Managing wheat yield and quality risks through plant density and nitrogen

Christine Zaicou-Kunesch, Melaine Kupsch & Anne Smith, Geraldton

Aim/Background

The objective of this research is to determine the value of agronomic management (plant density and nitrogen) on production of quality grain for profitable wheat systems. Increasing plant density is a useful tool to increase the competitiveness of a crop against weeds, however, how will this influence grain yield and quality for the new wheat varieties.

Trial Details

Property	Wenballa Farm, east of Dalwallinu
Plot size & replication	20m x 1.54m x 3 replications
Soil type	Loamy clay
Soil pH ($CaCl_2$) + EC	pH 5.4 (0-10cm); EC 0.09 dS/m
Paddock rotation	2009 wheat, 2010 wheat, 2011 canola
Nitrate (mg/kg)	0-10cm: 18, 10-20cm: 3, 20-40cm: 2, 40-60cm: 3
Ammonium N(mg/kg)	0-10cm: 2, 10-20cm: 2, 20-40cm:1, 40-60cm: <1
Variety	Mace, Corack, Cobra
Seeding date	22/5/12
Seeding rate	Various
Fertiliser	22/5/12: 100 kg/ha Agstar Extra, 25 kg/ha Muriate of Potash
Herbicides & Insecticides	22/5/12: 200 mL/ha Talstar, 100 mL/ha Dominex, 118 g/ha Sakura. 13/7/12: 1 L/ha Hasten, 1 L/ha Decision; 23/7/12: 700 mL/ha Barracuda, 2.5 g/ha Ally
Growing Season Rainfall	133mm

The trial was sown in the third week of May. To assess the response of varieties to increasing plant density, Cobra, Corack and Mace were sown at 4 seeding rates (40, 80, 120 and 160 kg/ha) to establish 98, 160, 203 and 251 plants/m^2 respectively (averaged across all varieties). To assess the response of varieties to added nitrogen at average and high plant density, nitrogen treatments of 14, 30, 60 N kg/ha were applied at seeding (Agstar Extra plus urea). The 90 kg/ha N treatment was a split application, 60 units at seeding and 30 units post emergent.

Results

Note: This trial has a high CV of greater than 10% indicating high variability across the trial. Interpret results with caution and make decisions based on additional sources of information such as agronomists, NVT trials and prior experience.

Increasing plant density of Cobra, Corack and Mace from 98 to 250 plants/m^2 had no effect on grain yield (Table 1) at Dalwallinu in 2012. Head numbers differed significantly between varieties at the higher plant density (Cobra- 188 heads/m^2, Corack 165 heads/m^2 and Mace 211 heads/m^2). However, this did not influence the yield of the varieties.

The yield of the varieties differed significantly (p= 0.05). Mace (2.08 t/ha) and Corack (2.11 t/ha) were significantly higher yielding than Cobra (1.70 t/ha) (Table 1). This result correlates to the significantly lower protein levels for Corack (14.0%) and Mace (13.5%) compared to Cobra (15%) averaged across all nitrogen treatments. This result indicates dilution of protein with higher yields and not reduced nitrogen uptake by Mace and Corack. (Note: whole grain screenings are not available at the time of print.)

At both plant densities (160 and 250 plants/m^2), the yield of varieties and head number were not significantly influenced by increasing nitrogen (14, 30 and 60kg/ha) at seeding. However, the 60 and 90 kg/ha of nitrogen did improve grain protein compared to the lower nitrogen treatments. As observed with increasing plant density, Corack and Mace were significantly higher yielding than Cobra (Table 2).

Table 1: Plant density influence on yield of wheat.

	Plant density (#/m^2)	Grain yield (t/ha)
Cobra	105	1.76
	169	1.68
	210	1.65
	266	1.72
Corack	88	2.09
	138	2.18
	199	2.15
	207	2.07
Mace	100	2.00
	176	2.05
	198	2.10
	292	2.16
	Nitrogen	**ns**
	Variety	**P=0.005; LSD=0.18**
	Var x N	**ns**
	CV%	**12%**

Table 2: Nitrogen influence on yield and protein of wheat (at 250 plants/m^2).

	Nitrogen (kg/ha)	Grain yield (t/ha)	Protein (%)
Cobra	14	1.67	13.5
	30	1.82	13.7
	60	1.70	14.7
	90	1.93	14.8
Corack	14	2.06	12.4
	30	2.15	13.0
	60	2.20	13.6
	90	2.00	14.7
Mace	14	2.16	11.9
	30	2.13	12.7
	60	2.06	13.1
	90	1.92	14.3
	Nitrogen	**ns**	**P=0.003; LSD=0.75**
	Variety	**P=0.05; LSD=0.19**	**P=<.001; LSD=0.19**
	Var x N	**ns**	**ns**
	CV%	**11.3%**	**3.4%**

Comments

Increasing plant density is a tool to improve a crop's competitiveness against weeds. This strategy did not adversely affect the yield of the varieties at the Liebe Main Trial Site in 2012.

Nitrogen treatments did not significantly influence crop yield however, did influence grain protein. The soil nitrogen levels and season are likely to have influenced this result. Soil testing and understanding the crops requirements as the season unfolds are useful strategies to manage crop performance economically.

The environment is likely to have had the bigger influence on the performance of the varieties than plant density or nitrogen. Growing season rainfall for 2012 was lower than average and disease patches (likely Rhizoctonia) were evident at the trial. The water use efficiency at the site was 13 kg/mm given growing season rainfall (April to October) was 133mm (plus 34mm in January) and grain yields of 1.98 t/ha across whole trial.

Acknowledgements

Appreciate the support of the Liebe Group with trial planning and preparation. DAFWA's technical services team for terrific trial management. GRDC and DAFWA jointly support this research aiming to improve profitability of wheat production through the Wheat Agronomy Project DAW 218.

Paper reviewed by: Kevin Young, DAFWA

Contact

Christine Zaicou-Kunesch
christine.zaicou-kunesch@agric.wa.gov.au
(08) 9956 8549