a GRDC-funded project under the E-concept process. Thanks go to agronomists with the Northern Growers Alliance who helped determine the treatments and rates to be used in the trials. We thank Jim Laycock (Incitec Pivot Ltd) and David McRae (Yara Nipro Pty Ltd) for their assistance with provision of fertilisers for trials. Special thanks also to Drew Penberthy and Jim Hunt for their assistance in locating suitable paddocks, along with Ian Gourley, Bart Brady, Anthony Martin, James Hockey, Angus Duddy and Derek Bloomfield for allowing us the use their paddocks for these trials.

References (can be found by a search of the GRDC website)

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PBA Chickpea program – chickpea evaluation in 2011

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Pulse Breeding Australia

Introduction

The PBA Chickpea program is a national program which delivers superior chickpea varieties faster. The program breeds both desi and kabuli types and is lead by NSW DPI with all core breeding activities occurring at the Tamworth Agricultural Institute. The medium and low rainfall sub-tropical region of northern NSW and southern QLD is a major target area for the program.

The major desi breeding objectives for this region are:

- increased ascochyta blight (AB) and phytophthora root rot (PRR) resistance
- improved adaptation through phenology, particularly chilling tolerance at podset
- increased root lesion nematode resistance
- increased salt tolerance
- The major kabuli breeding objectives for this region are:
- increased ascochyta blight (AB) resistance with a 9 mm seed size
- increased phytophthora root rot (PRR) resistance
- improved adaptation through phenology

The breeding program conducts evaluation across this region in close collaboration with project partners from DEEDI. Within NSW DPI, the program conducts screening for AB, PRR, virus and seed quality. The program also has key collaborators at SARDI (herbicide screening) and VIC DPI (salt, AB and Botrytis Grey Mould screening). A strong interaction also exists with pulse germplasm enhancement projects conducted at Curtin University, SARDI and VIC DPI.

Site details 2011

Location:	North Star (desi)	Moree (desi)	**Location:**	Edgeroi (desi)	Currabubula (desi and kabuli)
Cooperator:	Doolin Family	Stanger Family	**Cooperator:**	Gourley Family	Tudgey Family

Trials at North Star, Moree and Edgeroi were sown into cereal stubble, whilst the Currabubula site was sown into sorghum stubble.

Treatments

Site	Entries
North Star – sown 07/06/11	30 entries; released varieties and advanced PBA breeding lines
Moree – sown 08/06/11	30 entries; released varieties and advanced PBA breeding lines
Edgeroi – sown 04/07/11	30 entries; released varieties and advanced PBA breeding lines
Currabubula – sown 27/06/11	30 entries; released varieties and advanced PBA breeding lines
Currabubula – sown 28/06/11 Stage 3 kabuli	60 kabuli entries; released varieties and advanced PBA breeding lines

The following trials conducted by NVT are also being reported; Bellata (sown 03/06/11), Bullarah (sown 07/06/11), Coonamble (sown 08/06/11), Trangie (07/06/11) Tulloona (07/06/11) and Walgett (09/06/11).

Desi Results

Table 1. Yield (t/ha) of selected entries in Stage 3 and NVT desi trials across northern eastern NSW in 2011 (% PBA HatTrick(b)).

Name	Bellata	Currabubula	Moree	North Star	Long Term (2005–2011)[A]
PBA HatTrick(b)	3.26	1.84	1.52	2.59	1.80 (29)
Flipper(b)	88	–	–	–	94 (26)
Jimbour(b)	89	103	98	88	97 (29)
PBA Boundary(b)	111	103	99	98	103 (29)
PBA HatTrick(b)	100	100	100	100	100 (29)
CICA0709	110	99	111	95	102 (18)
CICA0912	94	100	111	107	104 (12)
CICA1001	89	111	111	94	104 (8)
CICA1007	105	114	99	95	107 (8)
CICA1103	103	107	93	88	104 (4)
LSD (P<0.05)	13	7	22	12	

[A] Number of trials in brackets

Table 2. Yield (t/ha) of selected entries in Stage 3 and NVT desi trials across northern western NSW in 2011 (% PBA HatTrick(b)).

Name	Bullarah	Coonamble	Edgeroi	Trangie	Tulloona	Walgett	Long Term[A] (2005–2011)
PBA HatTrick(b)	4.37	3.31	1.51	1.89	3.04	2.37	1.86 (38)
Flipper(b)	95	98		92	101	103	93 (37)
Jimbour(b)	101	98	91	96	96	100	95 (38)
PBA Boundary(b)	98	98	93	103	104	104	103 (38)
PBA HatTrick(b)	100	100	100	100	100	100	100 (38)
CICA0709	105	103	97	106	102	100	101 (25)
CICA0912	106	109	117	106	107	101	105 (15)
CICA1001	103	114	96	105	103	85	103 (9)
CICA1007	104	120	99	110	114	111	107 (9)
CICA1103	112	113	101	111	101	122	104 (6)
LSD (P<0.05)	11	6	14	8	11	14	

[A] Number of trials in brackets

- The recently released PBA Boundary(b) is the highest yielding desi variety across north eastern and north western NSW according to long term data. Whilst PBA Boundary(b) has higher AB resistance than PBA HatTrick(b), PBA Boundary(b) is susceptible to PRR, and therefore not suitable for all areas.
- The advanced breeding line CICA0912 performed very well under high disease pressure in the 2010 season. In 2011, CICA 0912 showed consistently higher yields than PBA HatTrick(b) across the north western trials and two out of the four north eastern sites. Long term yield data shows CICA0912 has a greater yield advantage over PBA Boundary(b) in both regions. CICA0912 has good resistance to both AB and PRR and a semi erect plant type which appears to maintain good harvestability during wet conditions at plant maturity. CICA1001, CICA1007 and CICA1103 were other advanced breeding lines which performed very well across both regions, but have not been tested as extensively.

Kabuli Results

Table 1. Yield of selected entries in Stage 3 and NVT kabuli trials across northern NSW in 2011 (% Genesis™ 090).

Name	Seed Size	North East (t/ha)		North West (t/ha)			
		Currabubula	Long Term [A] (2005–2011)	Coonamble	Tulloona	Walgett	Long Term [A] (2005–2011)
Genesis™ 090 t/ha	Sml	1.86	1.95 (10)	3.82	2.59	2.74	1.93 (17)
Almaz⊕	Med	97	88 (10)	92	98	80	84 (16)
Genesis™ 090	Sml	100	100 (10)	100	100	100	100 (17)
Genesis™ 114	Med	94	91 (10)	96	96	80	86 (16)
Genesis™ 425	Sml	98	95 (10)	90	93	78	90 (17)
Kalkee	Lge	93	89 (1)	101	100	93	86 (6)
CICA0857	Med	95	95 (1)	93	87	79	90 (7)
LSD (P<0.05)		9		7	3	11	

[A] Number of trials in brackets

- The small seeded (7–8 mm) Genesis™ 090 is the highest yielding kabuli variety in northern NSW. Of the medium to large seeded (8–9 mm) varieties, the newly released Kalkee performed very well in the north western region, possibly favoured by late Spring rainfall. Kalkee offers the largest seed size of all commercial varieties. Although Kalkee has excellent lodging resistance and harvestability, like all kabuli varieties it is susceptible to PRR.
- The advanced breeding line CICA0857 is earlier flowering and maturing than current kabuli varieties tested in the north. Although this phenology was not favoured by the late Spring rainfall in 2011, it can offer improved yields and seed size in shorter seasons where earliness is an advantage.

Summary

With an increasing range in chickpea varieties and types becoming available, growers and advisors should base variety selection on disease resistance, yield and marketing opportunities knowing that disease management is critical to success.

Acknowledgements

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Phosphorus fertiliser – Does product choice matter?

***Bill Manning*[1]*, Jim Hunt*[2] *and Guy McMullen*[3]**

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Introduction

Adequate phosphorus (P) is not only an essential component of profitable and sustainable crop production but is also an increasing component of crop gross margins. In recent years there have been considerable price movements for phosphatic fertilisers leading to interest in ways to improve P fertiliser use efficiency.

There has been a considerable increase in the use of liquid fertilisers especially for the supply of nitrogen for crop production. There are also several products available from a range of suppliers for use as starter fertiliser to provide P and micronutrients. Research in South Australia on highly calcareous soils (20–90%) has shown that there can be benefits in using liquid fertilisers over the traditional granular forms (Holloway *et al.* 2001). Soils in northern NSW have $CaCO_3$ concentrations much less then those found in the calcareous soils of SA.

McBeath *et al.* (2007) reported on dry matter responses to liquid and granular P fertilisers from soils collected from around Australia. Six soils from the northern grains region were studied with $CaCO_3$ levels ranging from undetectable to 1.3%. Five of these soils had positive dry matter responses to liquids greater then when granular products were used. One of the key conclusions was that grain yield responses to liquid P needed to be assessed under field conditions.

The aim of these trials was to see if there is any benefit in using liquid instead of solid P and to see if the volume of water used to apply liquid P has an influence on yield by increasing the volume of soil in which the P is distributed at higher water rates. Because most P is applied as starter fertiliser containing zinc, plus and minus zinc treatments were also included to test the affect of zinc.

Site details

Location: Kelvin

Co-operator: Keith Perrett

Sowing: EGA Gregory⁽ᵈ⁾ sown on 25th May 2010

Soil P Tests:

Soil Depth	Colwell P (mg/kg)	BSES P (mg/kg)
0–10 cm	19.6	28.3
10–30 cm	8.7	15.1

Treatments

Table 1. Fertiliser treatments Kelvin 2010.

Fertiliser	P rate (P)	Water (W)	Zinc (Zn)
Nil	0	0	Zn–
Nil	0	0	Zn+
Nil	0	125	Zn–
Nil	0	500	Zn–
Granular MAP	10	0	Zn–
Granular MAP	10	0	Zn+
Liquid Techgrade MAP	10	125	Zn+
Liquid Techgrade MAP	10	125	Zn–
Liquid Techgrade MAP	10	500	Zn–
Granular MAP	40	0	Zn–
Liquid Techgrade MAP	40	500	Zn–
Liquid Techgrade MAP	40	500	Zn+

Liquid P Comparison Trial – Plant Components

Table 2. Dry matter production, tillers and heads.

Fertiliser	P rate (L/ha)	Water (L/ha)	Zinc	Tillers/m^2	DM-GS30 kg/ha		Heads/m^2		DM-GS99 kg/ha
Nil	0	0	Zn–	307	1365	c	303	def	11750
Nil	0	0	Zn+	298	1165	c	275	f	10720
Nil	0	125	Zn–	334	1331	c	326	bcdef	11730
Nil	0	500	Zn–	293	1174	c	292	ef	10670
Granular	10	0	Zn–	315	1589	bc	318	cdef	11150
Granular	10	0	Zn+	421	2108	ab	341	abcde	12580
Liquid	10	125	Zn+	432	2020	ab	354	abcde	12780
Liquid	10	125	Zn–	358	1557	bc	347	abcde	11580
Liquid	10	500	Zn–	365	1566	bc	360	abcd	12720
Granular	40	0	Zn–	452	2634	a	403	a	13460
Liquid	40	500	Zn–	386	2138	ab	381	abc	12200
Liquid	40	500	Zn+	409	2076	ab	383	ab	12750
		P value		<0.10	<0.001		0.005		nsd
		5% lsd			600		63.0		

nsd = No significant difference.

- Crop dry matter increased significantly with P fertiliser.
- There was no significant difference in DM between granular or liquid fertilisers.
- The addition of zinc did not result in significantly higher dry matter production.
- Increasing the volume of water in which liquid P was applied did not increase dry matter production.
- Tiller number at GS30 was higher with P application but there was no significant difference between products used or the use of Zn.
- At harvest there was no difference between treatments for crop dry matter although there was a trend for increased head numbers at the higher P rates.

Grain Yield

- Crop yield responses were not as clear as was expected considering the very low soil test results for both Collwell-P and acid extractable P in the 0–10 and 10–30 cm depths.
- From the four nil P treatments (See Figure 1) there was no effect of applied water rates or applied zinc i.e. zinc and water alone did not influence yield.
- At 10 kg P/ha there was no statistical difference between granular P and the nil P treatments.
- Increasing the volume of water in which liquid P was applied did not increase yield.
- At 40 kg P/ha both the granular and liquid MAP were statistically higher yielding then the controls but there was no difference between products. The response to 10 kg P/ha as liquid techgrade MAP (TMAP) was unclear. The only treatment statistically different to all the nil P treatments was TMAP applied in 125 L water/ha without Zn. Further investigation of the responses to 10 kg P is needed.

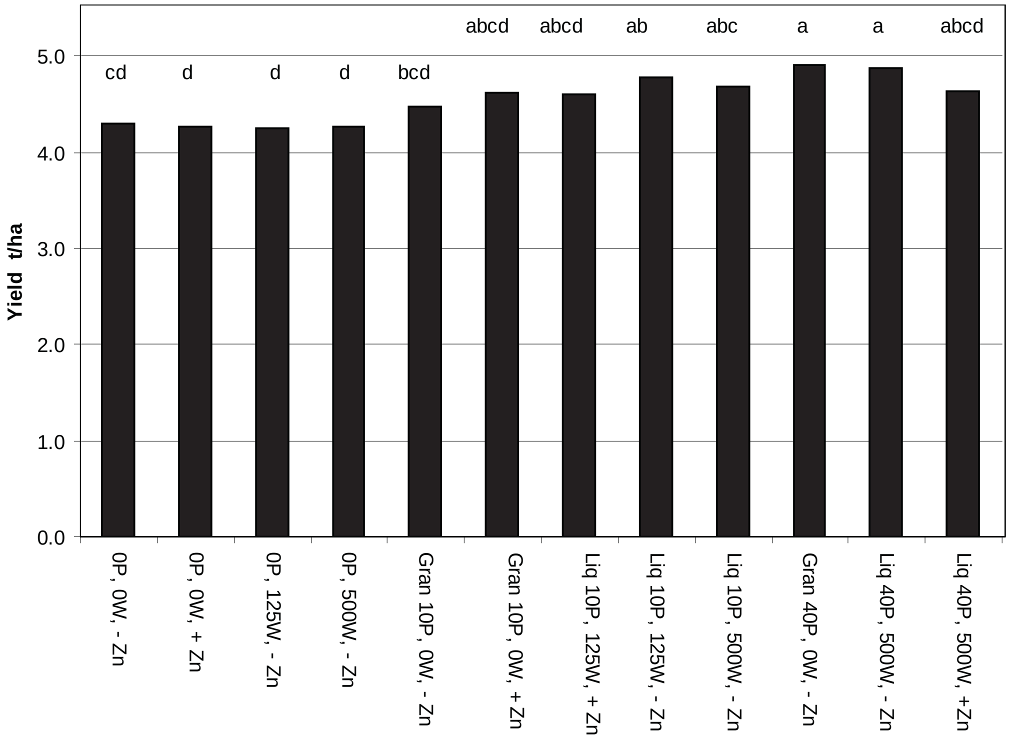

Figure 1. Grain yield at Kelvin 2010.

Grain Quality

There was no significant difference between any of the measured grain quality characters (protein, screenings, hectolitre weight and grain weight).

P Fertiliser product comparison trial

A second trial evaluated a range of commercial P fertilisers. All treatments were balanced for other nutrients so that only P varied.

Table 3. Product comparison trial at Kelvin 2010.

Fertiliser	Rate (kg P/ha)	Yield (t/ha)		Protein (%)	Screenings (%)	Grain Size (g/1000)	Hectolitre Weight (kg/hL)
Control	0	4.9	e	11.8	2.2	38.5	80.2
Solid MAP	10	5.2	d	11.4	2.3	38.4	79.5
Solid MAP + Zn	10	5.3	cd	11.6	2.0	39.2	79.5
Phos Acid	10	5.3	cd	11.4	2.3	38.7	79.8
Phos Acid + Zn	10	5.2	d	11.5	2.0	37.9	79.7
Supreme Z Extra	10	5.3	cd	11.5	2.3	37.7	79.5
Liq MAP	10	5.4	bcd	11.6	2.4	37.7	79.5
Liq MAP + Zn	10	5.3	bcd	11.4	2.5	38.4	79.5
HR Phos Acid	40	5.6	ab	11.6	2.0	37.7	79.0
HR MAP	40	5.7	a	11.8	2.0	37.9	79.6
HR Phos Acid + Zn	40	5.6	ab	11.3	2.2	36.7	79.8
HR MAP + Zn	40	5.5	abc	11.4	2.1	38.7	79.1
P value		<0.001		nsd	nsd	nsd	nsd
5% lsd		0.3					

Results showed that there was no difference between products or Zn treatments at equivalent P application rates. Grain quality was also unaffected by P application at this site.

Summary

Grain yield responses to fertiliser P were not as clear as was expected from this site. The wet seasonal conditions may have influenced the P response at this site due to increased root growth resulting in a greater capacity of the crop to utilize existing soil P reserves.

There was no difference between the type of fertiliser that was used with respect to plant growth or grain yield. When deciding whether or not to use liquid P fertilisers the additional cost of equipment to use liquid fertilisers would also need to be taken into account.

Acknowledgements

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Evaluation of dual purpose cereals – Somerton 2010

Loretta Serafin[1] and Dougal Pottie[2]

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Introduction

Grazing cereals is a common practice for mixed farming enterprises in certain parts of the northern grains region. Typically these crops are earlier sown, longer season varieties that provide greater dry matter production for grazing. The dual purpose cereals used in the region, including wheat, oats, barley and triticale, have the potential to provide supplementary grazing during winter when pasture growth is limited by low temperatures. The successful use of dual purpose cereals can be lucrative as it may increase livestock carrying capacity during the winter period while income is being generated from both forage and grain. Removing livestock in a timely manner is critical for limiting grain yield penalties associated grazing and removal must occur prior to stem elongation (Z31). However, dual purpose cereals do provide flexibility/risk management to the system as establishment costs can be covered by early grazing, which allows the crop to be managed for seasonal outlook, either weather or commodity prices. Grazing cereals during winter also provides indirect benefits by resting the pasture, which has the potential to create bulk of feed leading into late winter – early spring. Mixed farming systems are highly variable between farms and the challenge for growers is to find the balance for their between optimising dry matter (DM) removal to meet livestock requirements while preserving grain production. This paper evaluated a large number of dual purpose cereals at Somerton for dry matter production and grain recovery.

Site details

Co-operator:	Andrew and Belinda Davidson
Location:	"Clermont Park", Somerton
Sowing Date:	9th April, 2010
Sowing Rate:	Wheats: 80 kg/ha, Triticale and Barley: 90 kg/ha, Oats: 100 kg/ha.
Fertiliser at sowing:	85 kg/ha Granulock 15
Grazed:	1st Dry matter cut taken 24th June, 2010, followed by a grazing with sheep.
	2nd Dry matter cut taken 2nd August, 2010, followed by a grazing with sheep.
Harvest Date:	24–27th November, 2010

Treatments

The trial included 40 varieties, either commercially available or experimental lines, of dual purpose cereals from four crop types; oats, wheat, barley and triticale. All varieties were sown on the 9th April and grazed twice prior to Z31 (stem elongation). Therefore, grazing occurred either earlier or later in the tillering stages depending on the variety growth habit.

Dry matter assessments were completed using a multi-probe, which is then calibrated against hand cuts from each plot. Following each dry matter assessment, the trial site was grazed with a sufficient stocking density to ensure even grazing across all of the plots. Following the second grazing the site was kept for grain recovery.

Results

The trial established well and showed significant growth to the first grazing. The oat varieties tended to produce more dry matter quicker, namely Dawson[⦶], Graza 80⦶, MA7180W and Drover⦶. By the second grazing, six weeks after first grazing, there was more consistent dry matter production across crop types. The top performers for the second dry matter assessment were Eurabbie, Yiddah⦶ and Cooba in the oats, LongReach Beaufort, and two experimental lines LPB05-1693 and SUN554B in the wheat and AT573 which has since been released as El Alamein in the triticale.

Table 1. Dry matter production (t/ha) and grain yield (t/ha) and respective rankings from the Somerton grazing and grain trial in 2010

Variety	Crop Type	1st Dry Matter (t/ha)	% Mean	2nd Dry Matter (t/ha)	% Mean	Total Dry Matter (t/ha)	Dry Matter Rank	Grain Yield (t/ha)	% Site Mean	Grain Yield Rank
Dawson[PBR]	Oat	6.51	134	3.80	96	10.30	1	1.13	36.1	40
Graza80[PBR]	Oat	6.37	131	3.87	98	10.24	2	1.65	52.4	35
MA7180W	Oat	5.68	117	4.41	112	10.10	3	2.74	87.2	25
Eurabbie	Oat	5.45	112	4.57	116	10.02	4	2.38	75.8	29
LongReach Beaufort	Wheat	5.34	110	4.57	116	9.91	5	2.65	84.3	26
LPB05-1693	Wheat	5.25	108	4.66	118	9.90	6	3.18	101.2	21
Yiddah[PBR]	Oat	4.85	100	4.92	125	9.77	7	1.59	50.6	36
Cooba	Oat	4.95	102	4.77	121	9.72	8	1.21	38.5	39
Drover[PBR]	Oat	5.95	122	3.73	95	9.68	9	1.49	47.5	38
EGA Gregory[PBR]	Wheat	5.27	108	4.37	111	9.65	10	1.73	55.0	34
SUN554B	Wheat	5.12	105	4.44	113	9.57	11	2.28	72.5	32
Bimbil	Oat	5.05	104	4.38	111	9.43	12	1.52	48.5	37
AT573	Triticale	4.78	98	4.54	115	9.33	13	3.91	124.6	12
SUN521A	Wheat	5.10	105	4.13	105	9.23	14	3.31	105.4	19
Urambie[PBR]	Barley	5.01	103	4.18	106	9.20	15	4.05	128.9	10
MA8171W	Oat	4.83	99	4.35	110	9.18	16	2.37	75.5	30
Preston[PBR]	Wheat	5.11	105	4.05	103	9.16	17	2.63	83.9	27
SUN577D	Wheat	4.76	98	4.29	109	9.05	18	2.55	81.1	28
LPB06-0035	Wheat	4.94	101	4.10	104	9.03	19	1.92	61.4	33
MA6838W	Oat	4.72	97	4.23	107	8.94	20	3.51	111.7	16
9274	Wheat	5.42	112	3.39	86	8.81	21	3.75	119.7	13
SUN521C	Wheat	4.59	94	4.14	105	8.73	22	2.95	93.9	24
Endeavour[PBR]	Triticale	4.58	94	4.12	105	8.70	23	4.17	132.7	9
EGA Wedgetail[PBR]	Wheat	4.73	97	3.92	99	8.65	24	3.23	102.8	20
Yambla	Barley	4.98	103	3.63	92	8.62	25	2.99	95.2	23
Marombi[PBR]	Wheat	4.60	95	3.86	98	8.46	26	3.41	108.5	18
HRZ03.0086	Wheat	4.14	85	4.19	107	8.34	27	3.09	98.3	22
Naparoo[PBR]	Wheat	4.51	93	3.82	97	8.33	28	3.93	125.1	11
CS10.1010.3	Wheat	4.87	100	3.41	87	8.29	29	3.57	113.8	15
Tennant[PBR]	Wheat	4.43	91	3.58	91	8.01	30	4.85$_{a}$	154.7	2
Brennan[PBR]	Wheat	4.51	93	3.44	87	7.96	31	3.61	115.1	14
Frelon[PBR]	Wheat	4.73	97	3.16	80	7.89	32	4.69	149.5	4
EGA Eaglehawk	Wheat	4.04	83	3.82	97	7.86	33	2.32	74.0	31
Tobruk[PBR]	Triticale	4.28	88	3.30	84	7.59	34	5.41$_{a}$	172.2	1
Mackellar[PBR]	Wheat	4.18	86	3.40	86	7.58	35	4.40	140.2	6
Wrangler	Wheat	4.33	89	3.22	82	7.56	36	3.44	109.7	17
CFR732.24	Wheat	4.70	97	2.83	72	7.53	37	4.42	140.7	5
98613.86	Wheat	3.93	81	3.52	89	7.45	38	4.34	138.3	8
SQP Revenue[PBR]	Wheat	4.04	83	3.29	84	7.33	39	4.37	139.1	7
170	Wheat	3.81	78	3.04	77	6.85	40	4.84	154.2	3
Mean (t/ha)		4.86		3.94				3.14		
CV (%)		6.46		6.89				10.69		
LSD (P<0.05):		0.61		0.48				0.56		

Total dry matter production for the season was very high with the best varieties producing over 10t/ha of dry matter (Figure 1). In comparison the poorest performers produced just under 7 t/ha of DM.

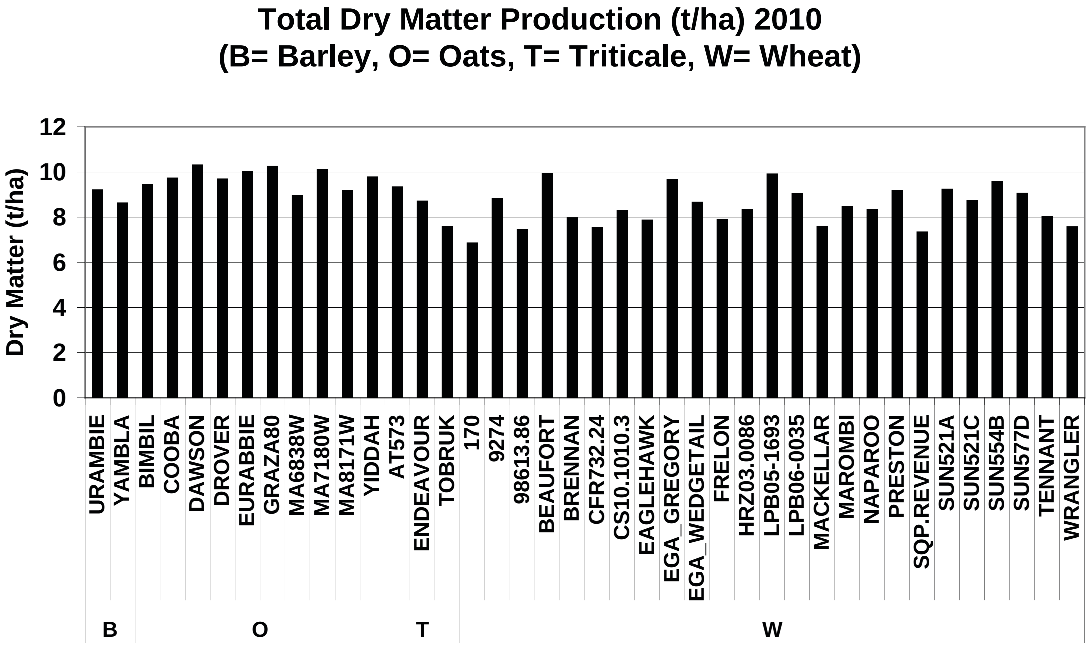

Figure 1. Total dry matter production (t/ha) from the Somerton grazing and grain trial in 2010.

Final grain yields (Figure 2) from the trial site also showed a large amount of variation between varieties. The highest yielding variety, Tobruk$^{\phi}$, a triticale produced 5.4 t/ha. This was in distinct contrast to Dawson$^{\phi}$ oats, which yielded 1.1 t/ha. The top performers for grain yield in 2010 was largely dominated by winter wheats.

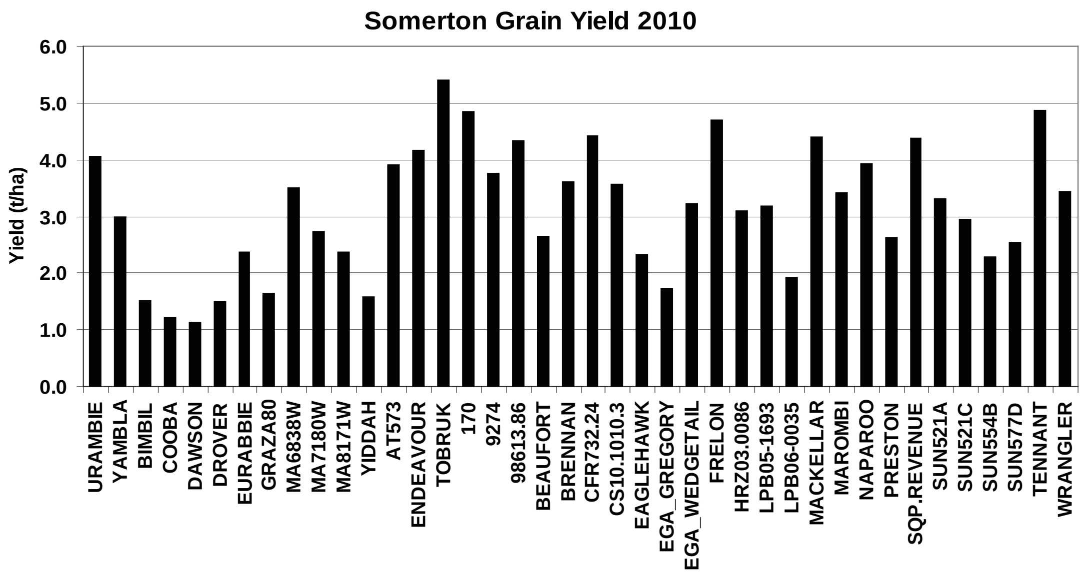

Figure 2. Grain yield (t/ha) from the Somerton grazing and grain trial in 2010.

Summary

In the 2010 season the overall highest dry matter production was achieved by the oat varieties, however, oats were the poorest performers for grain yield. Tobruk$^{\phi}$, a triticale and Tennant$^{\phi}$, wheat, were the highest yielding for grain. The best dual purpose performer; that is producing a combination of good dry matter production and grain yield, in 2010 was Urambie$^{\phi}$.

Insight into the best performing dual purpose cereals for this region would be gained from reviewing the results across a number of seasons.

Acknowledgements

This project is funded by NSW DPI. Thanks to Andrew and Belinda Davidson "Clermont Park" for provision of the trial site and assistance with its management. Thanks to Peter Formann for technical assistance.

Sorghum in the western zone – Row configuration x population x hybrid: Rowena 2010/11

Loretta Serafin, Guy McMullen, Ben Frazer and Steven Simpfendorfer
NSW DPI, Tamworth

Introduction

Sorghum is a reliable summer crop in eastern areas of northern NSW. However, there is a need to improve the reliability of sorghum yield in western cropping areas and to assess strategies that will allow growers to adapt to increasingly variable seasonal conditions. The introduction of hybrids with increasing levels of Staygreen (SG), or using a combination of tillering, plant population and row configuration may help improve the reliability of sorghum yield in this environment.

In the eastern zone there has been a reasonable amount of work evaluating population and row spacing. Modelling work has suggested that sorghum can be a reliable component of western cropping systems but this work needs applied research to verify the modelling and give growers confidence to incorporate sorghum into their rotations.

In northern NSW crown rot, a stubble-borne fungal pathogen continues to be the most prevalent and damaging disease affecting winter cereals. Sorghum is recommended as a break crop but the success is dictated by the extent of breakdown of the winter cereal stubble that hosts the crown rot fungus. Although altering row configuration and population may improve the reliability of sorghum yield it may also reduce the rate of decomposition of cereal stubble and hence the break crop benefit. Sorghum configuration and population may also impact on water accumulation during the fallow period which needs to be considered within the cropping system.

The trial outlined below aims to answer some of these questions and provide data for use in modelling the trial outcomes over long term climatic data sets. This was one of three trials planted across northern NSW in 2010/11, the other two sites being Gurley and Mungindi.

Site details

Co-operator:	Philip Harris
Property:	"Wondahree", Rowena
Sowing Date:	17th and 18th September, 2010
Planter:	Monosem double disc
Fertiliser:	41 kg/ha Supreme Z

Treatments

Hybrids

- MR43 (moderate SG and tillering)
- LT10 (low tillering and high SG)
- MR Bazley (PAC2437) (high tillering and low SG)

Row Configuration

- Solid on a 1 m spacing (Sol)
- Single skip (SS)
- Double Skip (DS)
- Superwide (1.5 m spacing)(DS)

Populations

Populations were targeted using germination for each hybrid and an estimated establishment of 80%. Three populations were targeted in each of the row configurations.

- 30,000 plants/ha
- 50,000 plants/ha
- 70,000 plants/ha

Starting crown rot levels

Crown rot levels were established by collecting standing wheat stubble prior to sowing. At this site crown rot levels were 49% colonisation of the crown (below ground) and 48% infection of the first node (above ground).

Starting soil water

The site was cored at sowing to establish starting soil water. Plant available water capacity (PAWC) was estimated to be 111 mm to 120 cm.

Establishment

Establishment counts were taken for each plot. This site had an excellent establishment for all hybrids. Target populations were achieved for 30 and 50,000 plants/ha. The 70,000 target population was not achieved with only around 63,000 plants/ha being established (Figure 1).

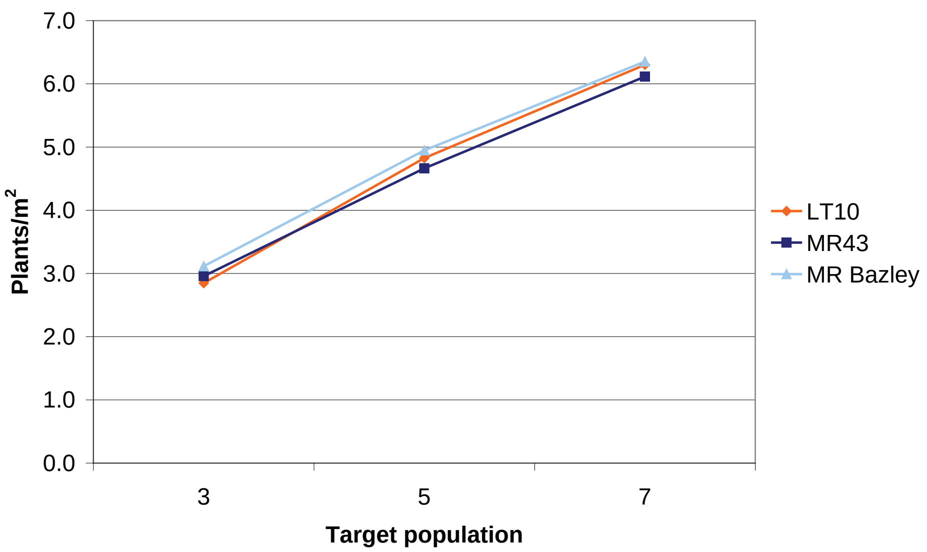

Figure 1. Plant establishment.

Effect of plant population on tiller and dry matter production

Higher populations produced more tillers per m^2 but fewer tillers per plant. However, generally tiller production slowed between 50 and 70,000 plants/ha shown by the reduced angle on the line in Figure 2.

Dry matter production increased as the target plant population was raised. The difference in dry matter production was an increase of around 0.5 t/ha between 30 and 50,000 but only an increase of 0.17 t/ha between 50 and 70,000 plants/ha (Figure 2).

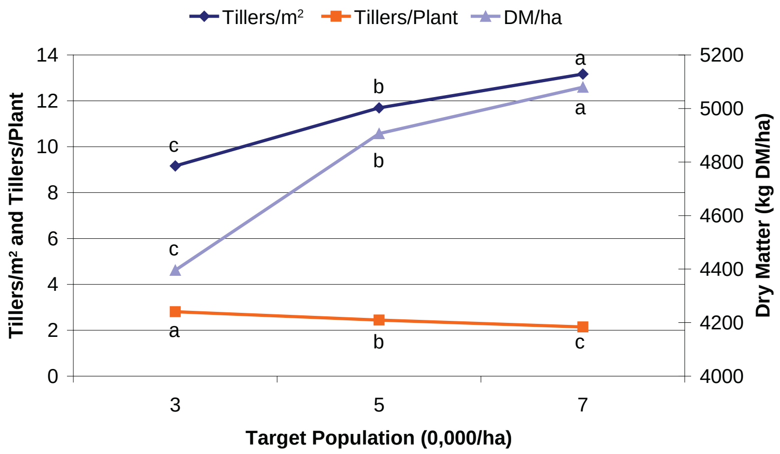

Figure 2. Effect of plant population on tillers per plant, per m² and dry matter production.

Tiller and dry matter production with different hybrids

There were significant differences between hybrids for tiller production. LT10 produced fewer tillers per plant and less tillers per m^2 than the other two hybrids (Figure 3).

Hybrids responded as expected to tillering with MR 43 displaying moderate and MR Bazley the highest level of tillering.

Overall differences between hybrids for tillering were fairly flat but still significant.

Differences between hybrids were not as significant for dry matter production. MR43 produced more dry matter than LT10 but neither was significantly different to MR Bazley (Figure 3).

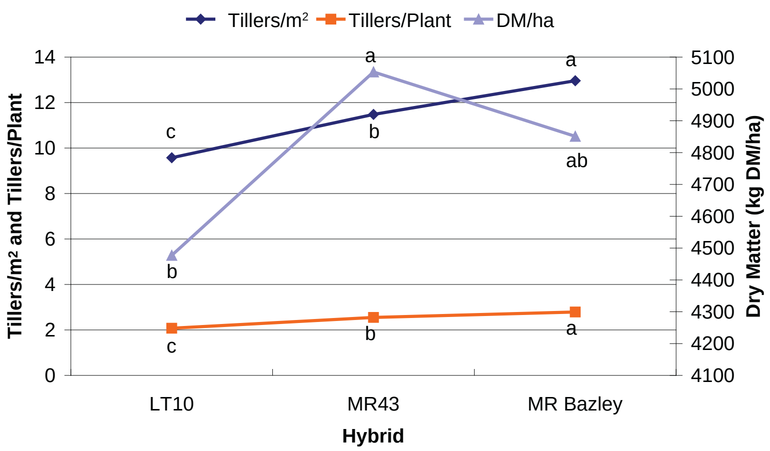

Figure 3. Effect of hybrid on tiller and dry matter production.

Effect of row configuration on tiller and dry matter production

Dry matter production declined as the effective row spacing increased (i.e. as going from solid configuration to double skip, Figure 4). Tillers per m^2 declined as effective row spacing increased.

There was little effect of row configuration on the number of tillers produced per plant.

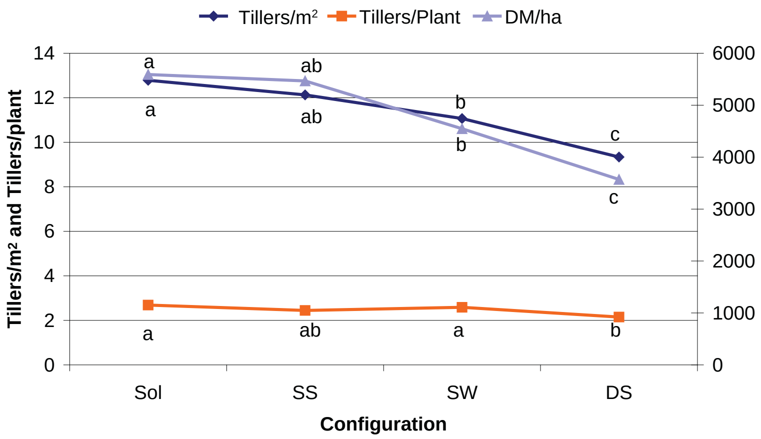

Figure 4. Effect of configuration on tiller and dry matter production.

Effect of row spacing and hybrid on tiller production

Tiller numbers per plant decreased as row spacing increased across all hybrids. So as the effective row spacing increased, the differences in tillering capacity of the hybrids became less important. MR Bazley and MR 43 tiller numbers were less affected by a 1.5 m row spacing (single skip and superwide configurations) than LT10 (Figure 5).

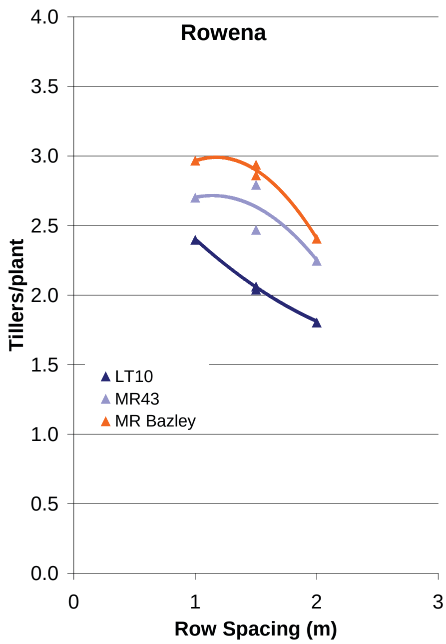

Figure 5. Effect of row spacing and hybrid on tillers per plant.

Effect of plant population and hybrid on head production

As the plant population increased the number of heads /m² also increased. LT10 was the only hybrid to show a linear response; as population increased the number of heads per m² also increased (Figure 6).

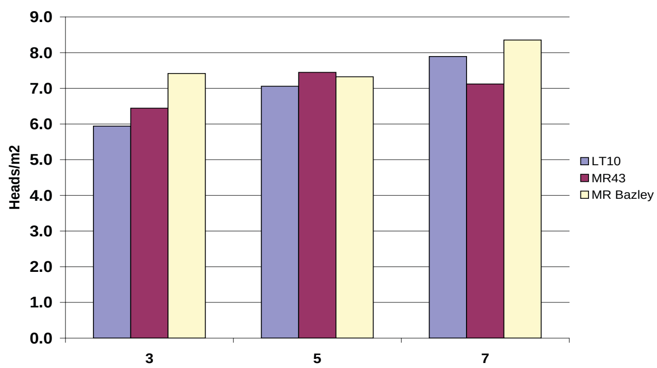

Figure 6. Effect of population and hybrid on heads/ m².

The number of heads per plant decreased as plant population increased. Heads per plant varied most across the three hybrids at the low population, most likely this relates to their tillering ability. At the 50 and 70,000 populations there were basically no differences in the number of heads produced per plant across the three hybrids (Figure 7).

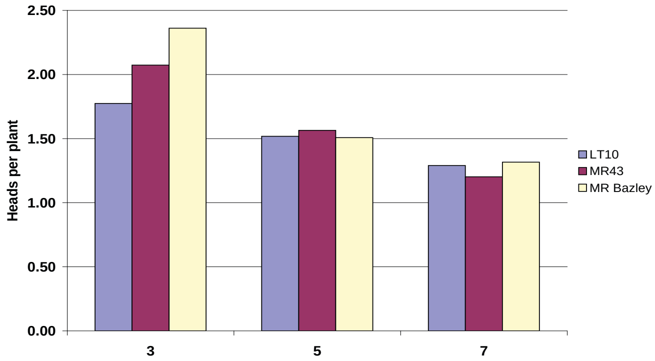

Figure 7. Effect of population and hybrid on heads per plant.

Effect of row configuration and hybrid on head production

The only configuration to produce obviously fewer heads /m^2 was the double skip (Figure 8). Differences between the other three configurations were much smaller. MR Bazley produced the highest number of heads across all configurations; this is consistent with its high tillering. Final differences in head numbers between LT10 and MR43 were small.

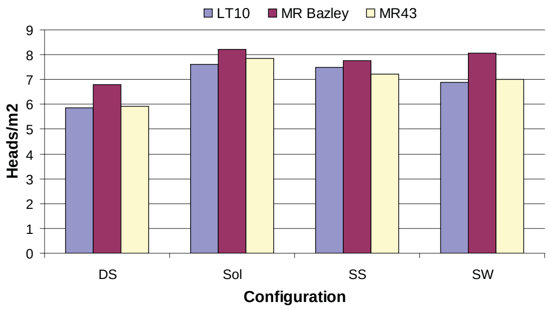

Figure 8. Effect of configuration and hybrid on heads per m^2.

Yield

The yield data at this site was compromised by poor seed set. Largely we believe this resulted from rain and cold weather during flowering.

As a result the reliability of the yield and grain quality data is poor and has therefore not been reported. All of the plant data is of a good standard though and was obviously not compromised by unfavourable conditions during flowering.

Finishing soil water

Finishing soil moisture across configurations was measured at harvest only for the hybrid MR43 and found to be similar with the exception of the skip area in the double skip plots. The middle of the skip area for the double skip configuration measured more moisture remaining at all depths down the profile. No significant difference was observed between on row and mid row soil moisture in any configuration.

The additional moisture in the middle of the double skip will hopefully has a positive impact on the wheat crop which will follow within the rotation.

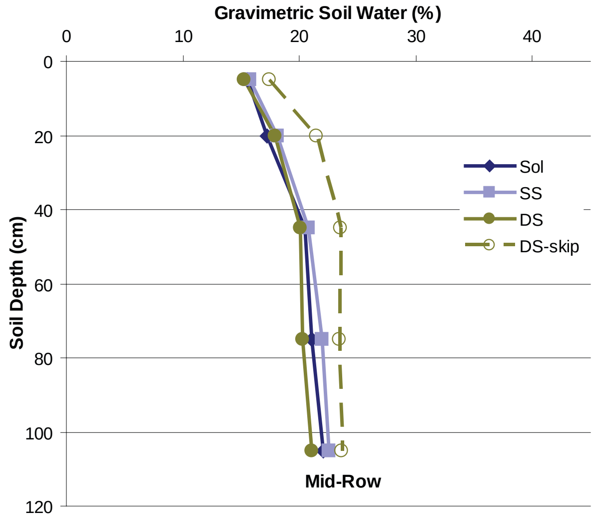

Figure 9. Gravimetric soil water in between plant rows across all row configurations

Future monitoring

Stubble and crown rot breakdown under different row configurations at harvest, over the fallow and into the following wheat crop are still being analysed. As part of this process samples of the remaining wheat stubble have been collected every 3 months across the different configurations and plant populations. Hopefully this will provide a clearer picture of the impact on crown rot levels after including sorghum as part of the rotation.

Acknowledgements

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Sorghum in the western zone – Selecting hybrids for the North West – Rowena 2010/11

Loretta Serafin, Guy McMullen and Ben Frazer

NSW DPI, Tamworth

Introduction

Hybrid selection in sorghum is usually targeted towards achieving market share. However, with increasing interest in trying to make sorghum a more reliable component of farming systems in the western zone of northern NSW there is new interest in trying to identify hybrids with suitable traits for this region.

The three main traits of interest include:

- maturity
- tillering – possibly lower tillering or uniculms
- staygreen or ability to handle stress post flowering.

These trials were aimed at evaluating a wide range of potential material to meet these needs. This was one of three trials planted across northern NSW in the 2010/11 season, the other two sites being Gurley and Mungindi.

Site details

Co-operator:	Philip Harris
Property:	"Wondahree", Rowena
Sowing Date:	17th and 18th September, 2010
Planter:	Monosem double disc
Fertiliser:	41 kg/ha Supreme Z

Treatments details

Hybrids

One commercial hybrid was selected; MR43 as a benchmark hybrid. Pacific Seeds as a supporting partner of this project was invited to supply their ten most suitable hybrids. The Queensland department, DEEDI also supplied a range of early stage sorghum hybrids out of their pre-breeding program which is led by David Jordan, based at Warwick.

Row configuration

All hybrids were planted on a Double Skip configuration as this is the most common configuration for sorghum sown in the western zone and is representative of the practices most of the trial co-operators use commercially.

Population

Populations were targeted using germination for each hybrid and an estimated establishment of 80%. All hybrids were targeted at establishing 50,000 plants/ha.

Establishment and tiller production

Establishment and tiller counts were taken for each plot.

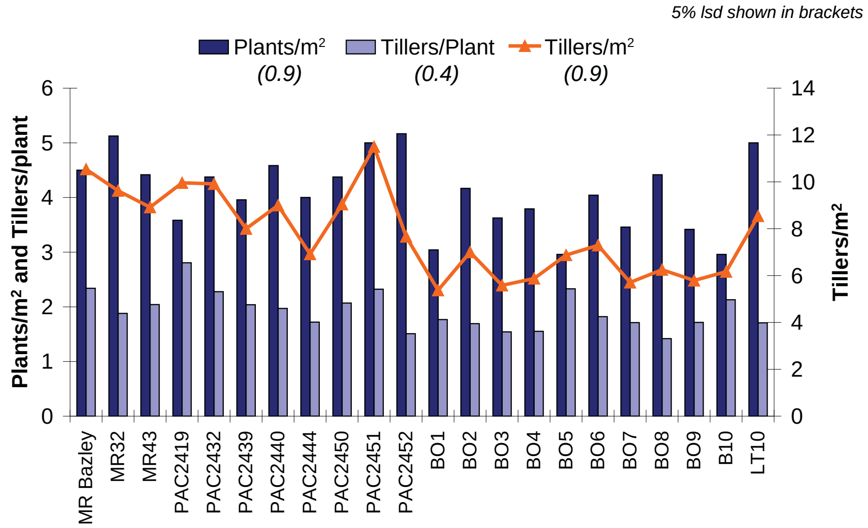

Figure 1. Hybrid plant establishment.

There were significant differences in the number of plants established and tiller production between the hybrids. The lowest tiller number recorded for any hybrid was 1.4 tillers per plant (BO8); the highest number of tillers produced per plant was 2.8 (PAC2419, Figure 1).

Head number

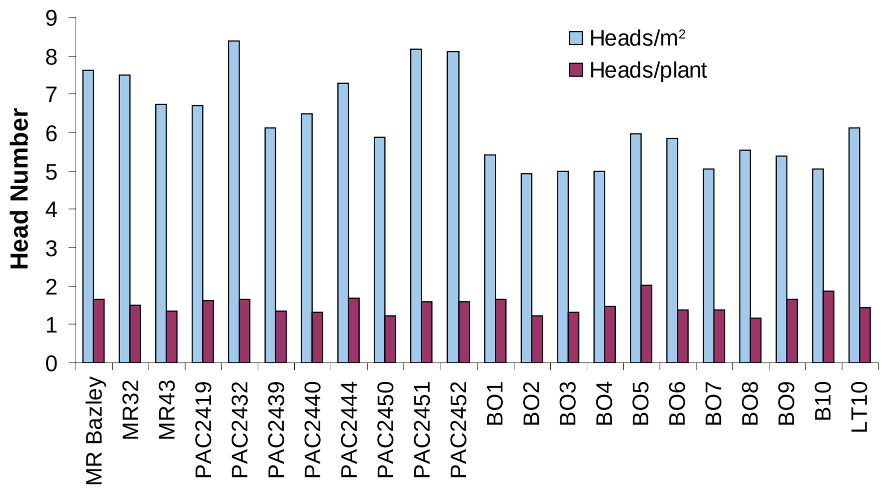

Figure 2. Hybrid head number per plant and per m²

There were significant differences in the production of heads per plant and per m². However the number of heads produced did not necessarily follow through to the highest yielding hybrids.

Yield

The yields from the site were compromised by poor seed set due primarily to rain and cold conditions at flowering. As a result the trial was harvested but the variability in the data made it unsuitable to report on.

Summary

The Rowena site produced good data showing variations in plant type for the main traits being considered such as tiller and head production. Unfortunately the site was unable to be used to build on the picture of hybrid performance in the area of yield. As a result the trial is being run again this season.

Acknowledgements

This project is funded by the NSW DPI and GRDC under project DAN00150 with support from Trevor Philp and Maree Crawford, Pacific Seeds. Thanks to Jan Hosking, Rod Bambach, Pat Mortell, Peter Formann and Alan Bowring for technical assistance. Thanks to Brad Coleman, for assistance with site selection and Philip Harris "Wondahree" for providing the trial site.

Sorghum in the western zone – Row configuration x population x hybrid: Gurley 2010–11

Guy McMullen[1], Loretta Serafin[1], Ben Frazer[1], Tim Burley[2] and Steven Simpfendorfer[1]

[1] NSW DPI, Tamworth
[2] NSW DPI, Moree

Introduction

Sorghum is a reliable summer crop in eastern areas of northern NSW. However, there is a need to improve the reliability of sorghum yield in western cropping areas and to assess strategies that will allow growers to adapt to increasingly variable seasonal conditions. The introduction of hybrids with increasing levels of Staygreen (SG), or using a combination of tillering, plant population and row configuration may help improve the reliability of sorghum yield in this environment.

In the eastern zone there has been a reasonable amount of work evaluating population and row spacing. Modelling work has suggested that sorghum can be a reliable component of western cropping systems but this work needs applied research to verify the modelling and give growers confidence to incorporate sorghum into their rotations.

In northern NSW crown rot, a stubble-borne fungal pathogen continues to be the most prevalent and damaging disease affecting winter cereals. Sorghum is recommended as a break crop but the success is dictated by the extent of breakdown of the winter cereal stubble that hosts the crown rot fungus. Although altering row configuration and population may improve the reliability of sorghum yield it may also reduce the rate of decomposition of cereal stubble and hence the break crop benefit. Sorghum configuration and population may also impact on water accumulation during the fallow period which needs to be considered within the cropping system.

The trial outlined below aims to answer some of these questions and provide data for use in modelling the trial outcomes over long term climatic data sets. This was one of three trials planted across northern NSW in the 2010/11 season, the other two sites being Rowena and Mungindi.

Site details

Co-operator:	Scott Carrigan
Property:	"Kelvin", Gurley
Sowing Date:	24th and 25th September, 2010
Planter:	Monosem double disc
Fertiliser:	41 kg/ha Supreme Z

Treatments

Hybrids

- MR43 (moderate SG and tillering)
- LT10 (low tillering and high SG)
- MR Bazley (PAC2437) (high tillering and low SG)

Row configuration

- Solid on a 1 m spacing (Sol)
- Single skip (SS)
- Double Skip (DS)

Populations

Populations were targeted using germination for each hybrid and an estimated establishment of 80%. Three populations were targeted in each of the row configurations.

- 30,000 plants/ha
- 50,000 plants/ha
- 70,000 plants/ha

Starting soil water

The site was cored at sowing to establish starting soil water. PAWC was estimated to be 131 mm to a depth of 120 cm.

Root lesion nematodes

Starting levels of root lesion nematodes were measured across the site as 2,924 *Pratylenchus thornei* / kg of soil. This is above the Queensland based threshold of 2,000 *Pratylenchus thornei* / kg of soil where yield loss can be expected in intolerant crops or varieties.

At harvest another background sample showed levels had risen to 7,609 *Pratylenchus thornei* / kg of soil.

Further testing of nematode levels in different treatments is now occurring.

Establishment

- Establishment counts were taken for each plot.
- MR43 and MR Bazley had similar establishment.
- LT10 had significantly lower plant establishment across all target populations.
- The 70,000/ha target population was not achieved. However, good separation was achieved between populations.
- There was no effect of configuration on establishment percentage (data not shown).
- As the target population increased, the establishment losses also increased.

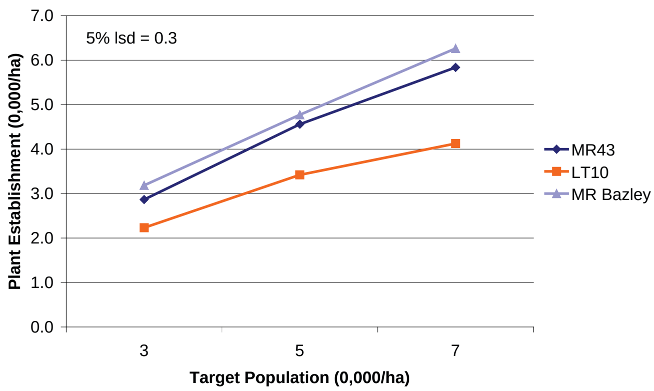

Figure 1. Effect of hybrid on plant establishment.

Tiller production

As the row configuration widened the number of tillers produced per m^2 reduced (Figure 2). This was expected due to increased competition between plants within the row.

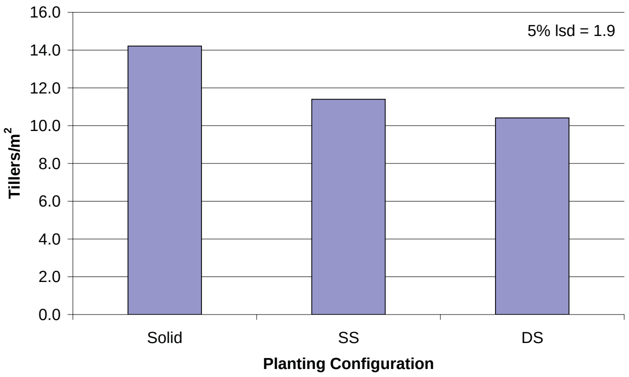

Figure 2. Effect of row configuration on tiller density.

- LT10 produced significantly fewer tillers per m², compared to MR 43 and MR Bazley (Figure 3).
- The higher populations produced more tillers per m² but less tillers per plant. Meaning the overall plant population was a stronger driver of tillering.
- Tiller production per plant reduced between 50 and 70,000 plants/ha.

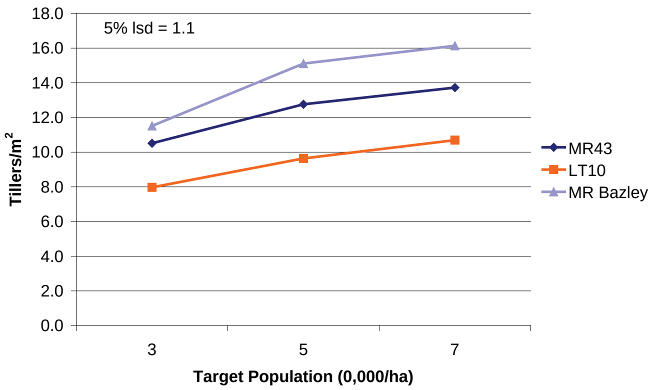

Figure 3. Effect of hybrid on tiller production.

- LT10 produced fewer tillers per plant than MR43 and MR Bazley (Figure 4).

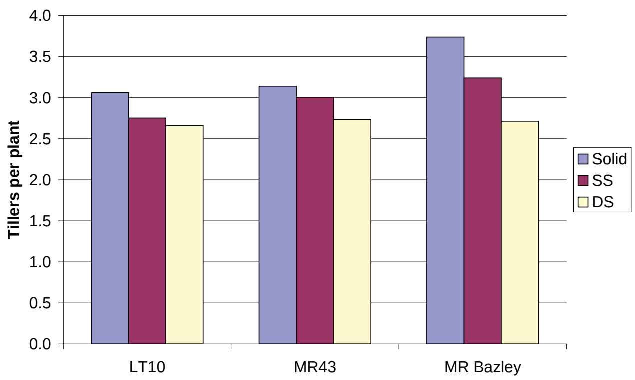

Figure 4. Effect of row configuration on tiller production across hybrids.

- As effective row spacing increases the number of tillers per plant decreases.
- MR Bazley showed the greatest impact of row configuration on tillering. Reducing from 3.7 to 3.2 to 2.7 tillers per plant across solid, single skip and double skip, respectively.
- Increasing row spacing to double skip had the effect of removing differences between hybrid tillering at this site.

Dry matter production

Crop dry matter production was assessed across all treatments at flowering.

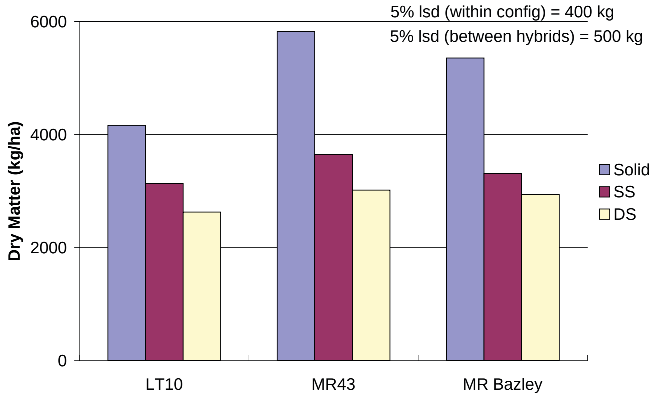

Figure 5. Effect of row configuration and population on crop dry matter production.

- MR 43 produced the largest amount of dry matter across all configurations.
- By increasing row spacing the dry matter production was reduced.

Head numbers

- As row spacing increased heads per m² decreased significantly. There was nearly half the number of heads per m² in the double skip configuration compared to the solid (Figure 6).

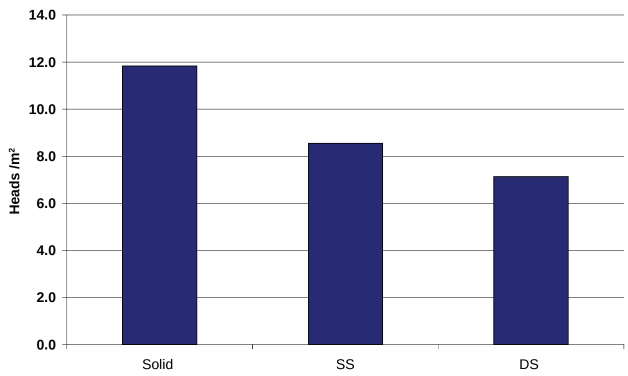

Figure 6. Effect of configuration on heads per m².

- As population increased heads per plant decreased (Figure 7).
- MR43 had the least number of heads per plant of all the hybrids.
- LT10 head numbers per plant were least affected by population.
- MR Bazley had substantially more heads per plant at 30,000 plant/ha than the other two hybrids.

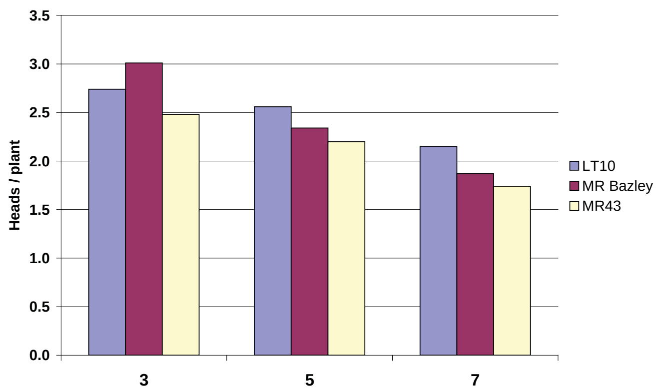

Figure 7. Effect of population and hybrid on heads per plant.

Yield

- Solid plant configuration yielded the best at all sites in the 2010/11 season, however the season was atypical, being wetter than average.
- Yield decreased as row spacing increased in the 2010/11 season.
- The solid plant configuration averaged 4.6 t/ha, whilst double skip yielded 2.8 t/ha; only 62% of the solid plant yield.

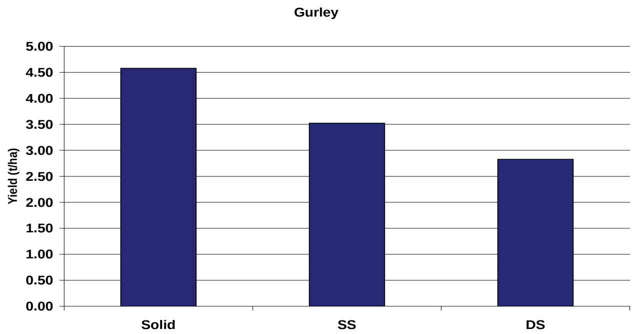

Figure 8. Effect of configuration on yield.

- As plant population increased yield increased (Figure 9).
- The yield difference shown between 50 000 and 70 000 plants/ha is not significant.
- However, the difference between 30,000 and 50,000 plants/ha of 0.2 t/ha was significant.
- In the 2010/11 season, row spacing had a much greater effect on yield than plant population.

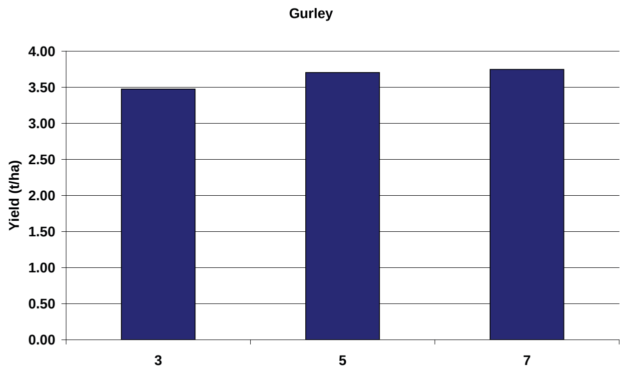

Figure 9. Effect of population on yield.

- There was no significant difference in yield between MR Bazley or MR43 at any configuration (Figure 10).
- LT10 yielded less compared to the other two hybrids except in the double skip configuration where yields were comparable.

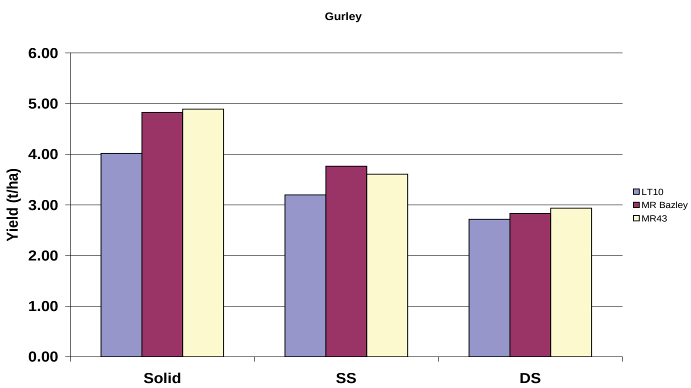

Figure 10. Effect of configuration and hybrid on yield.

Harvest soil water

- Finishing soil moisture across configurations was measured at harvest only for MR43 and found to be similar with the exception of the skip area in the double skip plots.
- The middle of the skip area for the double skip configuration showed more moisture remaining below 20 cm in the profile.
- No significant difference was observed between on row and mid row soil moisture in any configuration.
- The additional moisture in the middle of the double skip would be expected to provide positive impacts on the following crop.

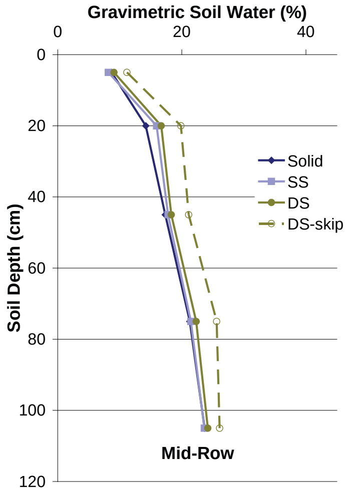

Figure 11. Finishing gravimetric soil water content.

Future monitoring

Stubble and crown rot breakdown in different row configurations at harvest over the fallow and into the following crop are still being tracked. As part of this process samples of the remaining wheat stubble have been collected every 3 months across the different configurations and populations for MR43.

Hopefully this will provide a clearer picture of the impact on crown rot levels after including sorghum as part of the rotation.

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Thanks to Gary Onus (Landmark) for assistance with the site selection and Scott Carrigan ("Kelvin", Gurley) for providing the site.

Sorghum in the western zone – Selecting hybrids for the North West: Gurley 2010/11

Guy McMullen, Loretta Serafin and Ben Frazer

[1] NSW DPI, Tamworth

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One commercial hybrid was selected; MR43 as a benchmark hybrid. Pacific Seeds as a supporting partner of this project was invited to supply their most suitable hybrids. The Queensland Department, DEEDI also supplied a range of early stage sorghum hybrids from their pre-breeding program which is led by Dr. David Jordan, based at Warwick.

Row Configuration

All hybrids were planted on a Double Skip configuration as this is the most common configuration for sorghum sown in the western zone and is representative of the practices most of the trial co-operators use commercially. However, the surrounding paddock at the "Kelvin" site was sown on superwide or 1.5 m row spacing.

Populations

Populations were targeted using a germination percentage for each hybrid and an estimated establishment of 80%. All hybrids were targeted at establishing 50,000 plants/ha.

Establishment and tiller production

Establishment and tiller counts were taken for each plot.

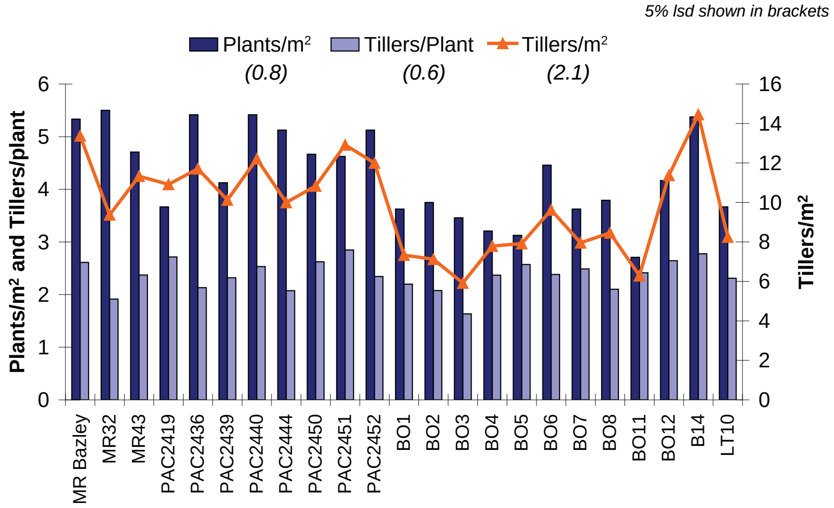

Figure 1. Tillering and establishment differences between hybrids at Gurley.

- There were significant differences in the number of plants established and tillers produced for each hybrid.
- Tillers were counted as the total number of stems, that is, the tiller number includes the main stem.
- The lowest tiller number recorded for any hybrid was 1.6 tillers per plant (BO3). In comparison the highest number of tillers produced per plant was 2.8 (PAC2451 and B14; Figure 1).

Head production

The number of heads produced per m² and per plant was also recorded.

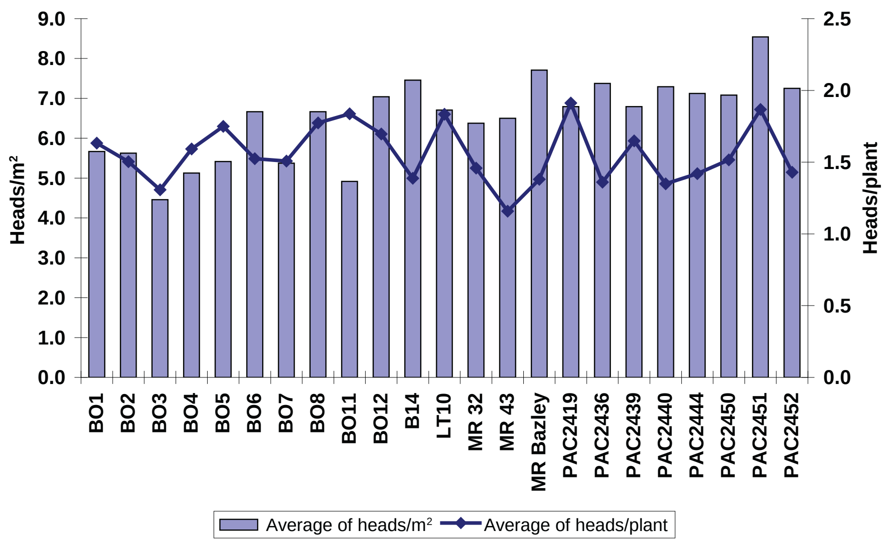

Figure 2. Head production between hybrids at Gurley.

Yield

Final grain yield was of most significance in the Pacific Seeds lines which are being evaluated for potential release. The coded lines (BO1 etc.) are lines selected from the DEEDI pre-breeding project. These lines are being trialled for their trait suitability for the western region and not their yield component. However, some of the lines performed reasonably well (e.g. B14; Figure 3).

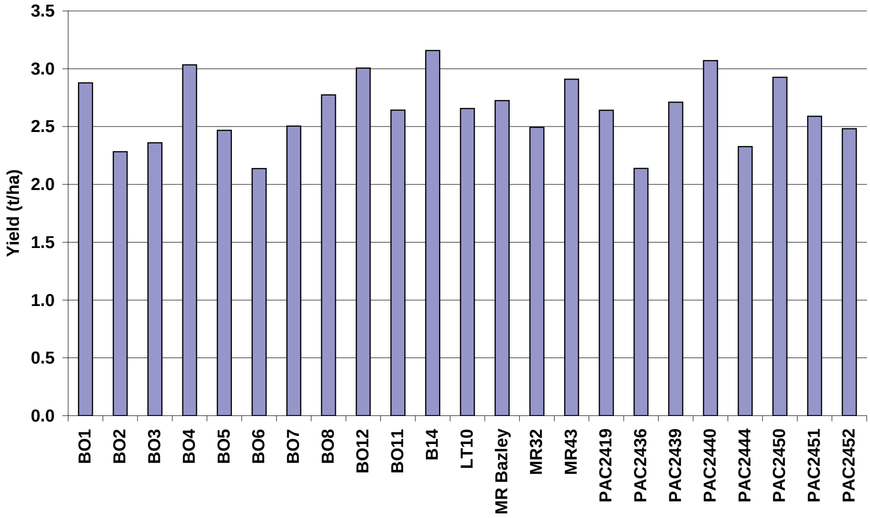

Figure 3. Grain yield (t/ha) in hybrids at Gurley.

Grain quality

Results from the thousand grain weights (Figure 4) and screenings from the Gurley and Mungindi sites showed very similar results for most hybrids. While screenings were generally higher at the Gurley site, overall results were still well below the receival standards of less than 11% required for the top grade of sorghum (Figure 5).

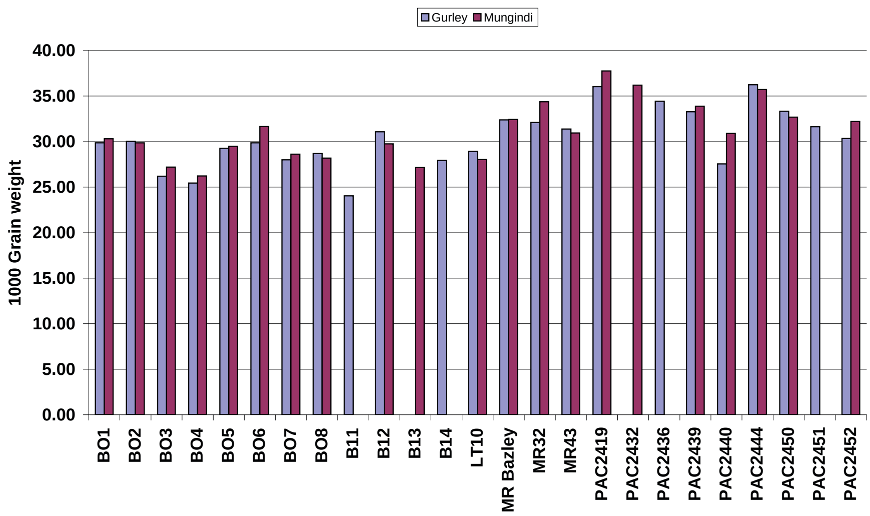

Figure 4. 1000 Grain weight results for hybrids at Gurley and Mungindi.

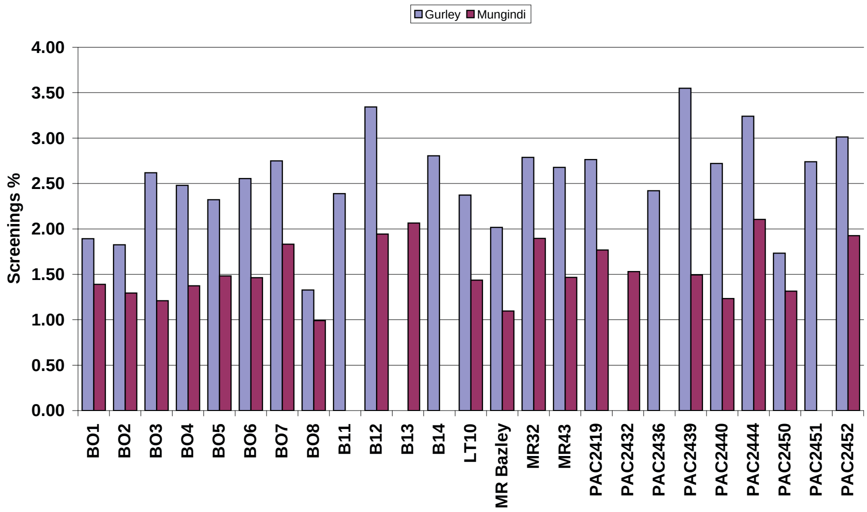

Figure 5. Screenings for hybrids at Gurley and Mungindi.

Acknowledgements

This project is funded by the GRDC under project DAN00150 with support from Pacific Seeds. Thanks to Trevor Philp and Maree Crawford, Pacific Seeds.

Thanks to Jan Hosking, Rod Bambach, Pat Mortell, Peter Formann, Tim Burley, Russell Carty and Alan Bowring for assistance with the site.

Thanks to Gary Onus (Landmark) for assistance with the site selection and Scott Carrigan, "Kelvin", Gurley for providing the site.

Sorghum in the western zone – Row configuration x population x hybrid: Mungindi 2010/11

Tim Burley[1], Guy McMullen[2], Loretta Serafin[2], Ben Frazer[2], Russell Carty[1] and Steven Simpfendorfer[2]

[1] NSW DPI, Moree

[2] NSW, Tamworth

Background

Sorghum is a reliable summer crop in eastern areas of northern NSW. However, there is a need to improve the reliability of sorghum yield and quality in western cropping areas and to assess strategies that will allow growers to adapt to increasingly variable seasonal conditions. The introduction of hybrids with increasing levels of Staygreen (SG), or using a combination of tillering, plant population and row configuration may help improve the reliability of sorghum yield in this environment.

In the eastern zone there has been a reasonable amount of work evaluating population and row spacing. Modelling work has suggested that sorghum can be a reliable component of western cropping systems but this work needs applied research to verify the modelling and give growers confidence to incorporate sorghum into their rotations.

In northern NSW crown rot, a stubble-borne fungal pathogen continues to be the most prevalent and damaging disease affecting winter cereals. Sorghum is recommended as a break crop but the success is dictated by the extent of breakdown of the winter cereal stubble which hosts the crown rot fungus. Although altering row configuration and population may improve the reliability of sorghum yield it may also reduce the rate of decomposition of cereal stubble and hence the break crop benefit. Sorghum configuration and population may also impact on water accumulation during the fallow period which needs to be considered within the cropping system.

The trial outlined below aims to answer some of these questions and provide data for use in modelling the trial outcomes over long term climatic data sets. This was one of three trials planted across northern NSW in 2010/11, the other two sites being Gurley and Rowena.

Site details

Co-operator:	Charles Boyle
Property:	"Amaroo", Mungindi
Sowing Date:	29th and 30th September, 2010
Planter:	Monosem double disc
Fertiliser:	41 kg/ha Supreme Z

Treatments

Hybrids

- MR43 (moderate SG and tillering)
- LT10 (low tillering and high SG)
- MR Bazley (PAC2437) (high tillering and low SG

Row Configuration

- Solid on 1 m spacings (Sol)
- Single skip (SS)
- Double Skip (DS)
- Superwide (1.5 m spacings) (SW)

Populations

- Populations were targeted using germination for each hybrid and an estimated establishment of 80%. Three populations were targeted in each of the row configurations.
- 30,000 plants/ha
- 50,000 plants/ha
- 70,000 plants/ha

Establishment

- The site had an excellent establishment, with plant populations above the targeted populations.
- There were differences in establishment between hybrids, with LT10 establishing the worst.
- There was no difference in the establishment across configurations (data not shown).

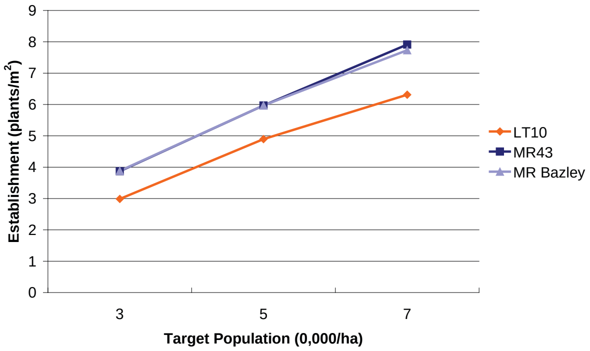

Figure 1. Plant establishment.

Tillers

- MR Bazley produced the most tillers per plant, followed by MR43 and then LT10 (Figure 2).
- Differences in the number of tillers per plant decreased as the plant population increased.
- At the 70,000 plant population there was no difference in the number of tillers produced per plant.

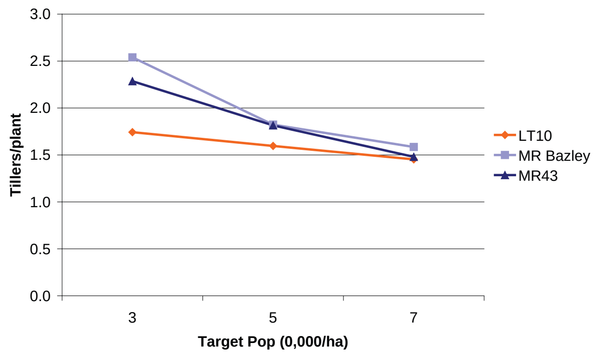

Figure 2. Effect of hybrid and plant population on tillers per plant.

- The number of tillers per plant reduced as the row configuration widened, although the superwide configuration produced a higher number of tillers per plant than expected (Figure 3).

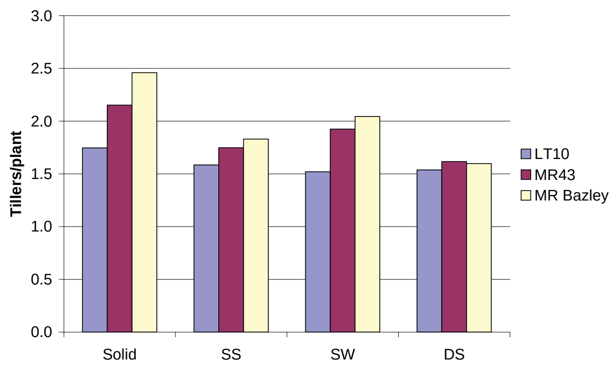

Figure 3. Effect of row configuration and plant population on tillers per plant.

Dry matter production

- MR 43 produced the most biomass at flowering, with LT10 producing the least.
- Biomass production increased as plant population increased, but the maximum was just over 4.5 t DM/ha (Figure 4).

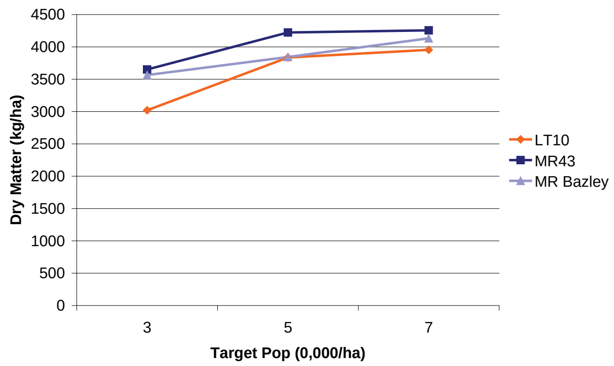

Figure 4. Effect of hybrid on dry matter production.

- Solid row configurations produced the highest dry matter in all hybrids, with single skip and double skip producing progressively less biomass (Figure 5).

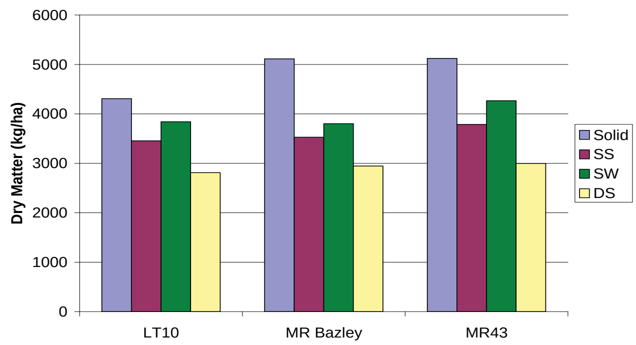

Figure 5. Effect of hybrid on dry matter production.

Head numbers

- Head numbers/m^2 declined as row spacing increased with the various configurations (Figure 6).

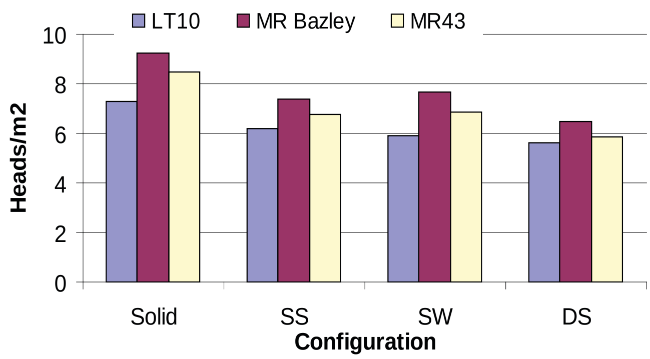

Figure 6. Effect of configuration on heads per m^2.

- Head numbers/m² increased as population increased.
- MR Bazley had the highest number of heads across configurations and population (Figure 7).

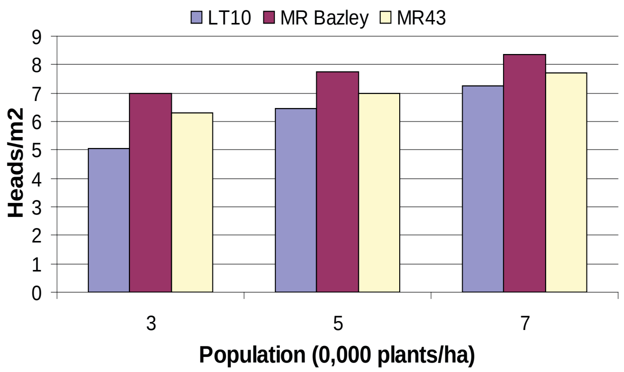

Figure 7. Effect of plant population on heads per m².

- Heads per plant decreased as plant population increased.
- Hybrids MR Bazley and LT10 had no significant difference in head numbers produced per plant, whilst MR43 produced fewer heads per plant (Figure 8).

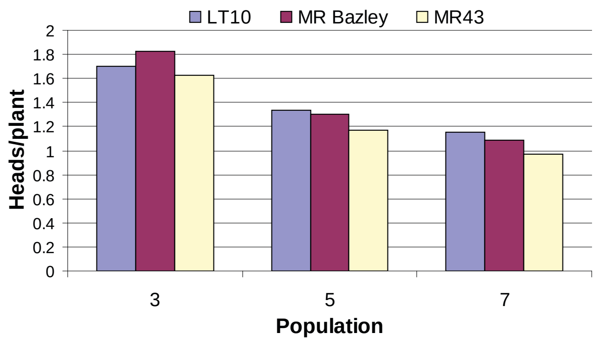

Figure 8. Effect of plant population and hybrid on heads per plant.

- As row spacing increased with the various row configurations heads per plant decreased.
- The superwide configuration had a greater number of heads per plant than the single skip configuration, despite having the same effective row spacing (Figure 9).

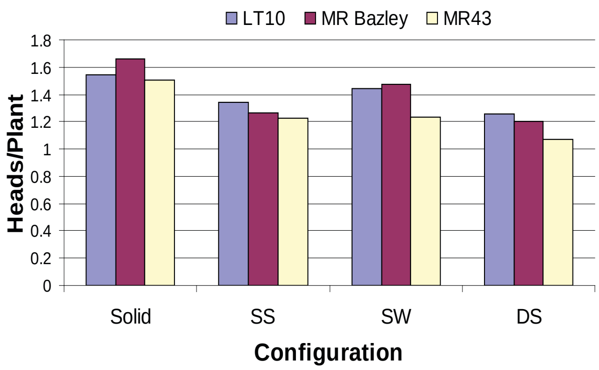

Figure 9. Effect of configuration and hybrid on heads per plant.

Yield

- Yield decreased as row spacing increased with the various configurations.
- The solid configuration yielded significantly more than the other configurations.
- The yield of single skip and superwide configurations were not significantly different.
- The yield of superwide and doubleskip configurations were also not significantly different (Figure 10).

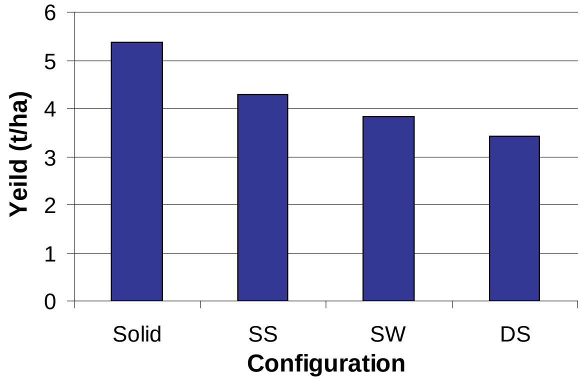

Figure 10. Effect of configuration on yield.

- Yield increased as plant population increased.
- There was no significant difference in yield between 50 000 and 70 000 plant/ha (Figure 11).

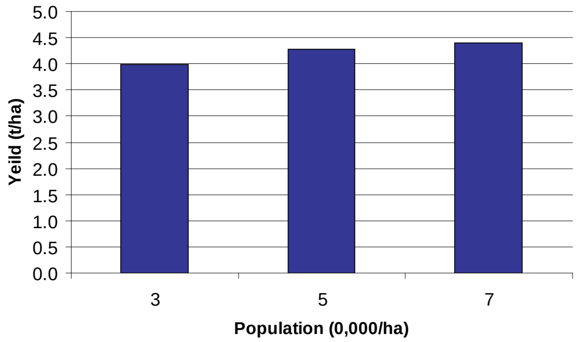

Figure 11. Effect of plant population on yield.

- LT10 yielded significantly less than the other two hybrids across all configurations except doubleskip.
- The yields of MR43 and MR Bazley were similar across all row configurations (Figure 12).

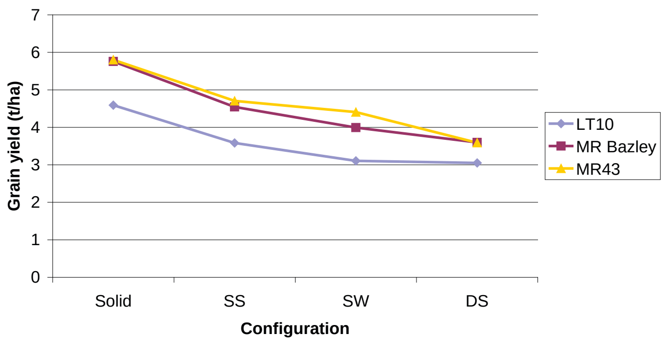

Figure 12. Effect of configuration and hybrid on yield.

- LT10 yielded significantly less than the other two hybrids across all plant populations.
- The yields of MR43 and MR Bazley were not significantly different across all plant populations (Figure 13).

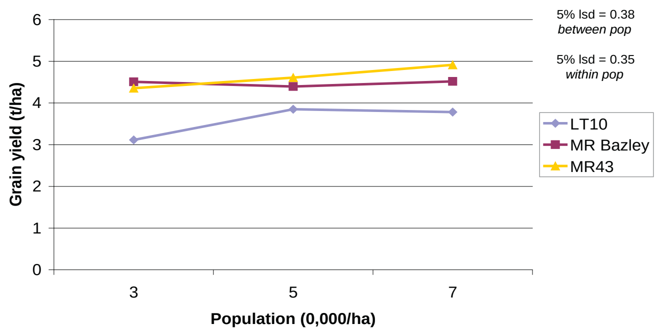

Figure 13. Effect of plant population and hybrid on yield.

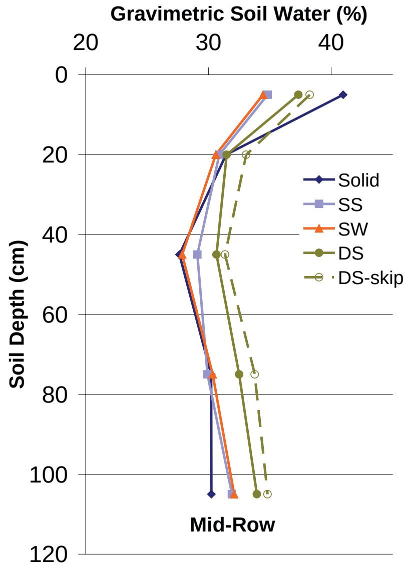

Figure 14. Finishing gravimetric soil water content

Future monitoring

Stubble breakdown and and crown rot levels in different row configurations at harvest over the fallow and into the following wheat crop are still being analysed.

As part of this process samples of the remaining wheat stubble have been collected every three months across the different row configurations and plant populations.

Hopefully this will provide a clearer picture of the impact on crown rot levels after including sorghum as part of the rotation.

Acknowledgements

This project is funded by the GRDC under project DAN00150 with support from Pacific Seeds. Thanks to Trevor Philp and Maree Crawford, Pacific Seeds. Thanks to Jan Hosking, Rod Bambach, Pat Mortell, Peter Formann and Alan Bowring for technical assistance.

Thanks to Tim Poole for assistance with the site selection.

Sorghum in the western zone – Selecting hybrids for the North West: Mungindi 2010/11

Tim Burley[1], Guy McMullen[2], Loretta Serafin[2], Ben Frazer[2] and Russell Carty[1]

[1] NSW DPI, Moree

[2] NSW DPI, Tamworth

Background

Hybrid selection in sorghum is usually targeted towards achieving market share. However, with increasing interest in trying to make sorghum a more reliable component of farming systems in the western zone of northern NSW there is new interest in trying to identify hybrids with suitable traits for this region.

The three main traits of interest include:

- maturity
- tillering – possibly lower tillering or uniculms
- staygreen or ability to handle post flowering stress.

These trials were aimed at evaluating a wide range of potential material to meet these needs.

This was one of three trials planted across northern NSW in 2010/11, the other two sites being Gurley and Rowena.

Site details

Co-operator:	Charles Boyle
Property:	"Amaroo", Mungindi
Sowing Date:	29th and 30th September, 2010
Planter:	Monosem double disc
Fertiliser:	41 kg/ha Supreme Z

Treatment details

Hybrids

One commercial hybrid was selected; MR43 as a benchmark hybrid. Pacific Seeds as a supporting partner of this project was invited to supply their most suitable hybrids. The Queensland Department, DEEDI also supplied a range of early stage sorghum hybrids out of their pre-breeding program which is led by Dr. David Jordan, based at Warwick.

Row Configuration

All hybrids were planted on a Double Skip configuration as this is the most common configuration for sorghum sown in the western zone and is representative of the commercial practices used by most of the trial co-operators.

Population

Populations were targeted using a germination percentage for each hybrid and an estimated establishment of 80%. All hybrids were targeted at establishing 50,000 plants/ha.

Establishment and tiller production

Establishment and tiller counts were taken for each plot.

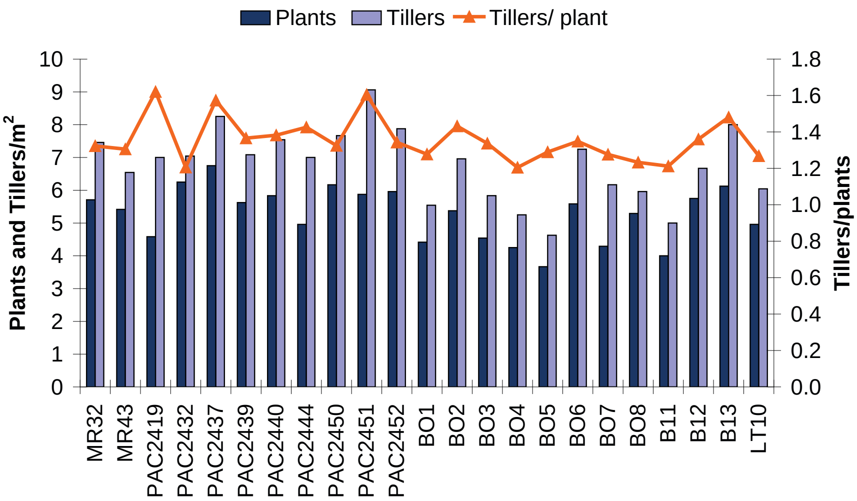

Figure 1. Hybrid plant establishment.

- There were significant differences in the number of plants established and tillers produced for each hybrid.
- The lowest tiller number recorded for any hybrid was 1.2 tillers per plant. In comparison the highest number of tillers produced per plant was 1.6 (Figure 1). Overall Mungindi was the lowest tillering of all three sorghum sites in 2010/11.

Head production

The number of heads produced per m^2 and per plant was also recorded. Across the hybrids there was a large amount of variation in the number of heads produced. The hybrid with the most heads; around 74,000 heads/ha (PAC2451 and PAC2452); had double the number of heads produced of by the lowest of the hybrids (B11 and B05; Figure 2).

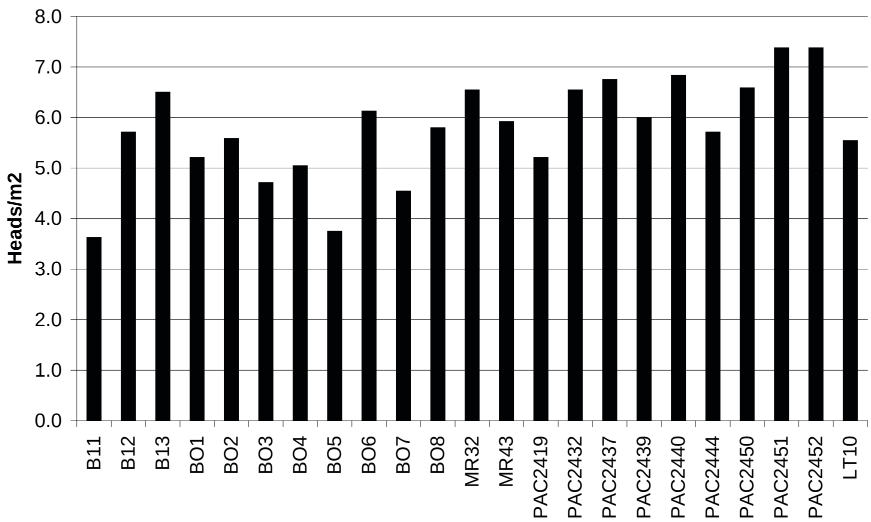

Figure 2. Head production between hybrids at Mungindi.

Yield

Final grain yield is of most significance in the Pacific Seeds lines which are being evaluated for potential release. The coded lines (BO1 etc.) are lines selected from the DEEDI pre-breeding project. These lines are being trialled for their trait suitability for the western region and not their yield component. However, some of the lines performed reasonably well (e.g. B13, Figure 3).

Grain yields were between 2.3 and 4.3 t/ha at the Mungindi site. The best performers were experimental lines from Pacific Seeds which yielded around 0.5 t/ha more than MR43 (Figure 3).

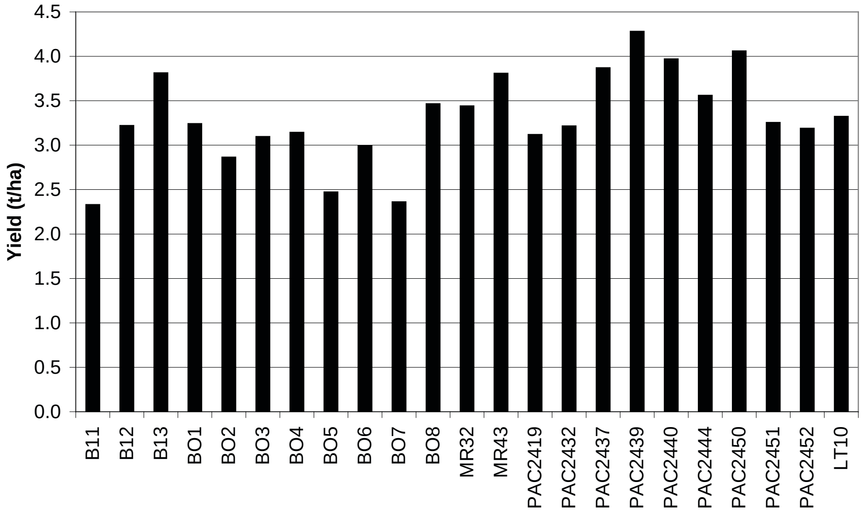

Figure 3. Grain yield (t/ha) in hybrids at Mungindi.

Grain quality

Results from the thousand grain weights and screenings from the Gurley and Mungindi sites showed very similar results for most hybrids. Screenings were all below 3% at the Mungindi site (data not shown).

Acknowledgements

This project is funded by the GRDC under project DAN00150 with support from Pacific Seeds. Thanks to Trevor Philp and Maree Crawford, Pacific Seeds. Thanks to Jan Hosking, Rod Bambach, Pat Mortell, Peter Formann, Russell Carty and Alan Bowring for assistance with the site. Thanks to Tim Poole for assistance with the site selection.

Disease

Chickpea seed tests from 2010 harvest explain establishment problems in 2011 crops

Kevin Moore, Gail Chiplin and Paul Nash
NSW DPI, Tamworth

Introduction

The 2010 chickpea season in the GRDC Northern region was the wettest on record with substantial rain falling during grain development and maturity. Diseases were common, crops lodged and grain was severely weather damaged. The chickpea industry was concerned about the quality of planting seed for the 2011 crop. Accordingly, we undertook a survey of seed samples from the 2010 harvest. Testing was completed in time for the 2011 planting but the results are only now being reported.

Methods

Seed lots and tests

- 81 seed lots from northern NSW and southern QLD were processed at the Tamworth Agricultural Institute.

The following tests were conducted on each seed lot:

- Emergence (Emerg %) – seedlings (120 seeds) that emerged after 2 weeks in an evaporatively cooled glasshouse (22–26°C)
- Germination (Germ %) – germination (100 seeds) in the lab after 8 days at 21°C.
- Pathology (Clean%, Botrytis%, Other %) – 200 surface sterilised seeds incubated on isolation media at 24°C. After 5 days the number of seeds with no fungal growth was recorded (Clean %). After 11 days the number of seeds from which *Ascochyta rabiei*, *Botrytis cinerea* (Botrytis %), or other fungi (Other%) was recorded.

Note: *A. rabiei* is relatively slow growing compared with *B. cinerea* and other fungi that colonise chickpea seed. Thus, a seed infected with *A. rabiei* (as we suspect many were), may not give rise to a discernable *A. rabiei* colony (this is supported by the isolation data – only one sample yielded *A. rabiei*; data not shown).

- 2011 crops sown with seed tested in the survey were inspected monthly from June to November.
- In June and July, plant establishment was estimated by counting plants (alive and dead) in paired one metre lengths of row at several locations in the paddock.
- At the same time, Botrytis Seedling Disease, (BSD) was estimated by counting total plants plus those with BSD along 3 transects at different locations in the crop.

Results

Emergence, germination and pathology of the seed tests

- Emergence – the data was sorted on emergence and the lots assigned a number to enable tracking for the other variables measured (see Figures 1–5). Emergence ranged from 0 to 93%. Half the lots had <50% emergence and only 26% met the Pulse Australia minimum Standard of 70% (Figure 1).
- Germination – varied from 0 to 100% but only 36 lots (44%) exceeded 70% and only 14 (17%) exceeded 90% (Figure 2). Germination was a poor predictor of emergence in the glasshouse, accounting for only 60.7% the variability in emergence. Normally, germination is a very good indicator of emergence; however, repeated wetting and drying has had a bigger effect on seedling vigour.

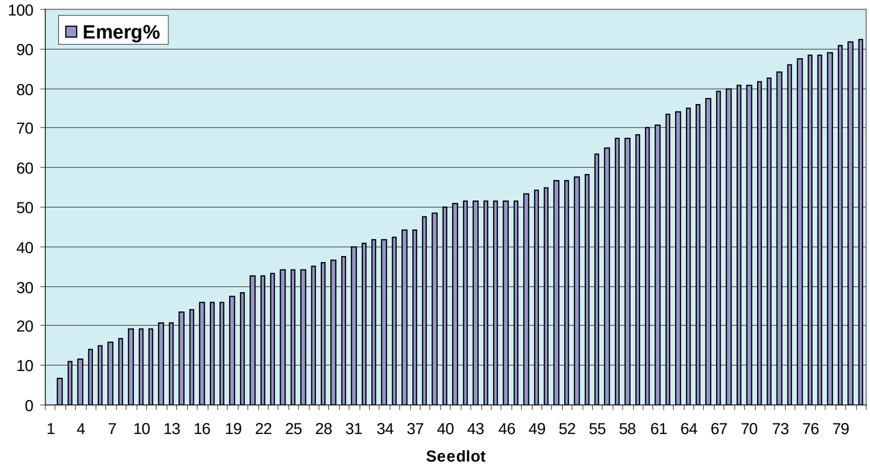

Figure 1. Emergence (%) of 81 seed lots after 2 weeks in potting mix

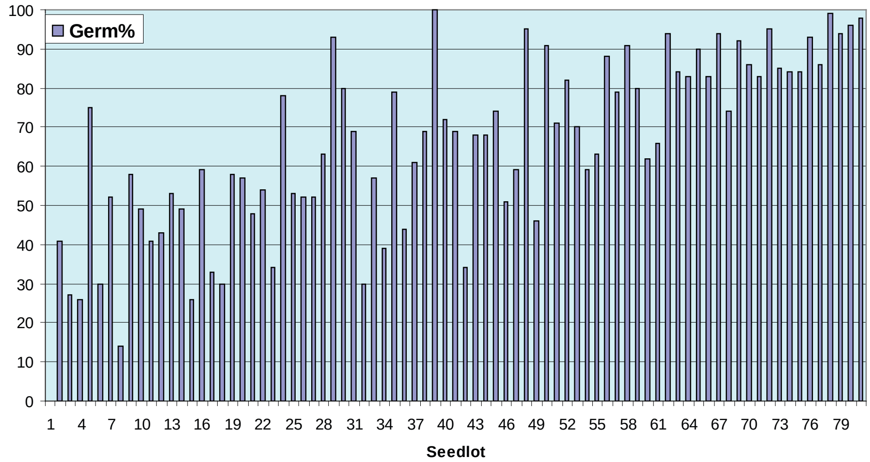

Figure 2. Germination (%) in moist paper towels after 8 days at 21°C

- Pathology – No seed lot was "Clean" (Figure 3) and only 10 lots (12%) had <50% clean seed.

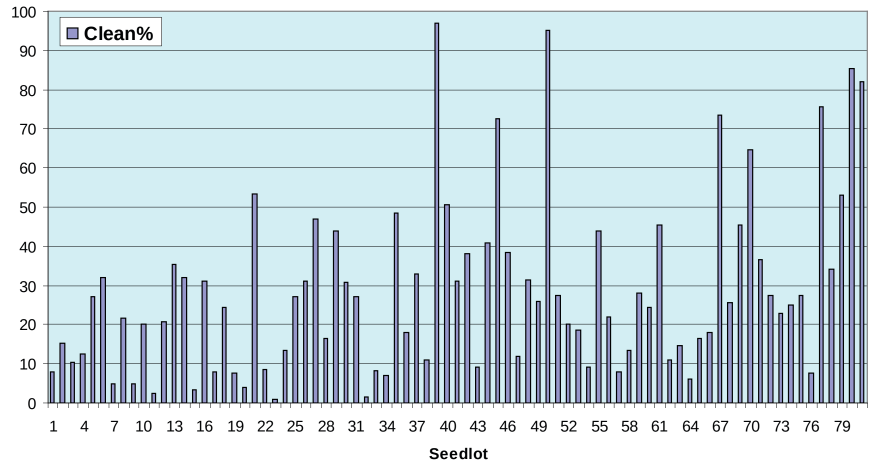

Figure 3. Percentage of seed with no fungal growth on isolation media after 5 days at 24°C

- Pathology – Colonisation of seed by *B. cinerea (Bc)* varied from 0 to 45% (Figure 4). In 22 lots (27%), *Bc* had infected <10% of the seed and nine (11%) had > 20% of their seed infected. We did not isolate *Bc* from 27 lots (42%).

Note: some of the "Other" fungi, grew faster than *Bc* and may have suppressed its growth. The isolation figures therefore may underestimate actual infection of seed by *Bc*.

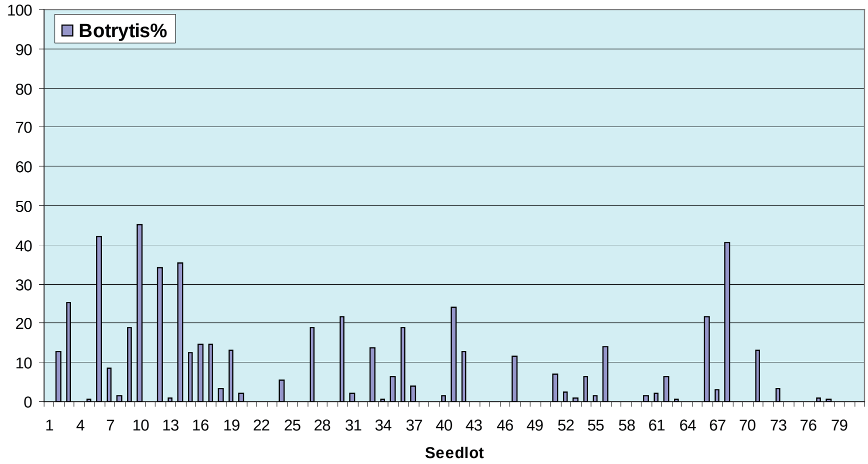

Figure 4. Percentage of seed yielding Botrytis cinerea after 10–12 days at 24°C.

- Apart from nine lots (not necessarily the same that had >20% Bc), 30% or more seed in 89% of seed lots had internal saprophytic fungi (Figure 5).

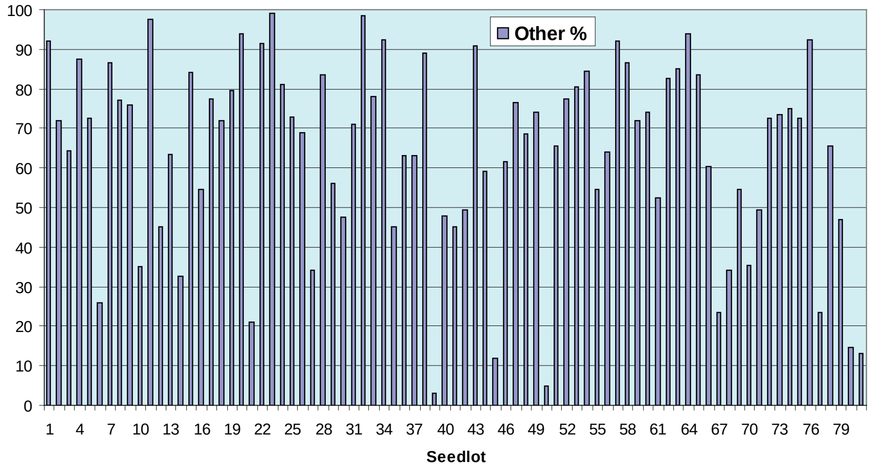

Figure 5. Percentage of seed yielding fungi other than Botrytis after 10–12 days at 24°C.

- There was no correlation between emergence and the percentage of seed that yielded either: no fungi (Clean%, R2 13.4%), Botrytis (Botrytis%, R2 9.3%), saprophytic fungi (Other%, R2 3.9%) or Ascochyta (R2 0% – data not shown).

Establishment and pathology of 2011 crops

Establishment varied from crop to crop ranging from 5 to >30 plants per square metre. BSD varied from crop to crop and from transect to transect within the same crop, ranging from 0 to 12%. **Note:** the assessment method does not detect seedlings that fail to emerge and thus can underestimate the actual level of Botrytis seedling disease.

The primary infections (i.e. originating from infected seed), led to secondary spread resulting in more seedling disease and/or collar rot. Secondary spread continued into September.

The most striking observation from the crop inspections was the importance of proper seed treatment. Without exception, the highest levels of seedling disease were in crops sown with seed treated on farm, either with inadequate coverage or below the label rate. This was clearly demonstrated in two crops sown with the same seed lot but treated by different operators – in one crop, Botrytis seedling disease was undetectable; in the other 4.5% of plants had Botrytis seedling disease.

Summary

This research helps explain why many 2011 chickpea crops had poor establishment and seedling disease problems, with fungal infection, weathering of seed and inadequate seed treatment the major causes of poor emergence and seedling blight. The work also highlights the importance of proper seed treatment.

The results of this study show clearly the importance of using quality seed, whether retained on farm or purchased. Seed is a major input cost and one of the most important factors in establishing a plant stand with the ability to achieve the full yield potential of the season. Poorly established crops not only limit yield potential but also have less competition with weeds. Disease occurrence and transmission is also an important factor which is impacted on by the quality of the seed .

Acknowledgements

This project is funded by NSW DPI and GRDC under Northern NSW Integrated Disease Management Project (DAN00143). Thanks to growers and agronomists who provided seed samples and details; to Dr Mal Ryley, DEEDI Toowoomba for pathology input.

Chickpea seed treatment improves crop establishment and increases yields – 2011 trials using seed from 2010 crops

Kevin Moore[1], Richard Daniel[2], Steve Harden[1], Anthony Mitchell[2], Rachel Herron[2], Paul Nash[1] and Gail Chiplin[1]

[1] NSW DPI, Tamworth

[2] Northern Grower Alliance

Introduction

The survey (see paper in this edition by Moore, Chiplin and Nash "Chickpea seed tests from 2010 harvest explain establishment problems in 2011 crops") of chickpea seed harvested in the 2010 season identified two seed lots that satisfied all three requirements for seed treatment research, namely:

- a high level of seed borne Botrytis,
- emergence to meet the Pulse Australia minimum Standard of 70%, and
- they had to be PBA HatTrick⁽ᴾ⁾ to minimise potential problems with Ascochyta blight

These two seed lots were used in 2011 on-farm trials in the Moree (Murray's Rd), Narrabri (Bellata) and Liverpool Plains (Breeza) districts. A fourth trial was conducted at the Tamworth Agricultural Institute. This paper summarises the Moree trial – the results at the other sites were very similar to the Moree trial .

Treatments

Two seed lots:

One seed lot (SL1 – number 68 in the above mentioned paper) was from Biniguy; the other (SL2 – number 71) was from Edgeroi. Off the header, SL1 had 80% emergence and 41% infection by *Botrytis cinerea*. SL2 had 82% emergence and 13% Botrytis.

To simulate commercial practice, both seed lots were machine graded. After grading, SL1 had 78% emergence and 22% Botrytis and SL2 had 84% emergence and 4% Botrytis. Sowing rates were adjusted to target 35 plants per square metre.

Four seed treatments:

1. Crop Care Thiram 600 (600g/L thiram)
2. Crop Care P Pickel-T® (360g/L thiram, 200g/L thiabendazole) both at label rates,
3. an Untreated control (Nil) and a
4. an off-label treatment (data not presented).

Treatments were applied following label directions; seed was treated in Hege® centrifugal seed treater until all seeds were thoroughly covered.

The trial was a Randomised Complete Block, with two seed lots, four seed treatments and four replicates. Plots were 2 m x 11.5 m (trimmed to 10 m), 5 rows @ 32 cm row spacing.

Measurements and analyses

On 10 June 11 (21 days after sowing), establishment was assessed by counting all plants that had emerged in the central three rows. Plants showing symptoms of seedling disease in the same rows were also recorded. Representative samples were examined at Tamworth for the presence of fungal pathogens.

Establishment counts and grain yields were analysed by ANOVA. Data for % plants with seedling disease were analysed using a Generalised Linear Model (GLM). Seedling disease was not detected in P Pickel-T® plots, so that data was excluded from the analyses to test for differences between the Nil, Thiram and off-label treatments. Data for Nil plots was then excluded to test for differences between Thiram and the off-label product. After analyses, the data was back transformed to the original scale.

Results

Establishment: Untreated seed lot SL1 had significantly (*P*=0.004) fewer plants per square metre 21 days after sowing than untreated SL2 (Table 1). Treating seed with either Thiram or P Pickel-T® significantly increased establishment but these products were not different from each other (Table 1) or the off-label treatment (data not shown).

Table 1. Plants per square metre (plts/m²) in a 2011 Moree chickpea seed treatment trial for two seed lots and three seed treatments.

Seed Lot	Seed treatment		
	Nil	Thiram	P Pickel-T®
SL1	8	29	31
SL2	16	29	29

- **Botrytis Seedling Disease:** Laboratory tests confirmed the seedling disease to be caused by *Botrytis cinerea*. GLM analyses showed a significant difference (*P*<0.001) between the Untreated (Nil) and treated seed but there were no differences between fungicides (Table 2). The off-label product was no better than Thiram or P Pickel-T® (data not shown). The incidence of disease in untreated SL1 (25.7%) approximated the level of Botrytis seed infection (22%). The higher incidence of disease in untreated SL2 (15.0%) relative to seed infection (4%) probably reflects the higher plant population (16 plts/m²) in the untreated plots, facilitating root contact between primary infections and nearby uninfected plants.

Table 2. Percentage of plants with Botrytis seedling disease in a 2011 Moree chickpea seed treatment trial for two seed lots and three seed treatments.

Seed Lot	Seed treatment		
	Nil	Thiram	P Pickel-T®
SL1	25.7	0.9	0.0
SL2	15.0	0.5	0.0

- **Grain Yield:** Treating seed with either Thiram or P Pickel-T® significantly (*P*<0.001) increased yield compared with untreated seed (Table 3). There was no difference between these fungicides or the off-label treatment (data not shown). The only significant difference between seed lots was in the Nil treatment, reflecting the higher plant establishment in SL2.

Table 3. Grain yield (t/ha) in a 2011 Moree chickpea seed treatment trial for two seed lots and three seed treatments.

Seed Lot	Seed treatment		
	Nil	Thiram	P Pickel-T®
SL1	1.86	2.91	2.66
SL2	2.37	2.86	2.80

Summary

This trial (and the others) showed clearly that the fungus causing chickpea Botrytis pre- and post-emergence seedling disease is readily controlled with registered seed treatments, provided they are applied correctly. However, we do not recommend using Botrytis infected grain as planting material even if treated properly. The seed will have lower vigour and this will increase the risk of other seedling diseases, render weed management more difficult and may increase the risk of viruses. Also, sowing rates will need to be increased to account for the reduced vigour, which may make using grower retained seed uneconomical.

Acknowledgements

Thanks to the growers who provided land for the trials and who managed the foliar diseases, weeds and insects. Thanks also to Crop Care who donated the registered seed treatments. This project is funded by NSW DPI and GRDC under Northern NSW Integrated Disease Management Project (DAN00143).

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Ascochyta management in current and new chickpea varieties – Tamworth VMP11 trial

Kevin Moore, Paul Nash and Gail Chiplin

NSW DPI, Tamworth

Introduction

Ascochyta blight, caused by the fungus *Ascochyta rabiei*, is the major chickpea disease in the GRDC Northern region. When Ascochyta first caused widespread losses across the region in 1998, all chickpea varieties were highly susceptible and in favourable seasons, needed regular protection with foliar fungicides – otherwise they died.

The chickpea breeding program has made significant progress developing varieties with improved resistance to Ascochyta. The northern program has now reached a stage, where in most seasons, varieties with resistances as good as or better than PBA HatTrick⁽ᵇ⁾ will require no in-crop foliar fungicide applications.

This has led to a reduction in the overall use of fungicides on chickpea crops and and will continue to do so. However, no variety is immune and their pods are more susceptible than their vegetative parts. Under conditions conducive to Ascochyta even these varieties need spraying. But at what rate and how frequently? Can we tailor a variety's Ascochyta management strategy to match its Ascochyta resistance rating? This has been the aim of the VMP (Variety Management Package) series of trials conducted at Tamworth since 2000.

Methods

Design: VMP11 was a Randomised Complete Block, with four varieties, three treatments and four replicates. The trial was sown into standing cereal stubble on 8 June 2011 using disc openers on 40 cm row spacing in plots 4 m wide by 10 m long. Each plot was separated from its neighbour on all sides by a 2 m x 10 m buffer of Genesis™ 425 (rated R to Ascochyta).

Four varieties: Jimbour⁽ᵇ⁾, PBA HatTrick⁽ᵇ⁾, PBA Boundary⁽ᵇ⁾ and CIAC0912 (a soon to be released desi).

Three treatments:

1. A low disease scenario with regular applications of 1.0L/ha Unite®720 (720g/L chlorothalonil) in 100L/ha water, the 1st applied before inoculation;
2. a high disease scenario with Nil sprays; and
3. a VMP treatment with a low and off label rate of chlorothalonil.

Only data for label rate and nil fungicide treatments are reported here. The first VMP spray for Jimbour⁽ᵇ⁾ was applied before inoculation. The first VMP spray for the other entries was applied on 27 Sep after two infection events, when the Jimbour⁽ᵇ⁾ was getting its 3rd spray.

Inoculation: On 7 Aug, when plants were at the 5–6 leaf stage, the trial was inoculated during a rainfall event with a mix of nine isolates of *Ascochyta rabiei* collected from commercial chickpea crops in 2009 and 2010 at a rate of 500,000 spores per mL in 100 L/ha water. From inoculation to desiccation (29 Nov), the trial received 346 mm of rain in 33 rain days (26 days >1.0 mm) compared with the 100 year average for the same period of 313 mm and 44 rain days (34 days >1.0 mm).

Results

Conditions were favourable for Ascochyta and the unprotected (Nil) Jimbour⁽ᵇ⁾ plots were dead by mid October. The results are summarised in Table 1. Key findings of VMP11 were:

- Under high disease pressure, Ascochyta can be successfully managed on susceptible varieties with registered rates of chlorothalonil.
- Well managed Jimbour⁽ᵇ⁾ yielded 2.7 t/ha with a Gross Margin (GM) of $792/ha.
- Under high disease pressure, unsprayed PBA HatTrick⁽ᵇ⁾ still gave a profitable yield (GM $478/ha).
- The new variety, PBA Boundary⁽ᵇ⁾, performed exceptionally well, yielding over 2 t/ha without any foliar fungicide.
- The next desi line to be released, CICA0912, performed even better with no significant difference in yield between six sprays of chlorothalonil fungicide (2.5 t//ha) and no sprays (2.4 t/ha).

Table 1. Number and rate/ha of chlorothalonil sprays, cost of spraying, grain yield, and gross margin for four desi chickpea varieties in the 2011 Tamworth VMP11 trial. (GM's also take into account other production costs estimated at $300/ha; chickpea price $450/t)

Variety and treatment/ha	No. Sprays	Cost $/ha	Yield kg/ha	GM $/ha
Jimbour(l) – 1.0 L	6	126	2707	792
PBA HatTrick(l) – 1.0 L	6	126	2767	819
PBA Boundary(l) – 1.0 L	6	126	2691	785
CICA0912 – 1.0 L	6	126	2540	717
Jimbour(l) – Nil	0	0	0	–300
PBA HatTrick(l) – Nil	0	0	1728	478
PBA Boundary(l) – Nil	0	0	2114	651
CICA0912 – Nil	0	0	2416	787

Summary

VMP11 confirmed the MR/R Ascochyta rating of PBA HatTrick(l) and demonstrated that PBA Boundary(l) and CICA0912 have even better resistance to that disease. The VMP treatment (data not presented) also showed that fungicide rates can be reduced especially with varieties with improved Ascochyta resistance .

Alternative summary

The VMP approach to refining chickpea Ascochyta management has demonstrated that the disease can be successfully managed in varieties as susceptible as Jimbour(l). VMP11 confirmed the MR/R Ascochyta rating of PBA HatTrick(l) and established that PBA Boundary(l) and CICA0912 have even better resistance to that disease. The VMP treatment (data not presented) also showed that fungicides rates can be reduced especially with varieties with improved Ascochyta resistance . To a farmer spraying 500 ha of chickpea three times, this represents a saving of $31,000. To the GRDC Northern Region chickpea industry, this translates to a saving of $24.8 million (based on an area of 400,000ha).

Acknowledgements

This project is funded by NSW DPI and GRDC under Northern NSW Integrated Disease Management Project (DAN00143). Thanks to chemical companies who provide products for research purposes and trial management.

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Sprayed vs unsprayed wheat national variety trials in 2010 – what did we learn?

Steven Simpfendorfer[1] and Peter Matthews[2]

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[2]NSW DPI, Orange

Introduction

The National Variety Trial (NVT) system is a Grains Research and Development Corporation (GRDC) initiative which conducts more than 630 trials annually across all states on 10 different crop species. The re-emergence of stripe rust infection in eastern Australia since 2003 has created a dilemma for NVT wheat trials as to whether this disease should be managed in the trials or not. That is, are the trials purely yield trials, in which case fungicides should be used to control stripe rust, or should the trials represent the true genetic potential of varieties including disease reaction to pathogens prevalent in the region? This is a debate beyond the scope of this current article. However, in response NVT took the initiative in 2010 of increasing the number of replicates of each variety at some sites to four and spraying two replicates with in-crop foliar fungicides to primarily control stripe rust and leaving the other two replicates unsprayed.

We used some of this data (available on the internet at www.nvtonline.com.au) to address the question of at what resistance rating does it become uneconomical to manage stripe rust.

NVT trials in 2010

Nine sprayed vs unsprayed wheat variety trials were conducted in NSW in 2010 with four in the south (Galong, Gerogery, Willbriggie and Canowindra), two in the central region (Trangie and Coonamble) and three in the north of the state (Spring Ridge, Coolah and North Star).

All sites consisted of four replicates with two replicates unsprayed and the other two replicates generally sprayed at GS30-32 followed by a second application at GS39. Products used at the nine sites were generally either a full rate of tebuconazole (290 mL/ha) or a full rate of epoxiconazole (500 mL/ha) at each timing. This provided very good disease control in the main season trials with selected commercial varieties common across all sites used in this comparison (Table 1).

Table 1. Main season wheat varieties used in comparison and resistance rating to stripe rust (WA Yr17+ pathotype)

WA Yr 17+ Resistance Rating	Main Season Varieties
VS	QAL 2000ⓓ
MS–S	Charaⓓ
MS	EGA Wylieⓓ, Ellisonⓓ, Janzⓓ, Kennedyⓓ, Langⓓ, Orionⓓ, Venturaⓓ
MR–MS	LongReach Crusaderⓓ, Dakotaⓓ, Sunco, Sunzellⓓ
MR	EGA Bountyⓓ, EGA Gregoryⓓ, LongReach Spitfireⓓ, Sunvexⓓ, Sunvaleⓓ
R–MR	GBA Hunterⓓ, GBA Rubyⓓ, Lincolnⓓ, Merindaⓓ
R	Livingstonⓓ

The 2010 season

The 2010 season was characterised by wet conditions throughout most of NSW which resulted in grain yields across the nine sites of on average around 5 t/ha. The seasonal conditions were very conducive to the development of stripe rust in the unsprayed treatments. Yield loss associated with stripe rust infection results from a loss of photosynthetic capacity – green leaf area. Although stripe rust was the predominant leaf disease present in these trials, low levels of yellow spot may have also existed at some sites. Additionally, the fungicide used in some of these trials may have increased green leaf retention as noted in other research. These factors cannot be separated from the main effect of stripe rust control in these trials. However, growers should be aware that these trials represent a 'best case scenario' of the yield responses that could be expected from fungicide application. These responses should not be expected in seasons with less in-crop rainfall and hence lower yields, with a shorter grain-fill period (hotter and drier seasonal finish) or with a different fungicide strategy than that used in these trials (i.e. lower label rates, different products, timings or single applications).

The WA Yr17+ pathotype (134 E16 A+ Yr17+) was the dominant pathotype at each of the nine trial sites in NSW in 2010 based on variety reactions. Hence, resistance ratings against this pathotype were examined for the main season wheat varieties.

Impact of resistance rating

Stripe rust resistance rating had a large effect on yields in the absence of fungicide intervention (unsprayed treatment). Average yield loss from stripe rust infection across the nine sites can be determined by comparing the sprayed and unsprayed treatments for each variety.

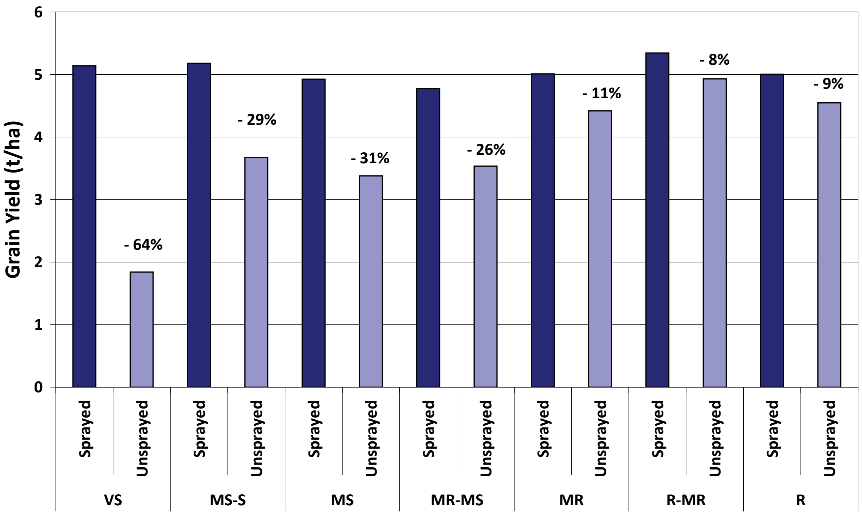

Figure 1. Yield of wheat varieties with varying stripe rust resistance sprayed and unsprayed with foliar fungicides in 2010.
(Bars are average of nine NVT trial sites in NSW in 2010; percentage figures represent yield difference between sprayed and unsprayed treatments)

Conclusions (Figure 1):

1. The level of stripe rust resistance had a large effect on yield in the unsprayed treatment.
2. Yield loss from stripe rust infection (difference between sprayed and unsprayed treatments) was 64% in the VS variety QAL2000$^{\phi}$, 29% in the MS–S variety Chara$^{\phi}$ and 9% in the R variety Livingston$^{\phi}$.
3. Average yield loss from stripe rust in the seven MS varieties was 31% (22% in Lang$^{\phi}$, up to 38% in Ventura$^{\phi}$).
4. Average yield loss from stripe rust in the four MR–MS varieties was 26%. LongReach Crusader$^{\phi}$ (42% yield loss) was noticeably worse than the other three varieties (17–21% yield loss).
5. Average yield loss from stripe rust in the five MR varieties was 11% (3% in EGA Bounty$^{\phi}$, up to 17% in Sunvex$^{\phi}$).
6. Increasing levels of stripe rust resistance did not have an associated yield penalty. Average yields of ~5 t/ha were achieved with full control of stripe rust (sprayed treatments) across most variety resistance classes.

Economics

The economic assumptions made in Figure 2 are a grain price of \$200/t and a total fungicide program cost of \$51.30/ha (i.e. one application of 500 mL/ha of epoxiconazole at \$24.00, one application of 290 mL/ha of tebuconazole at \$11.30, two fungicide applications by ground rig at \$8.00 each). Based on these assumptions an extra 0.26 t/ha of grain has to be produced to recover the cost of the fungicide spray program used. However, if the aim is to get a \$2 dollar return on every \$1 dollar spent then a yield benefit of 0.52 t/ha has to be provided by the spray program.

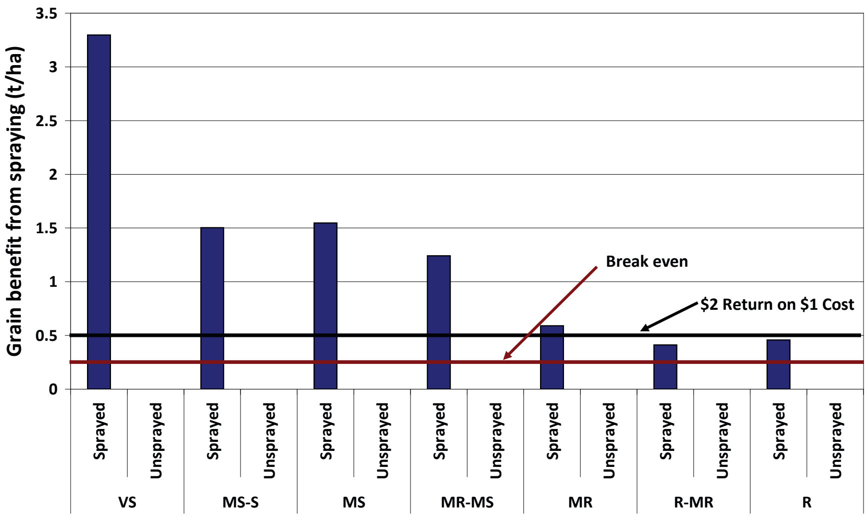

Figure 2. Economics of stripe rust management across resistance ratings.

Conclusions (Figure 2):

1. Not surprisingly, the largest economic benefit came from controlling disease in the most susceptible variety; QAL2000ᶲ; which is VS to WA Yr17+ pathotype of stripe rust. In this variety the fungicide spray program provided a $12.70 return on every $1 spent.
2. The fungicide program returned $5.77 for every $1 spent in the MS–S variety Charaᶲ and an average of $5.96 for every $1 spent in the seven MS varieties.
3. It was still economical to manage stripe rust in the four MR–MS varieties with an average return of $4.77 for every $1 spent.
4. Returns on investment became marginal in the five MR varieties with an average $2.27 return on every $1 spent. **Note:** this strategy would not have been economical in EGA Bountyᶲ.
5. Fungicide management was less economical in the three R–MR varieties with only a $1.58 return on every $1 spent or the R variety Livingstonᶲ, with a $1.77 return on every $1 spent. **Note:** Livingstonᶲ is R to the WA Yr17+ pathotype present in these trials but has reduced resistance to the WA Yr17+ Yr27+ pathotype which was first detected in eastern Australia in 2010.

Summary

It needs to be re-emphasised that the 2010 season was a particularly high yielding year characterised by good rainfall with an extended, mild grain-fill period which was very conducive to both the development of and yield loss from stripe rust. It is reasonable to assume that yield responses to stripe rust in 2010 were higher than would be expected on average. Under these conditions clear economic benefits were obtained from managing stripe rust in varieties rated MR–MS or lower while it was more marginal to manage stripe rust in varieties rated R–MR or better.

The economics of managing stripe rust in MR varieties was marginal and would not have been economical in one of the five varieties examined (EGA Bountyᶲ). **Note:** all fungicide applications in the nine NVT trials were applied by ground rig to small plots. If one or both of these fungicides were applied by air at a cost closer to $20/ha for each application (compared to $8/ha for ground rig), which was a fairly common commercial reality in 2010, this would have made fungicide management in the MR varieties uneconomical.

Yield responses observed in these NVT trials were generally obtained using a relatively expensive two spray program. These responses may not occur with different fungicide programs (single sprays, lower application rates or different timings). Additionally, a 0.52 t/ha yield benefit (at $200/t grain price) needs to occur to return $2 for every $1 spent controlling stripe rust using this strategy. This provided a marginal economic return in MR varieties in 2010 which was an above average season that produced yields of around 5 t/ha. Achieving an additional 0.52 t/ha of grain from fungicide application would be expected to be even more difficult in an average season with yields closer to 3 t/ha or in historically lower yielding environments.

Acknowledgements

This work was funded by GRDC through the NVT system. The authors thank the technical staff within NSW DPI who conducted the trials in 2010 outlined in this paper. The assistance of Alan Bowring in data manipulation is gratefully acknowledged.

Why is my 'Sunvale⒫' crop full of stripe rust?

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Introduction

Sunvale⒫ is a popular bread wheat variety throughout central and northern NSW which was commercially released by the University of Sydney in 1995. This makes it a 17 year old variety. Although Sunvale⒫ relies on the stripe rust resistance gene Yr17 it also has strong Adult Plant Resistance (APR) genes which have allowed it to remain a moderately resistant (MR) variety even to the WA Yr17+ pathotype, which has virulence for the Yr17 gene.

Significant levels of stripe rust have been reported in commercial Sunvale⒫ crops over the past few seasons. However, in GRDC funded National Variety Trials (NVT) in 2010, a season very conducive to the development of leaf diseases, Sunvale⒫ plots had very low levels of stripe rust development consistent with its MR rating.

This raised the issue as to whether this discrepancy in the commercial versus NVT reaction of Sunvale⒫ is related to seed purity, simple variety mix-up or some other factor. Genetic analysis, in collaboration with the University of Southern Queensland (USQ), was used to try and resolve this situation. This analysis compares the DNA molecular marker banding patterns in individual seeds with a unique pattern only observed in Sunvale⒫. The molecular work was backed-up by field observations of the various seed lots in a replicated small plot trial at Tamworth in 2011.

Experimental details

Agronomists were contacted in early 2011 to obtain commercial seed lots of Sunvale⒫ from the 2010 harvest. Twenty-three commercial Sunvale⒫ seed lots were obtained with 19 samples from northern NSW, 3 from Griffith and 1 from the Wellington region. Seeds from three different Sunvale⒫ checks were also included with Sunvale⒫ check 1 being sourced from 2011 NVT seed, Sunvale⒫ check 2 being sourced from AGT Narrabri 2006 seed and Sunvale⒫ check 3 being sourced from AGT Narrabri 2007 seed. Checks of three other varieties (LongReach Crusader⒫, Ellison⒫ and EGA Gregory⒫ x2) were also included to validate the testing.

DNA was individually extracted from twenty separate seeds from each sample and twelve different molecular markers (on chromosomes 1A, 6A, 1B, 2B, 3B, 4B, 7B x 3 and 2D x 3) were tested across each resulting DNA sample by Dr Anke Martin at USQ in Toowoomba. If the DNA from any single seed did not show the Sunvale⒫ banding pattern for at least one or more of the 12 markers, then it was considered to be another variety. All samples were sent to USQ "blind", identified only by a code.

All thirty seed lots were also sown as small plots (1 x 2 m) at Tamworth in 2011 to obtain detailed observations of head types and the stripe rust reaction of individual plants. Four replicate plots of each seed lot were sown in a randomised design with head type and stripe rust reaction recorded for each plot during flowering. Two basic categories of head type were scored being either a 'Sunvale⒫ type' which is shorter with a smaller compact head with very little gap between spikelets. This is characteristic of Sunvale⒫ and many other of the 'Sun' (Syd Uni) bred varieties (e.g. Sunco). The second category was wheat heads that were clearly not characteristic of Sunvale⒫ as they are much larger and longer with bigger gaps between spikelets so that the rachis (stem running up middle of head) becomes quite visible between spikelets. Other notes on crop height and presence or absence of awns were also taken. Stripe rust was scored for each plant type on a standard 1–9 visual scale developed by the National Rust Laboratory at Cobbitty.

Results

The seed samples from two of the three Sunvale(P) checks contained only Sunvale(P) seed (Figure 1). These two Sunvale(P) checks were kindly supplied by Dr Mequin Lui from AGT at Narrabri. The Sunvale(P) check 1 was seed used in the 2011 NVT trial network and appeared to contain a low level of contamination with one other variety. Because only twenty seeds were tested from each sample (due to cost issues) there is still the possibility that a low level of contamination generally <5% is present in any of the samples (commercial or checks).

Purity of commercial Sunvale(P) seed lots based on marker analysis varied dramatically with only 7 of the 23 (30% of samples) appearing to be >95% Sunvale(P) (Figure 1). The remaining 16 seed lots were contaminated with at least one other variety. Impurity levels were very high in some commercial seed lots with Sunvale(P) 17 only having 13 of the 20 seeds (65%) identified as true Sunvale(P) while the remaining seeds appear to consist of four different varieties. In the sample Sunvale(P) 6 only 2 of the 20 seeds tested (10%) were Sunvale(P) based on genetic testing. Sunvale(P) 6 seeds appeared to consist of 14 different varieties based on marker analysis. The Sunvale(P) 15 sample contained no Sunvale(P) seed with the molecular marker banding patterns indicating that the seed lot was composed of only one different variety with a pattern consistent with EGA Gregory(P). This result is probably due to a silo mix-up either at seed preparation for sowing or at harvest.

The field evaluations of head type and rust reaction were very consistent with the marker analysis. Field observations allowed detection of impurity levels <5% in commercial seed lots 5, 13, 14 and 16. Only seed lots Sunvale(P) 4, Sunvale(P) 7 and Sunvale(P) 12 (9% of seed lots) appeared to be pure Sunvale(P) based on molecular and field evaluations. Within 16 of the 20 commercial Sunvale(P) seed lots that had some level of contamination with another variety(s), the contaminant was very susceptible to stripe rust (MS to VS) while the true Sunvale(P) plants in the plots had an MR or better reaction. In the remaining four seed lots, the contaminant varieties in sample 9 both had Sunvale(P) like heads with possibly a slightly more susceptible MR–MS reaction to stripe rust. This would not be obvious in the paddock due to the similarity in head appearance and rust reaction so only became evident upon molecular analysis. In fact, sample 9 only varied from Sunvale(P) around the 2D markers indicating that the contaminant is closely related to Sunvale(P), possibly a sister line. Sample 10 appeared to have two contaminant varieties with the main one having an R–MR reaction to stripe rust while the lower frequency contaminant has an MS–S reaction. Sample 15 had a consistent 'non-Sunvale(P)' head type and an R reaction to stripe rust. The head type was similar to the two EGA Gregory(P) check samples, supporting the marker analysis that this was a straight variety mix-up. The dominant contaminant in sample 17 based on head type appears to be a durum wheat variety with an MR reaction to stripe rust.

Marker analysis indicated that the NVT Sunvale(P) seed source (Sunvale(P) check 1) contained a 5% impurity. This was also supported by the field observations with an average of 5% of scattered plants having a larger 'non-Sunvale(P)' head type with an MS–S reaction to stripe rust. The field observations also supported the marker analysis with the Sunvale(P) 6 seed lot. The exception being that the markers indicated that there are 14 different contaminant varieties but only 5 could be easily distinguished with field observations which included an awnless variety.

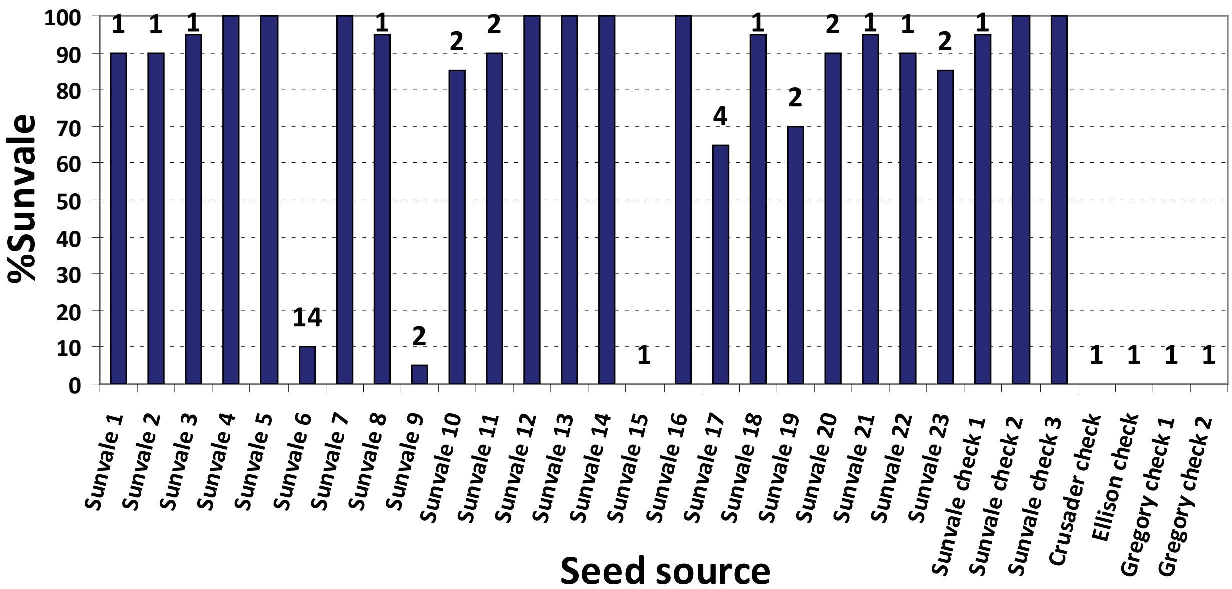

Figure 1. Purity of commercial cv. Sunvale(P) sources in 2011.
(Value above bars indicates the number of different contaminant varieties identified by marker analysis)

Conclusions

Impurity (variety contamination) appears quite common in commercial Sunvale(b) crops. If the Sunvale(b) seed happens to have been contaminated with a stripe rust susceptible variety, as evident in 16 of the commercial seed lots, then this would explain the perceived increased stripe rust susceptibility in commercial crops. That is, they are not pure Sunvale(b), but have been contaminated with another more rust susceptible variety. Straight variety mix-ups (e.g. Sunvale(b) 15) also appear to be an issue.

It is not surprising that high levels of impurity were observed in commercial Sunvale(b) lots given that this is a 17 year old variety. Growers need to take more care in ensuring variety purity and correct identification of seed lots for planting. Pure Sunvale(b) remains MR to stripe rust and does not require in-crop fungicide management. However, contamination of commercial Sunvale(b) seed lots has introduced more stripe rust susceptible varieties into these paddocks in most situations which is unfairly tarnishing the resistance rating of this variety and jeopardising industry confidence in stripe rust resistance breeding as a whole. This situation is unlikely to be unique to Sunvale(b) and may also possibly explain mixed reports of stripe rust levels commercially in more recently released MR varieties such as EGA Gregory(b).

Summary

1. Based on marker analysis, 16 of the 23 commercial Sunvale(b) seed lots (70%) contained a level of varietal contamination of at least 5%. This result was supported by careful field observations of plant/head type and stripe rust reactions.
2. One sample contained no Sunvale(b) and appears to be a mis-labelled sample of EGA Gregory(b).
3. Impurity levels ranged from <5% up to 95% in the contaminated Sunvale(b) seed lots.
4. In 16 of the 20 commercial Sunvale(b) seed lots that had some level of contamination with another variety(s), the contaminant was very susceptible to stripe rust (MS to VS) while the true Sunvale(b) plants in the plots had an MR reaction or better.
5. If your 'Sunvale(b)' crop is full of stripe rust then it is almost certainly contaminated with another more rust susceptible variety.

Acknowledgements

This survey was partially funded by GRDC under projects DAN00143 and USQ00012. We thank all the growers and agronomists who provided Sunvale(b) seed for this study and Dr Mequin Lui (AGT, Narrabri) for supplying two of the check sources of Sunvale(b).

Impact of sowing time and varietal tolerance on yield loss to the root-lesion nematode *Pratylenchus thornei*

Steven Simpfendorfer, Matt Gardner and Guy McMullen
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Introduction

Root-lesion nematodes (RLN) are microscopic worms that feed and reproduce inside plant roots which can lead to yield loss in intolerant cereal and pulse crops. *Pratylenchus thornei* (*Pt*) and *Pratylenchus neglectus* (*Pn*) are two important species of RLN in the northern grains region. Survey work indicates that *Pt* is more widespread throughout the region and has a higher frequency of populations >2,000 *Pt*/kg in the 0–30 cm soil layer. These levels present a high risk of yield loss in intolerant varieties. Tolerance is the ability of a variety to maintain yield in the presence of a pathogen e.g. *Pt* or the crown rot fungus. Tolerance in a variety will not reduce the levels of a pathogen that are present and may increase them for subsequent crops. These two trials aimed to examine the interaction of varietal tolerance to *Pt* with both sowing time and crown rot in a range of winter cereal types and varieties.

Site details

Locations:	"Jabiru", Mungindi	"Woolingar", Coonamble
Agronomist:	Rob Holmes, HMAg	Rohan Brill, NSW DPI
Nematodes:	18,515 *Pt*, 0 *Pn*/kg soil at 0–30 cm	5,522 *Pt*, 0 *Pn*/kg soil at 0–30 cm
1st Sowing:	10 May 2011	20 May 2011
2nd Sowing:	2 June 2011	22 June 2011

Treatments

- Five barley varieties (Oxford⟨PBR⟩, Commander⟨PBR⟩, Hindmarsh⟨PBR⟩, Shepherd⟨PBR⟩ and Grout⟨PBR⟩).
- Four durum wheat varieties (Caparoi⟨PBR⟩, Hyperno⟨PBR⟩, EGA Bellaroi⟨PBR⟩ and Jandaroi⟨PBR⟩).
- Nine bread wheat varieties (EGA Gregory⟨PBR⟩, SUN627A, LongReach Spitfire⟨PBR⟩, EGA Bounty⟨PBR⟩, Livingston⟨PBR⟩, LongReach Crusader⟨PBR⟩, Sunvex⟨PBR⟩, Ellison⟨PBR⟩ and Strzelecki⟨PBR⟩).
- All plus and minus crown rot at each sowing time.

Effect of sowing time on yield

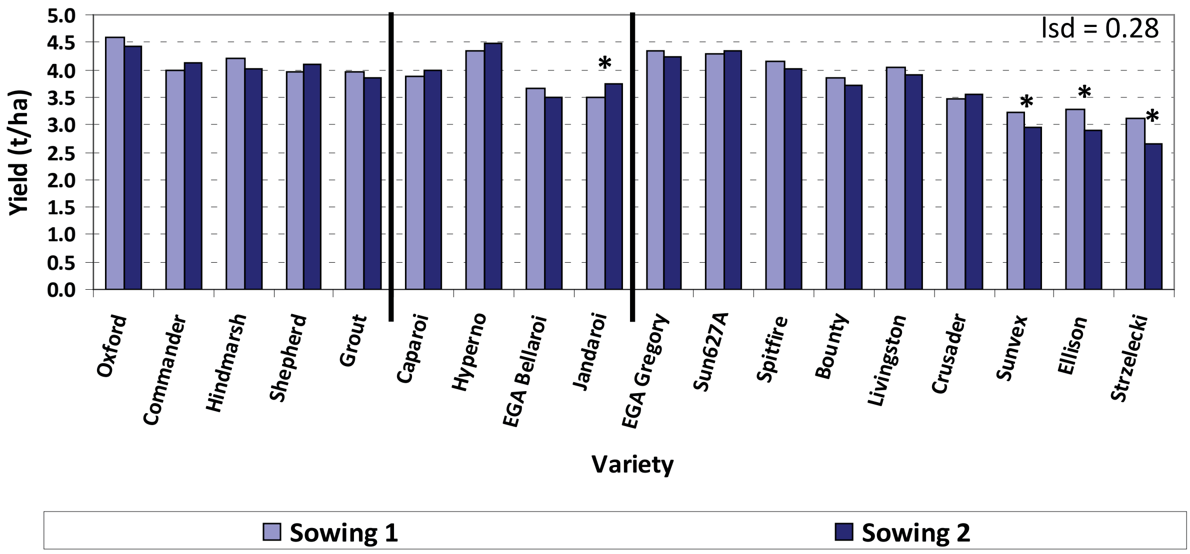

Figure 1. Yield of winter cereals at two sowing times (10th May and 2nd June): Mungindi 2011.
**** Indicates varieties which had a significant (P=0.05) difference in yield between sowing times.***

The trial site near Mungindi (10 km east of town) experienced good rainfall throughout the season, especially during flowering and grain-fill. Plots planted on the 10th May (Sowing 1) experienced 243 mm of in-crop rainfall while those sown on the 2nd June (Sowing 2) experienced 228 mm of in-crop rainfall. This along with generally milder temperatures during grain-fill minimised the impact of sowing time on yield at this site in 2011. Sowing time only had a significant impact on yield in the durum variety Jandaroi⭙, which was higher yielding with the later sowing, and in the three bread wheat varieties Sunvex⭙, Ellison⭙ and Strzelecki⭙ which were on average 11% lower yielding with delayed sowing (Figure 1). These three bread wheat varieties are all intolerant to very intolerant (I–VI) to *Pt* while the other bread wheat varieties in the trial have varying levels of increased tolerance.

The trial site near Coonamble (~40 km north-west of town) had a large difference in final yields between the two sowing times (Figure 2). Sowing 1 was planted into a dry seedbed on the 20th May in-front of a 12 mm rainfall event on the 23rd which resulted in good establishment. These plots experienced a total of 220 mm of in-crop rainfall. In contrast, plots sown on the 22nd June (Sowing 2) where sown into a moist but drying seedbed and only received 10 mm of rainfall in the month following sowing, which reduced establishment and early root development. Plots in Sowing 2 at Coonamble experienced a total of 180 mm of in-crop rainfall. This resulted in a significant reduction in yield with delayed sowing in all varieties, ranging from a loss of 0.8 t/ha (20%) in the barley variety Shepherd⭙ up to 2.1 t/ha (50%) in the bread wheat variety LongReach Crusader⭙ (Figure 2).

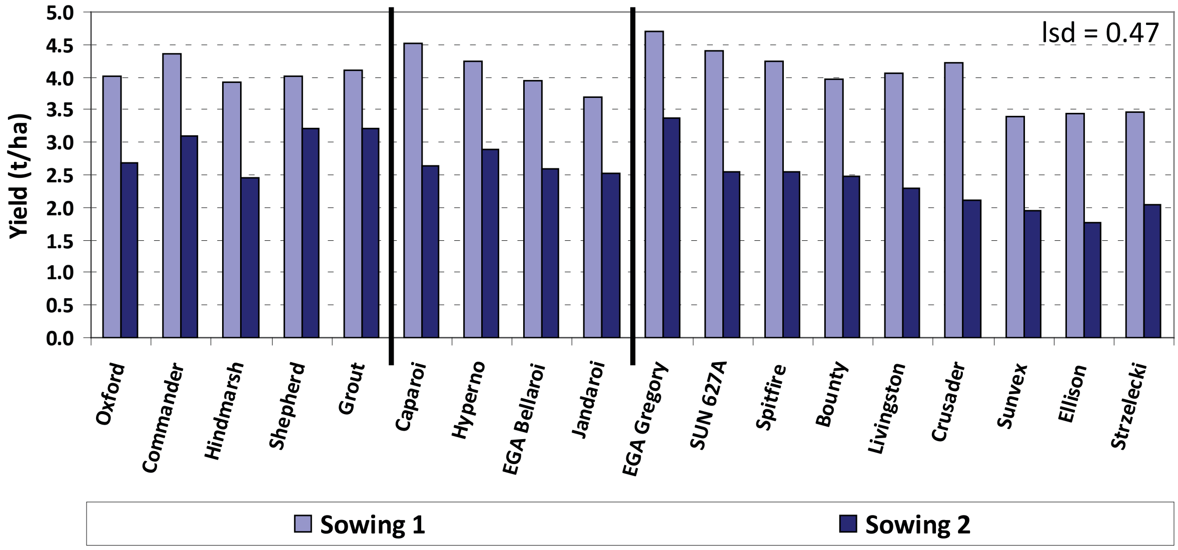

Figure 2. Yield of winter cereals at two sowing times (20th May and 22nd June): Coonamble 2011.

Impact of sowing time on yield loss from *Pratylenchus thornei* (*Pt*)

There are currently no commercially available winter cereal varieties that are fully tolerant of *Pt*. Consequently the impact of *Pt* on yield under high soil populations, such as at the Mungindi and Coonamble trials sites in 2011, is determined through comparison with the variety(s) with the highest known levels of tolerance. Tolerance ratings of the nine bread wheat varieties used in this study are outlined in Table 1 below.

Table 1. Tolerance rating of bread wheat varieties to Pratylenchus thornei

Moderately tolerant (MT)	Moderately tolerant – Moderately intolerant (MT–MI)	Moderately intolerant (MI)	Intolerant – Very Intolerant (I–VI)
EGA Gregory⭙	EGA Bounty⭙	Livingston⭙	Ellison⭙
	LongReach Spitfire⭙	LongReach Crusader⭙	Strzelecki⭙
	SUN627A (p)		Sunvex⭙

(p) Indicates provisional rating.

EGA Gregory⭙, with a rating of moderately tolerant (MT) to *Pt*, has the highest level of tolerance of the varieties examined in these trials. Hence, the following analysis looks at the average yield effects across varieties with decreasing levels of tolerance to *Pt* compared to this one MT variety. **Note:** this approach cannot differentiate any inherent yield advantage of an individual variety that is not related to its level of *Pt* tolerance. Hence, this method can be potentially biased as any yield difference is attributed to *Pt* tolerance. Additionally, this method may also underestimate the actual impact of *Pt* as the extent of yield loss in the MT variety cannot be determined.

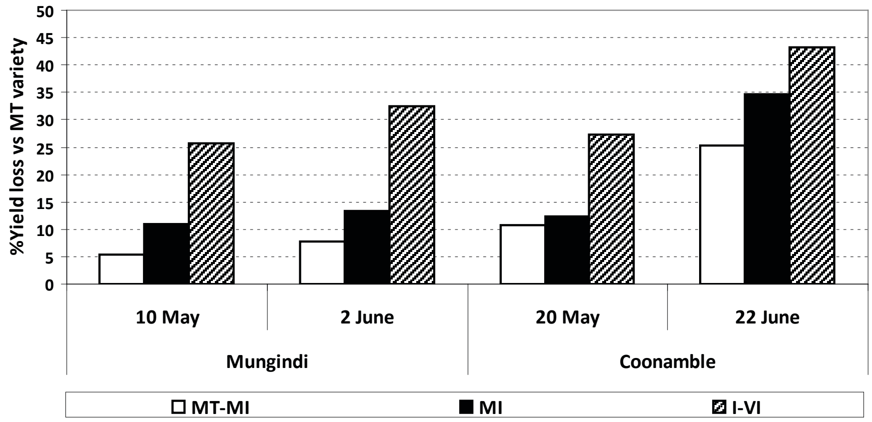

Figure 3. Yield loss from Pratylenchus thornei in wheat varieties with varying levels of tolerance.

Decreasing levels of tolerance increased yield loss from *Pt* (relative to the MT variety) at both sites and across both sowing times (Figure 3). There was generally a big jump in the extent of yield loss when moving from a moderately intolerant (MI) to an intolerant–very intolerant (I–VI) variety (additional 9–19%), consistent with the disparity in these ratings. Delayed sowing at both sites increased the extent of yield loss across all three tolerance levels. The impact of *Pt* on yield was highest with the second sowing time (22 June) at Coonamble that experienced the driest conditions during establishment and early crop growth. Variety choice can have a large impact on yield and hence profitability when cropping in soils with high populations of *Pt*. Sowing a MT–MI variety rather than a MT variety reduced yield by between 5 to 25%, sowing a MI variety reduced yield by between 11 to 35%, while planting a I–VI variety reduced yield by between 26 to 43% in these trials in 2011 (Figure 3).

Impact of crown rot on yield

Good levels of in-crop rainfall at Mungindi, especially during grain-fill, accompanied by mild temperatures limited the expression of crown rot at this site in 2011. Inoculation of plots at sowing with the crown rot fungus did not significantly reduce the yield of any variety at either sowing time.

Conversely, crown rot significantly impacted on the yield of all varieties at both sowing times under tougher growing conditions at Coonamble in 2011. Late rain and milder temperatures again reduced the extent of yield loss that would have occurred if hotter and drier conditions had occurred during grain-fill particularly with the later sowing. The direct impact of crown rot on yield was determined by comparing the yield of each variety in plots without crown rot relative to plots inoculated with the crown rot fungus at sowing. Averaged across the different winter cereal types, crown rot reduced yield by 18% in barley, 27% in durum and 22% in bread wheats. Sowing time did not have a significant impact on the extent of yield loss from crown rot infection at this site in 2011 (Figure 4).

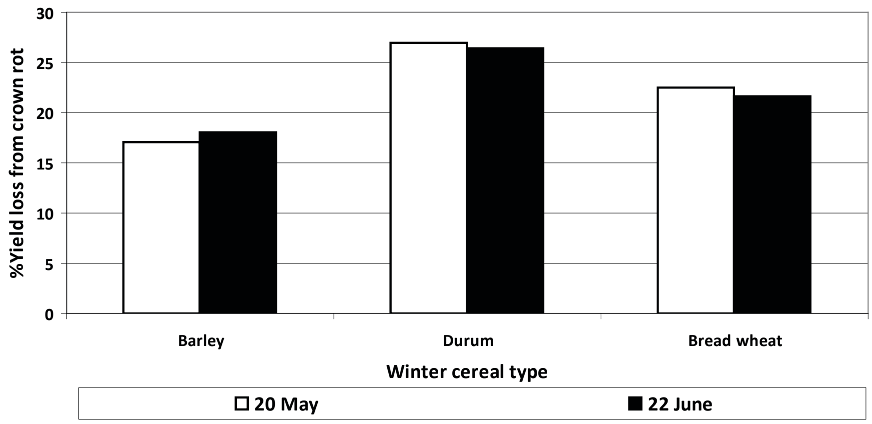

Figure 4. Yield loss from crown rot infection across types of winter cereals – Coonamble 2011.

Interaction of *Pt* tolerance with crown rot

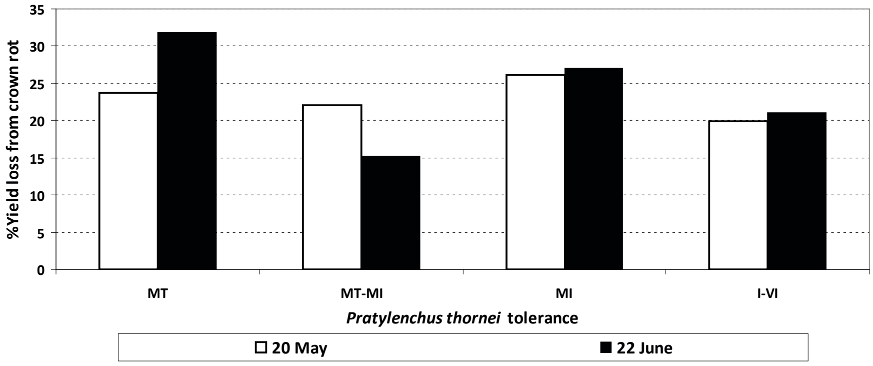

Figure 5. Effect of Pratylenchus thornei tolerance on yield loss from crown rot.

Yield loss from crown rot was not related to a varieties level of *Pt* tolerance with even the MT variety EGA Gregory⁽ᵇ suffering 24% yield loss from crown rot at the first sowing and 32% on the second sowing (Figure 5). Varieties rated I–VI to *Pt* suffered around 20% yield loss to crown rot under the same conditions. Varietal tolerance to crown rot appears to be independent of a varieties tolerance to *Pt*.

Summary

1. Wheat variety choice can have a huge impact on yield loss to *Pt* (up to 43% yield loss in intolerant bread wheat varieties in 2011).
2. Yield losses from *Pt* were exacerbated by delayed sowing and drier conditions.
3. Crown rot remains an important disease of winter cereals causing an average yield loss of 18% in barley, 27% in durum and 22% in bread wheat varieties at Coonamble in 2011. However, the impact of seasonal conditions on crown rot expression was clearly demonstrated at Mungindi.
4. Tolerance of wheat varieties to crown rot does not appear related to their level of *Pt* tolerance.
5. However, the difference in tolerance levels between wheat varieties appears larger for *Pt* than for crown rot.

Conclusions

Both *Pt* and crown rot are significant diseases of winter cereal crops in the northern cropping region. In these two trials conducted in 2011, *Pt* could be demonstrated to reduce yield by up to 43% under high starting populations with delayed sowing and drier growing conditions. Delayed sowing into late autumn/winter is likely to see crops initially develop under cooler soil temperatures which are likely to reduce the rate of root development. Conversely, earlier sown crops would establish under warmer soil conditions and have more rapid early root growth if adequate moisture is available. Drier soil conditions during crop establishment and early growth, e.g. with the second sowing time (22 June) at Coonamble in 2011, is also likely to restrict early root development. In theory, any restriction to root development is likely to negatively impact on a crops ability to compensate for feeding upon these root systems by *Pt*. Variety choice can have a large impact on yield and hence profitability when cropping in soils with high populations of *Pt*. Currently these trials have only examined the relative tolerance of varieties to *Pt*. It should be stressed that a varieties resistance to *Pt* (build-up of nematode populations within the soil) should also be an important consideration in variety choice.

Crown rot remains a significant disease in the region with losses dependent on soil moisture and temperature stress experienced during flowering and grain-fill. Crown rot caused up to 37% yield loss in durum varieties at the Coonamble site in 2011 but cooler, wetter conditions limited the expression (yield loss) of this disease at Mungindi. Averaged across the different winter cereal types, crown rot reduced yield by 18% in barley, 27% in durum and 22% in bread wheats at Coonamble in 2011. Previous research conducted by NSW DPI and the Northern Grower Alliance across 11 sites in northern NSW in 2007, has demonstrated that crown rot caused average yield losses of 20% in barley (up to 69% under drier conditions and hotter temperatures during grain-fill), 25% in bread wheat (up to 65%) and 58% in durum (up to 90%).

The Coonamble site demonstrates that the tolerance of wheat varieties to crown rot does not appear to be related to their level of *Pt* tolerance. Yield losses to both diseases in intolerant varieties can be significant (up to 43% for *Pt* and up to 37% for crown rot at Coonamble in 2011) under high inoculum levels. However, the benefit obtained from sowing a more tolerant bread wheat variety appears to be greater for *Pt* (up to 43%) than for crown rot (up to 21%). Another way of expressing this is that the difference in tolerance levels between wheat varieties appears larger for *Pt* than for crown rot. Selecting tolerant wheat varieties is one of the main options for maintaining profit in the presence of high populations of *Pt*. In contrast, even the most crown rot resistant/tolerant commercial wheat variety can still suffer up to 50% yield loss under high inoculum levels when hot/dry conditions occur during grain-fill. Variety selection is not a primary strategy for managing crown rot. Hence, under high soil populations of *Pt* more emphasis should be placed on a wheat varieties tolerance to *Pt* than to crown rot. Rotation to non-host crops remains the primary management tool for crown rot and can also be a valuable strategy to reduce or maintain *Pt* populations below the threshold (<2,000 *Pt*/kg soil) for yield loss in intolerant wheat varieties.

Acknowledgements

Firstly we thank the collaborators at each trial site who allowed access to their farms and provided valuable assistance throughout the season. At 'Jabiru' we thank the owner Bruce Longworth, manager Joe Robinson and agronomist Rob Holmes (HMAg). At 'Woolingar' we thank the owner Lindsay Meers, manager Jason Peters and district agronomist Rohan Brill (NSW DPI). Technical assistance provided by Rod Bambach, Zeb Taylor, Stephen Morphett, Jim Perfrement, Ben Bowman, Alan Bowring, Robyn Shapland, Kay Warren, Amy Alston and Patrick Mortell is gratefully acknowledged.

ⓓ Varieties displaying this symbol beside them are protected under the Plant Breeders Rights Act 1994.

Cereal pathogen survey of central and northern NSW – 2011

Steven Simpfendorfer[1], Amy Alston[1], Alan McKay[2] and Grant Poole[2]

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Introduction

PreDicta B is a DNA based soil test developed by the South Australian Research and Development Institute (SARDI) to detect and quantify a range of important cereal pathogens. Each cereal pathogen has a unique DNA code so the PreDicta B test is very selective and sensitive for the individual pathogens detected. Risk categories have been developed for DNA levels of a range of cereal pathogens in South Australian and Victorian cropping systems but these categories have not been validated or calibrated for central and northern NSW.

Project aims

To help calibrate risk categories for the DNA based soil testing service, PreDicta B in central and northern NSW. In collaboration with NSW DPI District Agronomists around 120 focus paddocks will be assessed each year for 3 years (2010–2012) in twelve agronomy districts ranging from Dubbo in the south up to the Qld border in the north and west to Warren, Walgett and Mungindi.

Pathogens detected by PreDicta B are:

1. *Pratylenchus thornei* and *Pratylenchus neglectus* which are the two important species of root-lesion nematodes (RLN). Nematodes are microscopic worms that feed and reproduce inside plant roots which can lead to yield loss in intolerant cereal and pulse crops. There is limited information on the distribution and importance of RLN in central and northern NSW farming systems.
2. *Bipolaris sorokiniana* is a soil and stubble-borne fungal pathogen which causes common root rot in winter cereals. Bipolaris has a dark, thick wall spore which can survive up to two years in soil. Common root rot infects the sub-crown internode (joins seed to crown) and generally causes ill-thrift in infected plants.
3. *Pythium* spp. This test detects a wide range of *Pythium* species which can cause damping-off (death) of winter cereal seedlings. *Pythium* spp. can also infect older plants and generally reduces the production of lateral roots which can lead to minor yield reductions which are often difficult to attribute to a cause.
4. *Fusarium pseudograminearum* (*Fp*) is the stubble-borne fungus which causes crown rot in winter cereals.
5. *Fusarium culmorum*/*F. graminearum*. This DNA test detects both *Fusarium culmorum* which can cause crown rot but is generally considered to be uncommon in northern NSW from previous studies and *F. graminearum* which is the main pathogen causing Fusarium head blight in winter cereals. However, this test can not differentiate between these two fungal species.

Survey details

In collaboration with NSW DPI District Agronomists, 248 focus paddocks were assessed around sowing in 2011 in twelve agronomy districts (19–24 paddocks/district) ranging from Dubbo in the south up to the Qld border in the north and west to Warren, Walgett and Mungindi. A one hectare area was established in each focus paddock. Two separate paddocks were surveyed on each farm in 2011. Paddock A is the same location as sampled in 2010 and a second paddock B which was planned to be sown to a winter cereal in 2011 was also established. Twenty small cores were collected in a grid across the trial area targeting the previous crop rows to a depth of 0–30 cm prior to sowing. Soil samples were sent to SARDI for PreDicta B analysis.

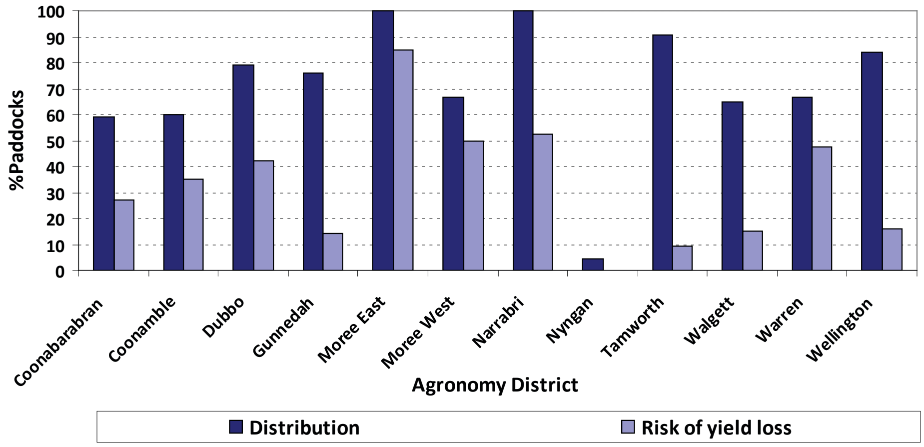

Figure 1. Distribution and potential importance of Pratylenchus thornei in central and northern NSW.

- *Pratylenchus thornei* (*Pt*) was widespread, being detected in all 12 agronomy districts, and distributed in 59 to 100% of random paddocks within a district. Nyngan was an exception with *Pt* detected in only 5% of random paddocks in this district. Averaged across districts, *Pt* was detected in 70% of random paddocks in central and northern NSW.
- The Qld based threshold for yield loss in intolerant wheat varieties is 2,000 *Pt*/kg soil.
- A lower percentage of random paddocks in 11 of the 12 agronomy districts (all except Nyngan), had *Pt* populations >2,000/kg soil indicating a risk of yield loss if intolerant varieties were sown in 2011. Averaged across districts, 33% of random paddocks had a risk of yield loss in 2011.
- The Moree East district appears to be particularly challenged with *Pt* being detected in 100% of random paddocks and at populations representing a risk of yield loss in 85% of paddocks in this district. One paddock in the Moree East district had the highest *Pt* population (50,152 *Pt*/kg soil) of all the 248 paddocks surveyed in 2011. In fact, 30% of the paddocks in the Moree East district had *Pt* populations >15,000 *Pt*/kg soil (>7.5 times the threshold for yield loss).

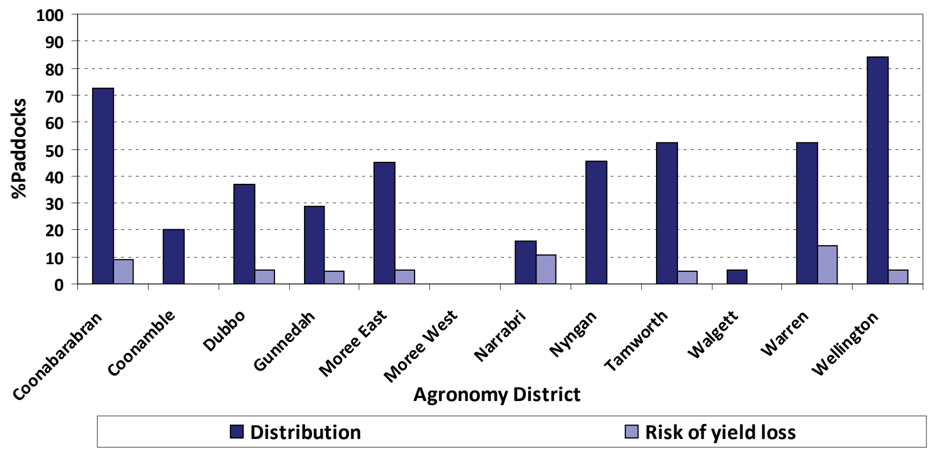

Figure 2. Distribution and potential importance of Pratylenchus neglectus in central and northern NSW.

- *Pratylenchus neglectus* (*Pn*) was widespread; being detected in 11 of the 12 agronomy districts (all except Moree West) but generally had a lower distribution within districts than *Pt* of between 5 to 84% of paddocks. Averaged across districts, *Pn* was detected in 38% of random paddocks in central and northern NSW.
- Only 5% of paddocks had high *Pn* populations (>2,000 *Pn*/kg soil) indicating a risk of yield loss in 2011 if intolerant varieties were sown.

Common root rot distribution and importance

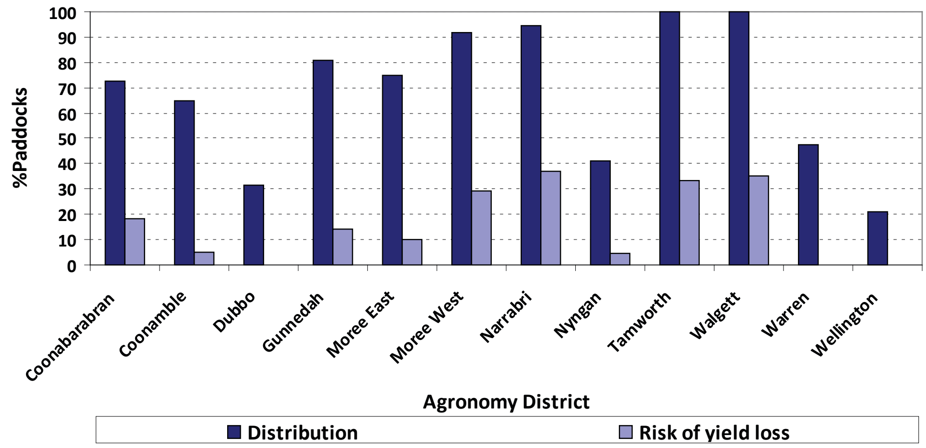

Figure 3. Distribution and potential importance of common root rot in central and northern NSW.

- *Bipolaris sorokiniana* (*Bs*), the cause of common root rot (CRR), was very widespread being detected in all 12 agronomy districts and distributed in between 21–100% of random paddocks within each district. Averaged across districts *Bs* was detected in 69% of random paddocks in central and northern NSW.
- *Bs* populations were generally low but reached populations representing a medium to high risk of yield loss from CRR in 2011 in around 30% of paddocks in the Moree West, Narrabri, Tamworth and Walgett districts based on preliminary risk categories.
- A Bipolaris level >339 pg *Bs* DNA/g soil represents a high risk of yield loss from CRR based on early preliminary studies with Graham Wildermuth (formerly QDPI). Four of the 20 paddocks surveyed in the Walgett district had levels ranging from 1,150 up to 3,940 pg *Bs* DNA/g soil, indicating a high risk of yield loss from CRR in these paddocks in 2011.

Pythium distribution and importance

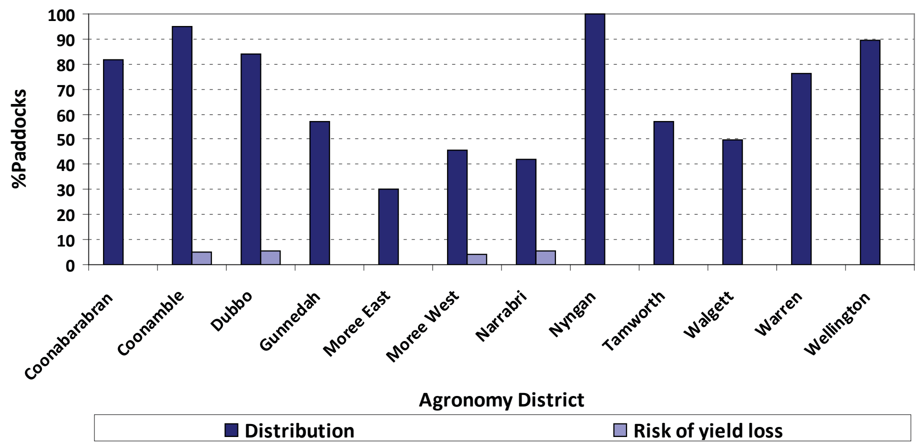

Figure 4. Distribution and potential importance of Pythium in central and northern NSW.

- *Pythium* was widespread being detected in all 12 agronomy districts and distributed in between 30–100% of random paddocks within each district. Averaged across districts *Pythium* was detected in 67% of random paddocks in central and northern NSW.
- *Pythium* populations were generally low with populations in only one paddock in the Coonamble, Dubbo, Moree West and Narrabri districts being high enough to represent a medium or high risk of yield loss from *Pythium* infection in 2011 (<2% of random paddocks) based on preliminary risk categories.

Crown rot distribution and importance

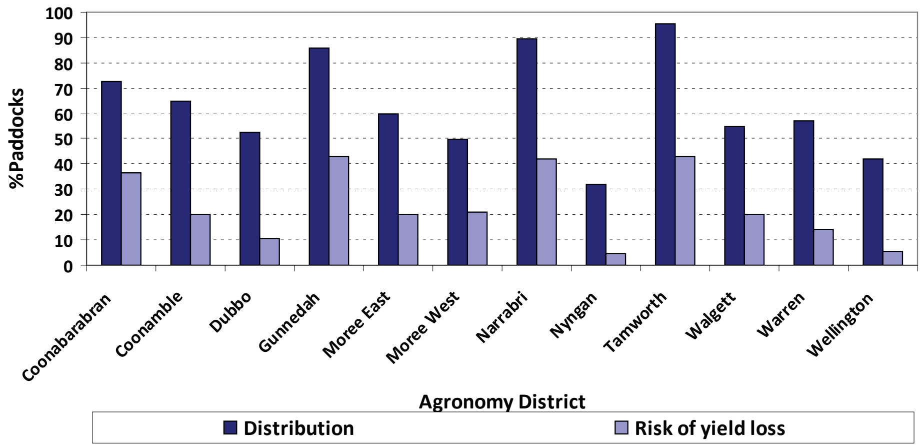

Figure 5. Distribution and potential importance of crown rot in central and northern NSW.

- *Fusarium pseudograminearum* (*Fp*), the main cause of crown rot in winter cereal crops, was widespread across the survey area being detected in 32 to 95% of paddocks within each district. Averaged across districts *Fp* was detected in 63% of random paddocks in central and northern NSW.
- *Fp* populations were generally low but reached populations representing a medium to high risk of yield loss from crown rot in 2011 in around 30% or more of paddocks surveyed in the Coonabarabran, Gunnedah, Narrabri and Tamworth districts based on preliminary risk categories.

Fusarium head blight distribution and importance

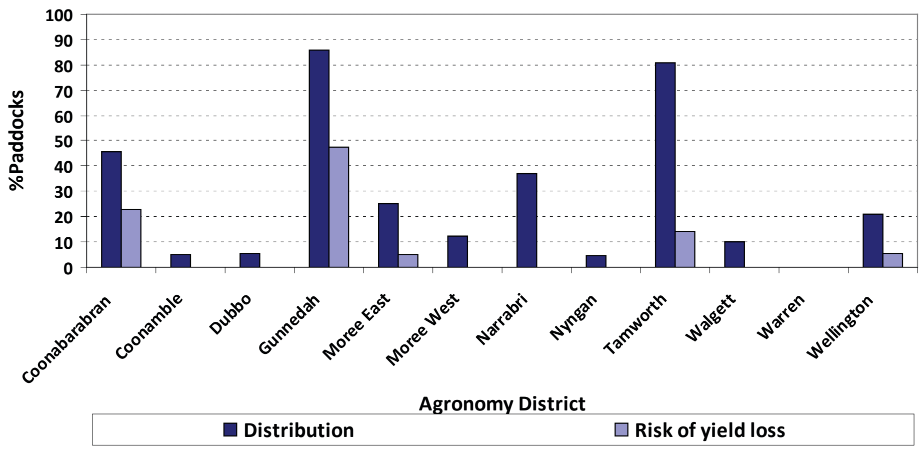

Figure 6. Distribution and potential importance of Fusarium head blight in central and northern NSW.

- Fusarium graminearum (*Fg*), the main cause of Fusarium head blight (FHB) in winter cereal crops, was detected in all districts except Warren. The number of paddocks within a district in which *Fg* was detected was generally low with the exception of Coonabrabran, Gunnedah, Narrabri and Tamworth districts. Averaged across districts *Fg* was detected in 23% of random paddocks in central and northern NSW.
- The actual level of *Fg* required to present a risk of yield loss from FHB is not known so we assumed that a similar level is required as for *Fp* to cause crown rot. Based on this preliminary level, *Fg* populations were generally low but reached populations representing a medium to high risk of yield loss from FHB in 2011 in 5 paddocks in Coonabarabran, 10 paddocks in Gunnedah, 3 paddocks in Tamworth and 1 paddock in both the Moree East and Wellington districts.

Summary

Root lesion nematodes (RLN) are widespread in central and northern NSW with either species being detected in 82% of the 248 paddocks assessed in this random survey. *Pt* generally has a much higher distribution (70% random paddocks) than *Pn* (38% random paddocks). Mixed populations of both RLN species were detected in 26% of paddocks but in only 3 of these paddocks (1.2% of surveyed paddocks) was the population of both *Pt* and *Pn* above the threshold for yield loss. Soil populations of *Pt* were generally higher with 33% of paddocks having *Pt* levels representing a risk of yield loss in 2011 compared to only 5% of random paddocks with *Pn*. RLN's need to become a consideration in rotation sequences within central and northern NSW to maintain, and reduce where needed, populations of both nematode species below damaging levels.

Bs is also widespread in central and northern NSW being detected in around 69% of the 248 random paddocks surveyed in 2011. Fortunately, *Bs* populations around sowing were generally low and only represented a risk for yield loss from common root rot in 16% of paddocks.

Pythium was similarly widespread in the region being detected in 67% of the 248 random paddocks surveyed in 2011. Fortunately, *Pythium* populations around sowing were generally low and only represented a risk for yield loss in <2% of paddocks based on southern thresholds.

Fp, the cause of crown rot, was detected in 63% of the 248 random paddocks surveyed in 2011. Levels were high enough to represent a medium to high risk of yield loss from crown rot in 23% of the paddocks surveyed across central and northern NSW.

Fg, the cause of Fusarium head blight, was detected in 28% of the paddocks surveyed in 2011 with a much higher distribution in 80% or more of paddocks surveyed in both the Gunnedah and Tamworth districts. The Coonabarabran district also had a high distribution of *Fg* (45% of paddocks). The numbers of paddocks in these districts with higher levels of *Fg*, representing a risk of FHB in 2011 was also greater being 48% of paddocks in the Gunnedah, 23% in the Coonabarabran and 14% in the Tamworth districts. These districts encompass or border the Liverpool Plains region which has historically had issues with FHB caused by *Fg*, including the 2010 season. Wet weather during flowering (anthesis) is still required for these high inoculum levels within some paddocks to cause significant FHB infection but it does appear promising that the PreDicta B test can identify particular paddocks at risk.

Note, both Fusarium species (*Fp* and *Fg*) can cause FHB as occurred in the wet 2010 season. However, only *Fg* produces an airborne spore whereas FHB infection from *Fp* results from rain splash of larger spores from the tiller bases infected with crown rot. This is a much rarer event and usually results in less severe FHB infection compared to that caused by *Fg*. It has also been shown that *Fg* can be associated with causing crown rot but *Fp* is the dominant species isolated from infected tillers in the northern region. However, in practical terms the detection of either *Fp* and/or *Fg* at high levels (>100 pg DNA/g soil) within a paddock should be taken as a medium to high risk situation in terms of both crown rot and FHB if conditions conducive to the expression of either disease eventuates during the season.

PreDicta B, a soil based DNA test, appears to be a valuable tool for detecting and determining at the individual paddock level the relative risk posed by the major soil-borne wheat diseases in central and northern NSW.

Acknowledgements

This survey is partially funded by GRDC under projects DAN00143 and DAS00115. Assistance of NSW DPI District Agronomists in co-ordinating survey paddocks and sampling is gratefully acknowledged. We also thank all the growers who allowed access to their paddocks for this survey.

Fungicide management of stripe rust in wheat: up-front vs in-crop options in 2011

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Introduction

Stripe rust, caused by the fungus *Puccinia striiformis*, has re-emerged as a significant issue to wheat production in eastern Australia since 2002. Yield and quality losses are related to reductions in green leaf area resulting from pustule formation on infected leaves. Variety resistance is ultimately the best option for managing stripe rust in the long term. However, in the short to medium term growers planting moderately susceptible varieties are reliant on the use of fungicides either at sowing (in-furrow on fertiliser or seed treatments) or in-crop (application of foliar fungicides), or a combination of both options. The development of new pathotypes of the stripe rust fungus, which reduce the resistance of selected commercial varieties, can make fungicide intervention necessary in other situations.

This study evaluated a range of at sowing and in-crop fungicide strategies on the control of stripe rust in a moderately susceptible (MS) bread wheat variety, Ellison⁽ᵇ⁾ and a moderately resistant (MR) variety, EGA Gregory⁽ᵇ⁾. The trials were conducted at thirteen sites across central and northern NSW in 2011 to examine management options under varying scenarios of stripe rust pressure and seasonal conditions.

Trial details

Eleven of the thirteen trials were conducted at National Variety Trial (NVT) sites in central and northern NSW and were sown, managed for weeds and harvested by the NSW DPI mobile units. Two additional sites were conducted at Tamworth and managed by the Cereal Disease Management group. Trial sites are outlined in Table 1.

Treatment details

Two bread wheat varieties EGA Gregory⁽ᵇ⁾, which is moderately tolerant (MT), and Ellison⁽ᵇ⁾ which is moderately susceptible (MS) to the Yr17+ pathotype of stripe rust were used at all sites. The thirteen treatments were:

1. Nil control treatment with no fungicide application either at sowing or in-crop.

- Seven at sowing (up-front) fungicide options for controlling stripe rust:

2. Fluquinconazole (Jockey® Stayer®) on seed (300 mL/100 kg seed) (8 sites only)
3. Fluquinconazole (Jockey® Stayer®) on seed (450 mL/100 kg seed)
4. Triadimefon (Triad® 500WP) on Granulock® 12Z (200g/ha)
5. Flutriafol (Intake®) on Granulock® 12Z (400 mL/ha)
6. Experimental 1 on Granulock® 12Z (IF#1)
7. Experimental 2 on Granulock® 12Z (IF#2)
8. Experimental 3 on Granulock® 12Z (IF#3) (5 sites only)

- Three in-crop foliar fungicide options of:

9. Tebuconazole (Folicur®, 145 mL/ha) at Z32
10. Tebuconazole (Folicur®, 145 mL/ha) at Z32 + Z39
11. Tebuconazole (Folicur®, 145 mL/ha) at Z25 + Z39

Two up-front + in-crop treatment combinations of:

12. Flutriafol on Granulock® 12Z (400 mL/ha) + Tebuconazole (145 mL/ha) at Z39
13. Full disease control treatment of Flutriafol on Granulock® 12Z (400 mL/ha) + Tebuconazole (145 mL/ha) at Z32 + Z39

All treatments also included 50 kg/ha of Granulock® 12Z either added at sowing or included in the treatment as specified above for the in-furrow treatments (4, 5, 6, 7, 8, 12 and 13).

Trial sites and impact of stripe rust on yield

Seasonal conditions and pressure from stripe rust infection varied markedly across the 13 trial sites. Consequently, the trials have been divided into three varying outcomes for interpretation of the results as outlined in Table 1.

Table 1. Trial locations, average yield and stripe rust pressure at 13 trial sites conducted in 2011

**** Determined from comparing Ellison⌽ in untreated plots (T1) at each site with full disease control trt (T13). ns = yield difference not significant at 95% confidence level.***

Trial outcome 2011	Location	Average yield (t/ha)	Yield loss from stripe rust*
High disease pressure	North Star	4.73	45%
	Spring Ridge	6.89	31%
	Tamworth 1	3.39	31%
Moderate disease pressure	Bullarah	4.47	22%
	Wongarbon	3.65	22%
	Tamworth 2	2.87	19%
	Trangie	3.15	18%
Low disease pressure	Somerton	6.43	ns
	Coolah	5.10	ns
	Nyngan	3.03	ns
	Burren Junction	2.67	ns
	Gilgandra	2.22	ns
	Coonamble	1.53	ns

High disease pressure sites had even infection levels across plots with around 50% or more of the top three leaves covered in pustules at flowering in untreated Ellison⌽ plots. This resulted in 31–45% yield loss from stripe rust infection. The moderate disease pressure sites again had even infection across the site with around 20% of the top three leaves of untreated Ellison⌽ covered in pustules at flowering resulting in 18–22% yield loss. The low disease pressure sites tended to have patchy infection in plots with <5% of the top three leaves in untreated Ellison⌽ plots covered in pustules when averaged across the entire plot. That is, individual plants may have had much higher infection levels but were only distributed in small patches. This resulted in yield losses in Ellison⌽ of between 0– 8% which were not significant.

Stripe rust management options in a moderately susceptible variety: Ellison⌽

At the three high disease pressure sites (North Star, Spring Ridge and Tamworth 1) yield responses to the various fungicide strategies clearly reflected the impact of each treatment on stripe rust levels within the canopy. With the up-front options, Flutriafol (Intake®) on starter fertiliser provided the longest protection with only low levels of infection (<5%) evident on the flag leaves of Ellison⌽ at North Star during flowering. The IF#1 experimental treatment also had good activity with around 5–10% infection of flag leaves on Ellison⌽ during flowering.

Treatment effects on stripe rust activity under high disease pressure were broadly in the order of: Intake®>IF#1 >Triad®>IF#2>Jockey® Stayer® at 450 mL=IF#3.

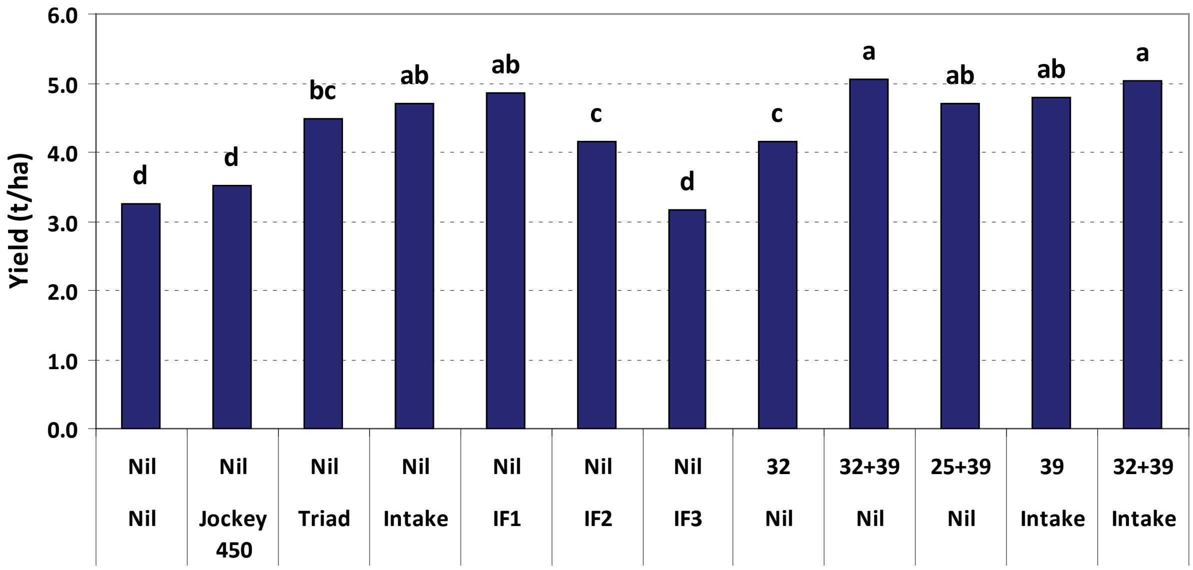

Figure 1. Effect of up-front (bottom line) and in-crop (top line) fungicide treatments on yield of the MS wheat variety Ellison⌽: average of high disease pressure sites in 2011.

The impact of stripe rust on Ellison[ⓓ] at the three high pressure sites averaged to a yield loss of 1.8t/ha (35%) when comparing the full disease control treatment (Intake® + 145 mL/ha of tebuconazole at GS32 + GS39) to the nil control (Figure 1). Up-front treatments alone of Intake® or IF#1 provided yields equivalent to the full disease control. The lowest yields from up-front options alone came from the Fluquinconazole (Jockey® Stayer® at 450 mL) seed treatment and the IF#3 experimental treatment (Figure 1). Note, the IF 3 experimental treatment had little to no stripe rust activity but also reduced seed emergence.

All in-crop fungicide sprays were a 145 mL/ha rate of tebuconazole (Folicur®). Stripe rust in the MS variety Ellison[ⓓ], even under high disease pressure, was effectively controlled with a fungicide application at GS32 (2nd node) followed by a second application at GS39 (full flag leaf emergence). This provided yield equivalent to the full disease control (Figure 1). Under high disease pressure a single application at GS32 provided half the benefit (+0.9 t/ha) of a GS32 + GS39 (+1.8 t/ha) spray program (Figure 1). On average the GS25 + GS39 treatment was 0.35 t/ha lower yielding than the GS32 + GS39 treatment but was not significant. However, this was biased by the Spring Ridge site which had a late onset of stripe rust infection (post GS32) resulting in no difference in yield between these two treatments. Under earlier disease onset (<GS25) the GS25 + GS39 was significantly lower yielding at both North Star (–0.55 t/ha) and Tamworth 1 (–0.50 t/ha) than the GS32 + GS39 strategy. The GS25 spray provided early protection but significant levels of rust developed on the Flag-1 and Flag-2 leaves which were not emerged at GS25 and hence were unprotected until the second application at GS39. Although there was a trend towards an increased yield benefit when combining the up-front Intake® treatment with an in-crop fungicide application at GS39 or GS32 + GS39 the difference was not significant from the Intake® only treatment at any of the three high disease pressure sites.

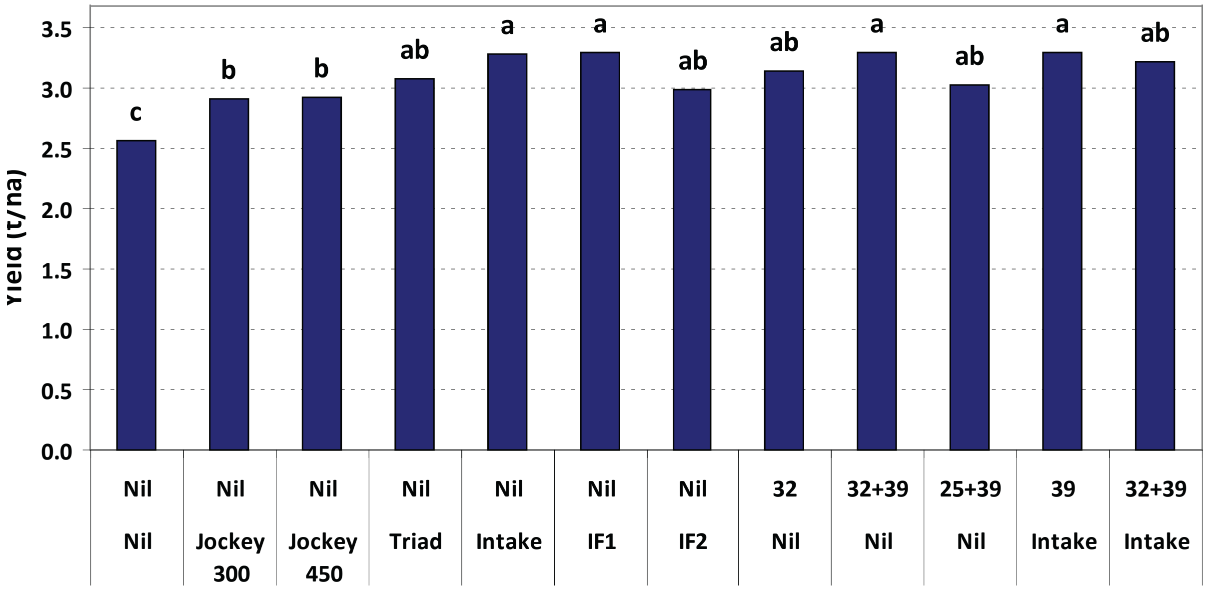

Figure 2. Effect of up-front (bottom line) and in-crop (top line) fungicide treatments on yield of the MS wheat variety Ellison[ⓓ]: average of moderate disease pressure sites in 2011.

The moderate disease pressure sites (Bullarah, Wongarbon, Tamworth 2 and Trangie) in 2011 resulted in an average yield loss from stripe rust infection of 20% in the MS variety Ellison[ⓓ] (Figure 2). Under lower disease pressure the various fungicide treatments provided greater protection of green leaf area resulting in smaller differences in yield between treatments compared to the high disease pressure sites. All fungicide strategies examined significantly increased the yield of Ellison[ⓓ] compared to the nil control treatment. Of the up-front options, Intake® and IF#1 were superior to the two rates of fluquinconazole (Jockey® Stayer®) with Triad® intermediate. Under moderate disease pressure the GS32 in-crop fungicide application alone provided an average 0.58 t/ha benefit which was not significantly different from the benefit (0.74 t/ha average) provided by the GS32 + GS39 spray treatment at any of the four sites. The GS25 + GS39 treatment trended towards lower yield than the GS32 + GS39 spray strategy but was not significant when averaged across sites. The exception was at Bullarah where the GS25 + GS39 treatment was significantly lower yielding (–0.64 t/ha) than the GS32 + GS39 application.

At the remaining low disease pressure sites none of the fungicide strategies (up-front, in-crop or combination of both) significantly increased the yield of the MS variety Ellison[ⓓ] at any of the sites. However, the experimental IF#3 treatment did significantly reduce the yield of Ellison[ⓓ] at the Somerton and Coolah sites, where this treatment was examined, compared to the nil control. This was related to a detrimental effect of IF#3 on emergence rather than stripe rust infection as only low levels of disease were present at these sites.

Stripe rust management options in the moderately resistant variety: EGA Gregory⊕

None of the fungicide treatments, including the full disease control treatment (Intake® + 145 mL/ha of tebuconazole at GS32 + GS39) provided a significant yield benefit over the nil fungicide control in the MR variety EGA Gregory⊕ at any of the 13 trial sites in 2011. Even at North Star, the site with the highest pressure from stripe rust in 2011, no pustules were evident on EGA Gregory⊕.

Economics

The following values have been used; fluquinconazole (Jockey® Stayer®) at $50/L with a 55 kg/ha sowing rate, triadimefon (Triad® 500WP) at $4.95/ha, Intake® at $20/L, tebuconazole (Folicur®) at $15/L with a 75 L/ha in-crop spray application rate by ground-rig at an application cost of $8/ha. Note: no application cost has been applied with GS25 spray as it was assumed that it was applied with an in-crop herbicide spray at this growth stage. An APW grade of $180/t has been assumed as the grain price as grain quality data was not available at the time of writing this paper. Obviously costing and resulting economics will vary dramatically e.g. using own ground rig or cheaper fungicide pricing for bulk purchases, differences in grain quality, grain price etc. Hence, the following is a guide only and growers/advisers should do their own sums based on their individual pricings.

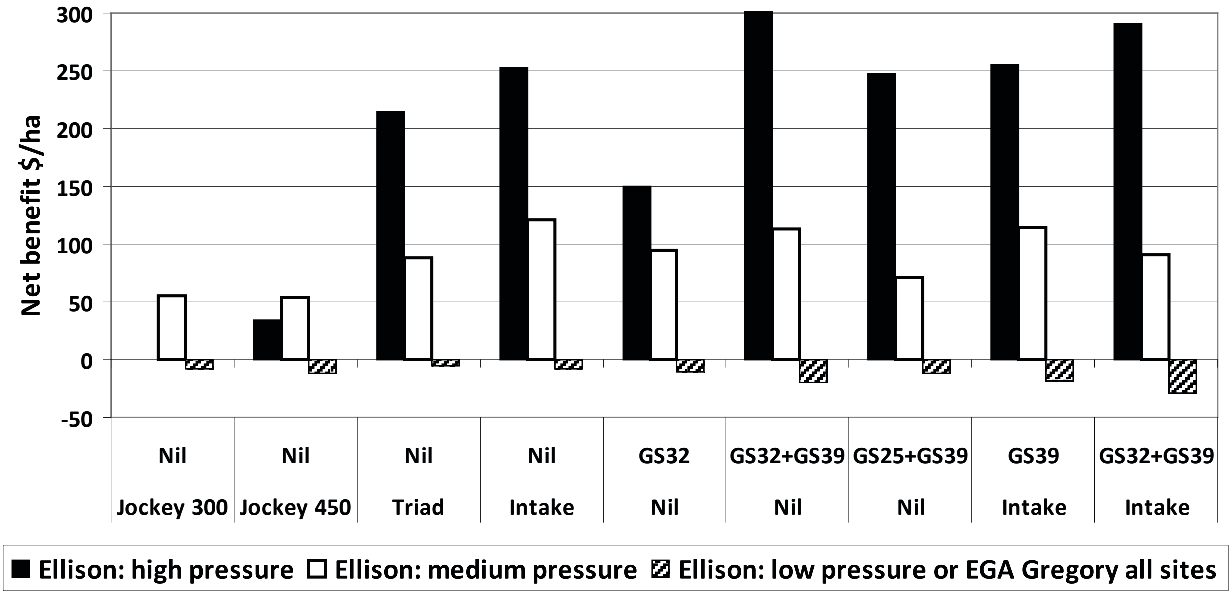

Figure 3. Net benefit from various fungicide treatments under different variety and disease pressure situations in 2011.

The best returns under high and medium stripe rust pressure in the MS variety Ellison⊕ were obtained from Intake®, the GS32 + GS39 in-crop fungicide applications or a combination of these treatments (Figure 3). A GS32 spray alone in Ellison⊕ lost $152/ha if not followed by an additional application at GS39 (i.e. GS32 + GS39) under high disease pressure. However, under moderate disease pressure the loss from not doing the second spray in Ellison⊕ at GS39 was only $19/ha. In a two spray strategy delaying the first spray until GS32 returned an additional $55/ha under high disease pressure and $42/ha under moderate disease pressure in Ellison⊕ compared to doing the first application at mid-tillering (GS25). Both treatments then required a second spray at GS39.

Under low stripe rust pressure in Ellison⊕ the net benefit was basically the cost of the various fungicide strategies as no significant yield gain was associated with the various treatments under these conditions. The situation was the same for the MR variety EGA Gregory⊕ under all disease levels in 2011 as similarly no significant yield benefit was associated with any of the fungicide treatments (Figure 3).

Varying costs are associated with the different fungicide strategies examined that are not reflected in a net benefit analysis. Therefore a return on investment assessment examining the dollar return on each dollar spent on the various options is an important risk consideration for growers and advisers.

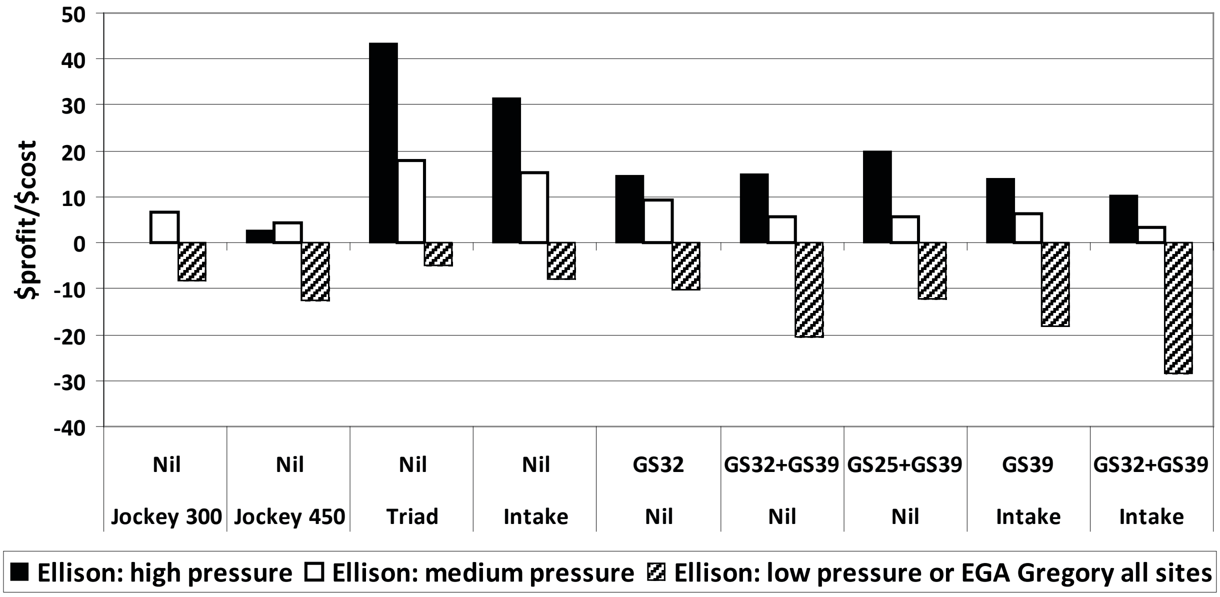

Figure 4. Return on investment from various fungicide treatments under different variety and disease pressure situations in 2011.

In these trials the Triad® and Intake® up-front options alone had the highest return on investment under both high and medium disease pressure (Figure 4). Note, this approach is very sensitive to individual pricing situations e.g. if a grower had their own ground rig (assume cost of application $4/ha rather than $8/ha with contractor) then the GS32 + GS39 strategy would have returned $25 per $1 spent under high disease pressure and $10 per $1 spent under moderate disease pressure.

Summary

In the moderately susceptible (MS) variety Ellison(b):

1. Flutriafol (Intake®) in-furrow was the best of the up-front options when not backed up by an in-crop fungicide application.
2. Similar levels of disease control and yield benefit were obtained with in-crop sprays at GS32 + GS39.
3. A single in-crop spray at GS32 appears to be a reasonable option under moderate stripe rust pressure but was significantly poorer than a GS32 + GS39 strategy under high disease pressure.
4. In a two spray strategy (2nd spray at GS39), delaying the first spray from GS25 until GS32 provided greater protection of the mid canopy and had an improved net benefit under both high and moderate disease pressure.

In the moderately resistant (MR) variety EGA Gregory(b) no significant yield benefit was obtained with any of the stripe rust treatments at the 13 sites in 2011.

Conclusions

Inclusion of a fungicide when performing an in-crop weed spray around mid-tillering (GS25) in wheat crops has become a fairly common practice commercially in much of northern NSW for managing stripe rust. The top three leaves in wheat are the highest yield contributors so the aim of any stripe rust management strategy in susceptible varieties is to keep these leaves largely clean of infection. However, when applying a fungicide at GS25 none of these important leaves have emerged so they are unprotected by fungicide once they do come out. Delaying the first fungicide application to GS32, when the Flag-2 leaf has emerged, protects this leaf from infection plus reduces the time and subsequent disease build-up until the second spray is applied at full flag leaf emergence (GS39). Delaying the first spray from GS25 until GS32 returned an additional \$55/ha under high disease pressure and \$42/ha under moderate disease pressure in the MS variety Ellison⁽ᵇ.

Up-front options are not used widely in central and northern NSW. In particular the use of flutriafol (Intake®) on starter fertiliser and to a lesser extent Triad® in-furrow provided good levels of disease control and return on investment under both high and moderate disease pressure in 2011. These were the cheaper options examined so also had the lowest risk exposure under low disease pressure where basically due to a lack of significant stripe rust infection none of the fungicide strategies provide a yield benefit. It should be stressed that for these trials we obtained good coverage of the starter fertiliser (Granulock® 12Z) with the various in-furrow treatments due to our ability to rapidly dry the wet fertiliser after treatment due to the small volumes required. This can present a logistical problem commercially but these in-furrow treatments appear worthy of consideration and further evaluation.

Finally, no significant yield benefit was obtained at any of the 13 sites in 2011 from any of the fungicide strategies aimed at controlling stripe rust in the MR variety EGA Gregory⁽ᵇ. Even at North Star, which had the highest pressure from stripe rust in 2011, there was no benefit from even the full disease control (Intake® + GS32 + GS39). None of these sites were complicated by infection from yellow spot, a different stubble-borne leaf disease to which EGA Gregory⁽ᵇ is susceptible. In terms of just stripe rust, management in the MR variety EGA Gregory⁽ᵇ was not warranted in 2011.

Acknowledgments

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⁽ᵇ Symbol beside them are protected under the *Plant Breeders Rights Act 1994.*
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Timing of fungicide sprays for rust management in faba bean

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Introduction

The most important foliar diseases of Faba bean in northern NSW are rust (*Uromyces viciae-fabae*) followed by chocolate spot (*Botrytis fabae*). An early spray (4–6 weeks after sowing) of mancozeb to control the establishment of the disease during autumn is the recommended control strategy for both rust and chocolate spot. The economics of later fungicide applications depend on seasonal conditions, disease pressure, grain price and yield potential. Chlorothalonil is also registered for rust and chocolate spot. The aim of this trial was to investigate the efficay of two different fungicides (mancozeb and chlorothalonil) and application timings, in particular the length of protection gained from early sprays as well as the value of late applications.

Site details 2011

Location: Breeza

Soil Type: Black Vertosol

Co-operator: Liverpool Plains Field Research Station (LPFRS)

Treatments

Obtaining robust data from fungicide trials containing unsprayed controls (treatment 1 in Figure 1) can be difficult in small plot trials due to the movement of inoculum from unsprayed control plots into neighbouring plots. In order to control such variation this trial was established on a large scale using 'plots', of approximately 50 m length by 60 m width. The trial was planted on the 28th April using the variety Cairo(). The first fungicide treatment occurred on July 12th using 1 kg/ha of mancozeb (430 g/kg) or 1.4 L/ha of chlorothalonil (720 g/ha). Plots were inoculated by placing pots with rust infected plants in the centre of each plot after the first fungicide treatment on July 12th just before canopy closure. The second application of fungicide occurred on September 16th (mid podding).

Table1. Fungicide treatments at Breeza 2011

Treatment	Early Spray	Late Spray
1	Nil	Nil
2	Nil	mancozeb
3	mancozeb	Nil
4	mancozeb	mancozeb
5	chlorothalonil	Nil
6	chlorothalonil	chlorothalonil

Results 2011

The 2011 season was characterised by a dry winter followed by an unusually wet spring.

Table 2. Rainfall at Breeza

Month	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
LPFRS 2011 (mm)	35	49.5	16.5	3	25	81	76	171.5	69.5
Breeza Long Term Average (mm)	40	41	43	41	40	40	54	64	67

Table 3. Grain yield at Breeza 2011

Treatment	Early Spray	Late Spray	Yield (t/ha)	Significance
1	Nil	Nil	2.7	a
2	Nil	mancozeb	4.3	bc
3	mancozeb	Nil	4.1	bc
4	mancozeb	mancozeb	4.5	c
5	chlorothalonil	Nil	3.7	b
6	chlorothalonil	chlorothalonil	4.1	bc

Table 4. Seed size at Breeza 2011

Treatment	Early Spray	Late Spray	100 seed weight (grams)	Significance
1	Nil	Nil	50	a
2	Nil	mancozeb	65.5	c
3	mancozeb	Nil	60.7	bc
4	mancozeb	mancozeb	65.9	c
5	chlorothalonil	Nil	56.3	ab
6	chlorothalonil	chlorothalonil	61.9	bc

Summary

All the fungicide treatments produced a significantly higher yield compared to the nil fungicide control (Treatment 1). Within the mancozeb treatments there were no significant differences amongst the various timings, however there was a trend to greater yields in the treatments that involved late sprays (Treatments 2 and 4). This may have been a result of a dry winter and wet spring which favoured disease development late in the season. There were no significant differences between the mancozeb and chlorothalonil treatments although there were higher yields in the mancozeb treatments.

All the fungicide treatments except the early chlorothalonil only (Treatment 5) produced higher 100 seed weights compared to the no fungicide control (Treatment 1). Greater seed weights with treatments containing a late mancozeb spray (Treatment 2 and 4) were obtained but they were not significantly higher than the early mancozeb only (treatment 3) and the early and late chlorothalonil (Treatment 6). This data supports the use of an early mancozeb spray in Cairo⁽ᵇ⁾ faba bean. Further investigation of the value of late fungicide sprays is required.

Acknowledgements

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