

Nutrition & Soils

Nitrogen response of six wheat and four barley varieties across two sowing dates – Nyngan 2016

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Key findings

- The experiment was highly responsive to nitrogen application (N).
- Averaged across the two sowing dates, yield ranged from 0.89 t/ha in LRPB Dart[®] without applied N to 4.95 t/ha in LRPB Flanker[®] with the highest application rate of 160 kg N/ha.

Introduction

Nitrogen (N) is the nutrient needed in greatest quantity by grain crops. In winter cereal crops such as wheat and barley, N is important for determining both yield and grain protein levels. However, in lower rainfall environments, high soil N levels can contribute to 'haying off' in wheat when adequate moisture is not available to finish the crop. In the 2016 season at Nyngan, the site was waterlogged during mid to late winter. Below average spring temperatures, combined with both plentiful subsoil moisture and continued rainfall, allowed crops the chance to meet high yield potentials provided that N nutrition was adequate.

Site details

Location	'Folkestone', Nyngan
Co-operator	Kevin, Trevor and Michael Dutschke
Soil type and nutrition	See Table 1
Rainfall	A total of 450 mm rainfall was recorded from April to Oct 2016. The long-term average annual rainfall for Nyngan is 444 mm, which demonstrates how much wetter the 2016 growing season was in comparison.
Trial design	Ten varieties × 6 N rates × 2 sowing dates. Three replicates of each treatment blocked for sowing date with N rate and variety randomised within these blocks.
Fertiliser	70 kg/ha Triple Super at sowing.
Plant population	Target 100 plants/m ²
Weed management	Pre-sowing: Roundup CT 1.5 L/ha + Logran 38 g/ha In-crop: Axial 200 mL/ha plus Velocity, 1 L/ha
Insect management	Fastac [®] 125 mL/ha (alpha cypermethrin 100 g/L) to control cereal aphids.
Disease management	Radial [®] Fungicide (azoxystrobin 75 g/L + epoxyconazole 75 g/L) @GS32 and Prosaro (prothioconazole 210 g/L + tebuconazole 210 g/L) GS 39 targeting stripe rust prevention in wheat.

Harvest dates	31 October for SD1 and 15 November for SD2.
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Table 1. Site soil chemical characteristics for 0–10 cm depth at Nyngan in 2016.

Characteristic	Depth (0–10 cm)
pH (1:5 CaCl ₂)	5
Aluminium Exc. (meq/100 g)	0.065
Zinc (mg/kg)	0.76
Sulfur (mg/kg)	9
Phosphorus (Colwell) (mg/kg)	33
Organic carbon (OC) (%)	0.99
Nitrate + ammon. N kg N/ha 0–120 cm	133

Treatments

Varieties (10)

Wheat (6): LRPB Dart[®], EGA Gregory[®], LRPB Flanker[®], LRPB Lancer[®], LRPB Spitfire[®] and Suntop[®]

Barley (4): Compass[®], Fathom[®], LaTrobe[®] and Spartacus[®]

Sowing date (SD)

SD1: 19 April 2016

SD2: 7 May 2016

Nitrogen rates

Urea pre-drilled 30 mm to side of plant row immediately before sowing at six rates 0, 20, 40, 40 + 40, 80, 160 kg N/ha. The 40 + 40 treatment had 40 kg N/ha as urea applied at sowing and 40 kg N/ha as urea top-dressed at the end of tillering.

Results

Grain yield

There was a linear response across all varieties in grain yield to increasing rates of N application ($r^2 = 0.97$) with the 160 kg N/ha rate yielding 2.8 t/ha more than the nil N application (data not shown). Optimum yield response to applied N (kg grain/ha for kg N/ha applied) was achieved from the 40 + 40 kg N/ha (26 kg/ha grain) and 80 kg N/ha (25 kg/ha grain) treatments. The 160 kg N/ha rate provided the highest overall yield, producing 17.9 kg grain/ha per kg N applied.

Fathom[®] and Compass[®] barley varieties yielded 0.1–0.3 t/ha more than La Trobe[®] and Spartacus[®]. For the wheat varieties, LRPB Dart[®] had a significantly lower yield than all other wheat varieties (Figure 1).

Protein

Nitrogen application treatments and variety affected protein levels. Averaged across the two sowing dates, the bread wheat variety LRPB Dart[®] had significantly higher protein levels than all other wheat varieties, being above 10% in all N treatments (Figure 2). However, it was also the lowest yielding. In the bread wheats, the only other nitrogen treatments to exceed 10% protein were the LRPB Spitfire 40:40 split treatment and the 160 kg N/ha treatment for LRPB Lancer[®], Suntop[®], LRPB Spitfire[®] and EGA Gregory[®].

A minimum protein content of 9% (note that Fathom[®] is a feed variety) is required for barley to receive malt classification. The only N treatments that produced greater than 9% protein in the barley varieties were the 40:40 split treatment in Fathom[®], La Trobe[®] and Spartacus CL[®], and the 160 kg N/ha treatment in all four barley varieties (Figure 2).

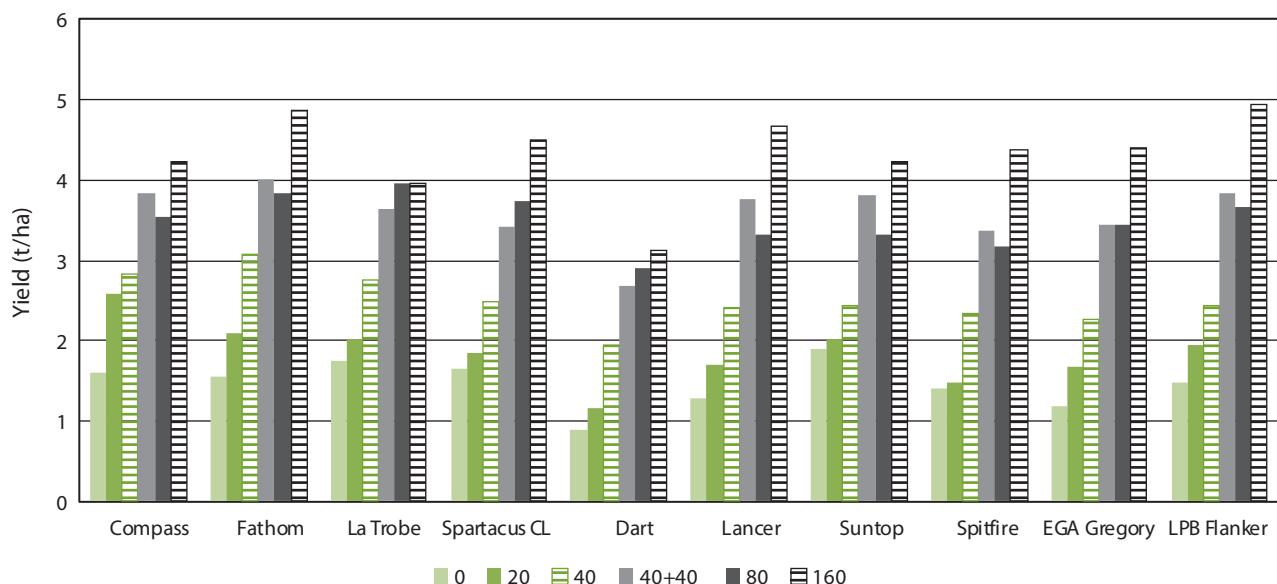


Figure 1. Average grain yield response across two sowing dates of six wheat and four barley varieties to six applied N (kg N/ha) treatments – Nyngan 2016. (L.S.D ($P<0.05$) = 0.66 t/ha).

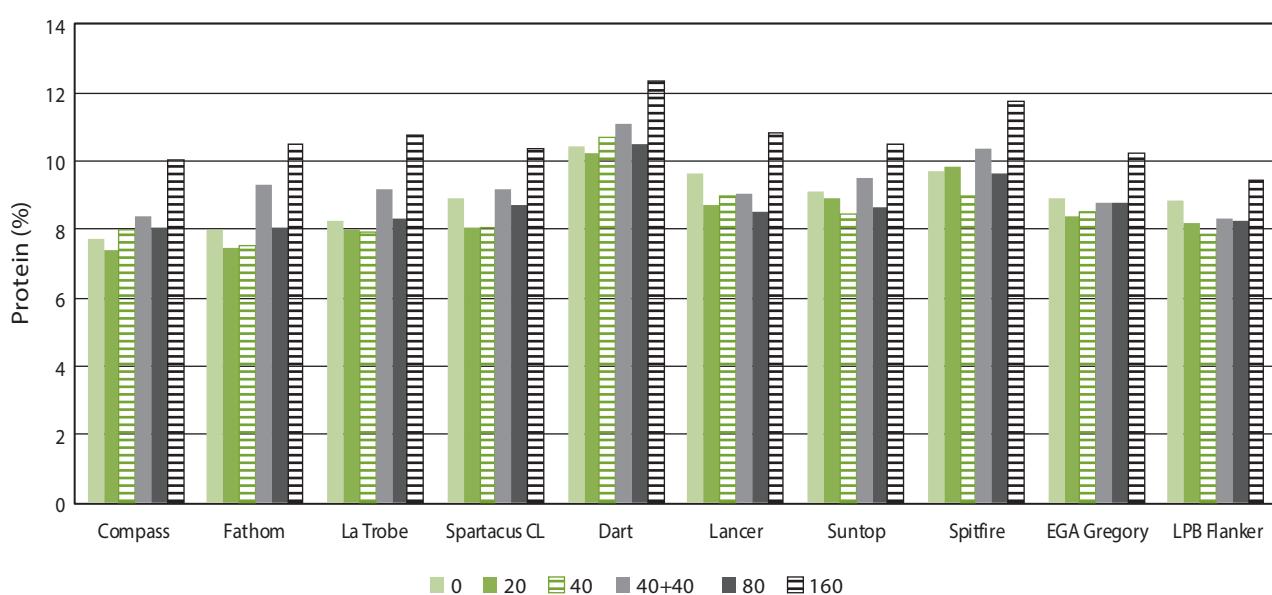


Figure 2. Average grain protein response (%) across two sowing dates to six nitrogen treatments – Nyngan 2016. (I.s.d. ($P<0.05$) = 0.79%).

Conclusions

An extremely wet winter, low sunlight and low spring temperatures combined to produce an atypical season at Nyngan in 2016. In contrast, in a similar experiment conducted in the 2015 season at Nyngan that had a hard finish, all N rates above 20 kg N/ha led to a decline in yield and an increase in screenings of up to 50% in some varieties. Hence, these findings should be interpreted with caution but do highlight the value of higher N application rates in terms of both yield and protein achievement in seasons with more favourable growing conditions.

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