DAW00249
Tactical Wheat Agronomy for the West

16ES25 Do current wheat varieties differ in their optimum seeding rate and nitrogen strategy?

Authors	Jeremy Curry
Location of trial	Grass Patch

Summary (Key messages)

- ***Varieties did not significantly differ in yield, but increasing nitrogen and seeding rate increased yield.***
- ***Grain protein was low across the trial (average 8.5%), and varieties did not differ in their total protein yield. The highest N rate and the lowest seed rate gave the highest average protein, but no treatment exceeded 9.6% protein.***
- ***Average grain weights were high across the trial (average 47.2mg), although differences of up to 7mg per seed existed between varieties and up to 3.9mg between treatments within a variety.***

Background

Seeding rate and rate of nitrogen application are important decisions made in every season. Cereals are generally able to compensate for lower seeding rates with their tillering ability; however, as other limitations to production are removed and yields are increased, plant population becomes a factor that can limit yield. Therefore, the relationship between optimum plant density at different levels of nitrogen supply are uncertain. Additionally, there are a range of high yielding cultivars that are available and adopted in Western Australia. These varieties differ, particularly in maturity, tillering ability and other growth habits, and therefore may also require different seeding strategies.

This trial series looks to determine the relationship between N rate and seeding rate, and whether target plant density changes with increasing nitrogen supply. Additionally, a range of varieties are assessed to look at whether they differ in their optimum seeding rate and N rate strategies.

Aim

To determine the response of current varieties to increases in seed rate and N rate in a low rainfall system.

Trial Details

- Property: Danny Sanderson's Grass Patch
- Growing Season rainfall (May to October) = 229 mm (Grass Patch DAFWA Weather Station)
- Soil type: Alkaline shallow loamy duplex
- Previous crop: Canola
- 72 treatments:– 6 varieties x 3 plant densities (60, 120 or 240pl/m^2) x 4 N rates (0, 10, 30, 50N)
- Sowing date: May 16

Varieties	Maturity	Grade
Cutlass	mid-long	APW
Emu Rock	short	AH
Mace	short-mid	AH
Scepter	short-mid	AH
Trojan	mid-long	APW
Yitpi	mid-long	AH

Results

Plant establishment numbers generally met target plant densities for each treatment. Plant numbers averaged 60pl/m2, 126pl/m2 and 228pl/m2 for the target densities of 60pl/m2, 120pl/m2 and 240pl/m2.

Varieties differed in their tiller number, ranging from 196 tillers/m^2 (Cutlass) to 231 tillers/m^2 (Trojan). Increasing N rate from 0N to 50N increased tiller number from an average of 193 tillers/m^2 to 234 tillers/m^2. Despite the ability of wheat to compensate for seeding rate with increased tillering, plots with a target density of 60pl/m^2 averaged 170 tillers/m2, compared to 200 and 241 tillers/m^2 for the 120pl/m^2 and 240pl/m^2 target densities.

All varieties averaged between 2.7t/ha (Mace) and 3.3t/ha (Scepter), differences that were not statistically different. Increasing N rate at seeding from 0N to 50N increased average grain yield from 2.6t/ha to 3.3t/ha. Increasing seeding rate resulted in a statistically significant increase in yield, although of only ~100kg/ha when increasing from 60pl/m^2 to 120 or 240pl/m^2.

Grain protein was low across the trial, with an overall average of 8.5%. Increasing N at seeding from 0N to 50N resulted in a 0.3% increase in average protein, with increasing plant density from 60pl/m^2 to 120pl/m^2 or 240pl/m^2 resulting in just a 0.1% decrease. Varieties differed in their average protein, although not in their overall protein yield (kg N/ha) which takes into account yield dilution of protein, and varieties did not differ in their response to N or SR.

Screenings were low across the trial (1.1% average), and grain weight (47.2mg) and hectolitre weights (82.9kg/hL) were high. There were up to 7mg difference in grain weight between varieties (Mace lowest, Emu Rock highest), and up to 3.9mg difference between treatments within varieties.

Cuts were taken at maturity from Scepter and Mace from the 10N and 50N treatments from each of the plant densities. These two varieties were similar in all harvest cut measurements except for harvest index (HI) (a ratio of yield to total biomass), of which Scepter was slightly higher. This increased HI was a result of its increased grain weight, as well as averaging 5.3 more grains per ear than Mace across all treatments (not statistically significant). The 50N treatments resulted in 1.6t/ha more biomass, 3 more grains per ear and as mentioned previously, more tillers/m^2 than the 10N treatments. Increasing plant density from 60pl/m^2 to 240pl/m^2 reduced grain number per ear from 4^2 to 29, and reduced harvest index.

Table 1 Soil analysis at Grass Patch in 2016

Depth (cm)	0-10	10-20	20-30	30-40	40-50	50-60
pH (CaCl2)	6.2	8.3	8.8	8.9	8.9	8.8
pH (water)	7.2					
Total P (µg/g)		44	46	36	28	26
P (HCO3) (µg/g)	21	8	7	5	3	<2
K (HCO3) (µg/g)	281	800	930	940	1000	900
Total N (%)		0.029	0.028	0.016	0.013	0.013
N (NH4) (µg/g)	7	1	1	<1	<1	<1
N (NO3) (µg/g)	5	12	14	8	4	4
S (µg/g)	4.5					
Organic carbon (%)	0.64	0.3	0.29	0.22	0.17	0.16
PRI (mL/g)		37	73	51	45	33
PBI	24.8					
Reactive iron (µg/g)	262.9					
Reactive Aluminium (µg/g)	693.60					
Conductivity (dS/m)	0.077					
Soil colour	BRGR					
Hand texture	2.0					
Clay (%)		41	42.5	39	38	37
Gravel (% by weight)	0					
B (CaCl2) (µg/g) if pH>7.5		7.3	12	16	18	17

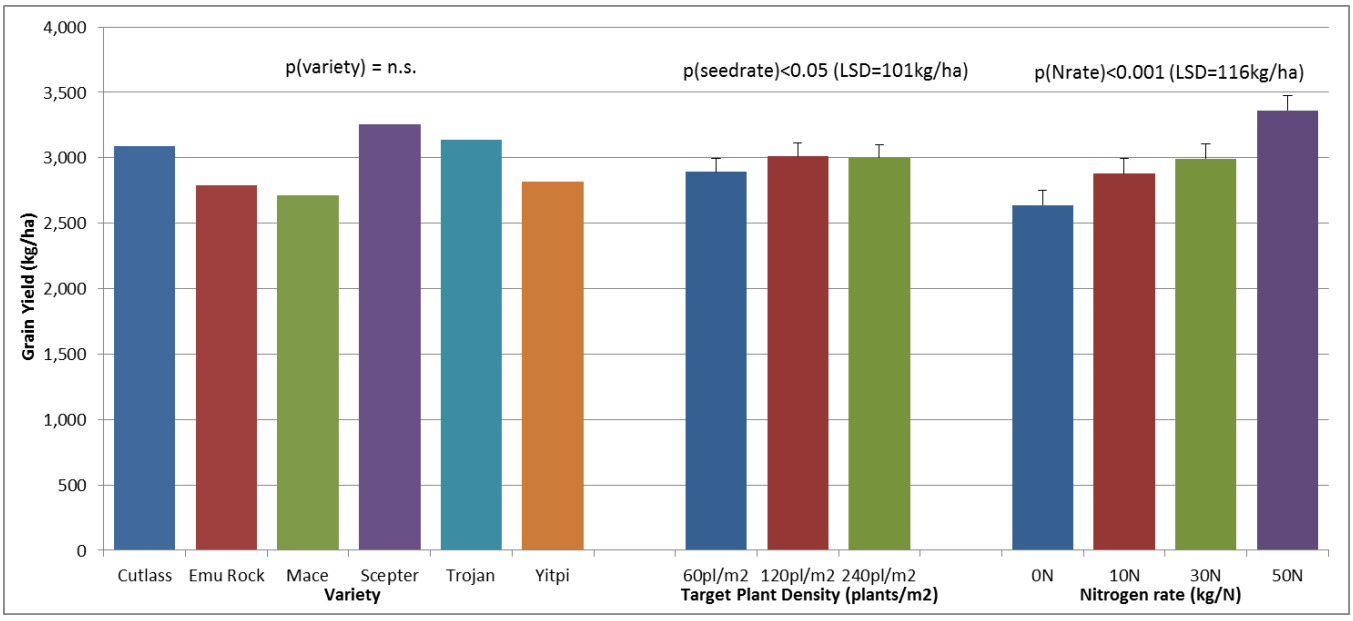

Figure 1 Seed yield of wheat at Grass Patch in 2016. There was no significant difference in average yield between varieties, but seed rate and N rate treatments were significant. There were no significant interactions for yield between treatments (variety, seed rate or N rate).

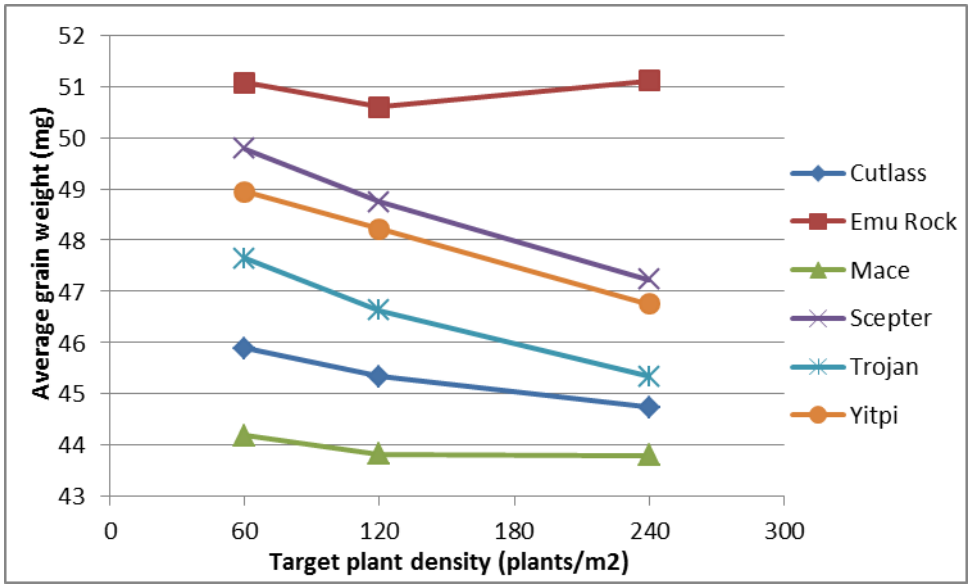

Figure 2 Average grain weight of the six varieties across the three target plant densities. Variety, seed rate, and the variety x seed rate interaction were significant at this site.

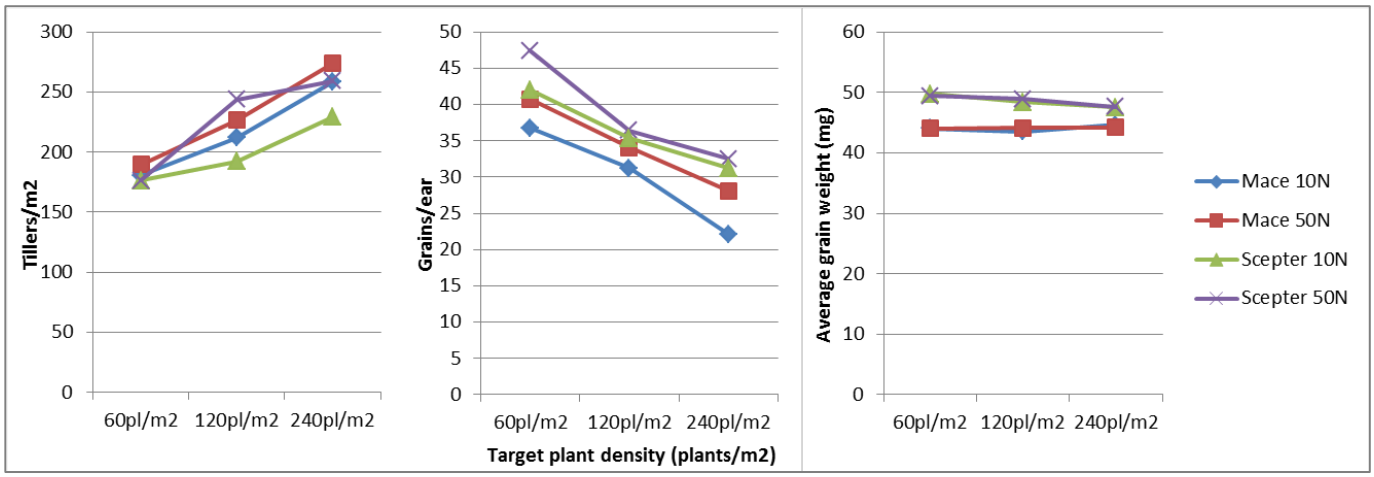

Figure 3 Tiller number, grain number per ear and average grain weight of Mace and Scepter at 10N and 50N at each of the three target plant densities.

Conclusion

At Grass Patch in 2016, yield potential was reasonably high and as a result, the nitrogen treatments applied at seeding were insufficient to be non-limiting, with the highest N treatment recording the highest yield. As a result, although seeding rate was statistically significant for increasing yield, the increase was modest (~100kg/ha) as a result of compensation through better harvest index (through more tillers per plant and higher average grain weight and despite fewer grains per ear) at the lowest plant density. No treatments had sufficient grain protein to meet milling grades, although increasing N rate gave a higher grain protein despite the increase in yield. A later application of nitrogen would likely give a better chance of varieties meeting protein specs, as would higher rates of nitrogen given the good yield potential of the site.

This trial did not show a difference in varieties in terms of their response to increasing N or seeding rate for most measures and so does not support tailoring seeding rate and N rate (at seeding) for any particular variety.

This trial also did not find many interactions between N rate and seeding rate, with only NDVI at 10WAS and average grain weights showing this interaction. Therefore, it does not support the idea that target plant density will change with increased N rate at seeding.

Average grain weights were high and varied between varieties and treatments. These differences in kernel weight, although not important in terms of meeting milling grade specifications (besides their association with hectolitre weight and screenings), have large implications for meeting target plant densities if this seed was used the following season. Scepter had an average kernel weight of 49mg

compared to 44mg for Mace at this site. Therefore, were these seed sources to be used for seeding the following year, Scepter would require an extra 8kg/ha seeding rate to establish the same plant density as Mace (assuming germination % and establishment % are equal). Variation in grain weight of seed sourced from different sites or seasons can be even larger, and so knowledge of grain weight is the most important factor when trying to target a particular plant density.

Acknowledgements

This trial is funded as a part of the GRDC/DAFWA co-funded project, “Tactical Wheat Agronomy for the West”. Big thanks to Danny Sanderson for providing the site, to Chris Matthews and the Esperance TSU for trial management, and to Rachel Brunt for her technical assistance.

For more information contact

Jeremy Curry, Research Officer, Esperance on 9083 1160.

Email: Jeremy.curry@agric.wa.gov.au