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Wheat variety response to plant population and sowing date – Terry Hie Hie 2015

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Key findings

- Sowing date, particularly for mid–late maturing varieties, was found to be a significant determinant of grain yield potential, with yield reductions of >25% observed due to a delayed sowing date (8 May vs. 7 June).
- Variety and sowing date in particular affected grain quality parameters, with a significant increase in the level of screenings for all varieties when the sowing date was delayed.
- Higher plant populations had a greater influence on grain yield when the sowing date was delayed. Yield potential was optimised at 200 plants/m^2 for a 7 June sowing date vs. 100 plants/m^2 for the earlier 8 May sowing date, supporting the principal of increasing targeted plant populations when sowing is delayed.
- Altering variety and maturity type, and increasing targeted plant population in response to a delayed sowing date did not fully compensate for yield losses associated with a delayed vs. timely sowing date.

Introduction

Wheat producers in northern NSW now have access to varieties with a range of maturities which, coupled with no-till farming systems, has lengthened the potential sowing window. It is also possible to achieve a high yield potential from a wide range of plant populations, given wheat's ability to adjust tiller numbers and head size in response to environmental conditions.

The question facing growers is what impact does variety choice, sowing date (SD) and plant population have on grain yield and quality (e.g. screenings).

Growers often query whether, if they sow an early-maturing variety later in the sowing window with an increased plant population, it can achieve comparable yield and grain quality potential as a mid–late maturing variety sown in the earlier part of the window.

Studies have often focused on yield potential, with grain quality a secondary consideration. Grain quality parameters such as screenings are, however, major causes of price downgrades and reduced profitability. Differences between wheat varieties to have a tendency to produce higher levels of screenings have been reported in previous studies.

The aim of this experiment at Terry Hie Hie on the north-western plains of NSW was to determine if there were differences between varieties with varying maturity types in terms of grain yield and quality parameters with different plant densities and sowing dates.

Site details

Location	'Part Anchor', Terry Hie Hie
Co-operator	Michael Ledingham
Soil type and nutrition	Grey vertosol
Previous crop	Wheat
Starting water	Approximately 161 mm of plant available water (PAW) to 120 cm when cored on 21 May (pre SD 2)
In-crop rainfall	Approximately 190 mm (May to November)
Starting nitrogen	Soil nitrate nitrogen (N) was approximately 63 kg N/ha (0–120 cm)
Trial design	A fully factorial, three replicate split plot design.
Fertiliser	40 kg/ha Granulock Z extra and 300 kg urea (140 kg N/ha) side banded at planting.

Harvest date	18 November 2015

Treatments

Varieties (6)	EGA Eaglehawk[PBR], EGA Gregory[PBR], LRPB Dart[PBR], LRPB Lancer[PBR], LRPB Spitfire[PBR], Suntop[PBR]
Sowing date (SD)	SD 1: 8 May 2015 SD 2: 7 June 2015
Plant populations (PP)	PP 1: 50 plants/m^2 PP 2: 100 plants/m^2 PP 3: 200 plants/m^2

Results

Grain yield

There was a grain yield (GY) response to plant population for SD 1, but no population by variety interaction. Grain yield was optimised at a target plant population of 100 plants/m^2 with no significant difference (P<0.05) between 100 and 200 plants/m^2. Whereas, a population of 50 plants/m^2 resulted in approximately 400 kg/ha decrease in GY. LRPB Lancer[PBR], Suntop[PBR] and EGA Gregory[PBR] were the highest yielding varieties with LRPB Spitfire[PBR] the lowest yielding variety in SD 1, when averaged across population treatments (Table 1).

Table 1. Grain yield (t/ha), screening (%), thousand grain weight (g) and grain protein concentration (%) for six wheat varieties averaged across populations for the 8 May sowing date (SD1).

Variety	Grain yield (t/ha)	Screening (%)	Thousand grain weight (g)	Grain protein concentration (%)
LRPB Lancer	5.28[a]	3.6[a]	31.5[a]	12.0[b]
Suntop	5.18[a]	8.9[c]	31.1[a]	11.4[c]
EGA Gregory	5.09[a]	6.4[b]	31.2[a]	11.3[c]
EGA Eaglehawk	4.35[b]	13.9[d]	26.3[b]	12.4[ab]
LRPB Dart	4.11[bc]	10.1[c]	30.0[a]	12.4[ab]
LRPB Spitfire	3.89[c]	8.6[c]	31.4[c]	12.8[a]
l.s.d. (P = 0.05)	0.27	1.7	1.6	0.4

Values within columns with the same letters denote no significant difference

When looking at the grain quality parameters for SD 1, plant population had no effect on screenings (% grain below the 2.0 mm screen). There were, however, significant differences between the varieties (genotype effect) with screenings ranging from 3.6% for LRPB Lancer[PBR], averaged across treatments, up to 13.9% for EGA Eaglehawk[PBR]. Importantly, apart from LRPB Lancer[PBR], all other varieties examined in this experiment in SD 1 exceeded the critical 5% screenings level which would have caused downgrading at receival (Figure 1). It is interesting to note that the thousand grain weight (TGW), a measure of kernel size, did not differ significantly between genotypes with the exception of EGA Eaglehawk[PBR]. This indicates that differences in screenings could have been due to variations in kernel shape/plumpness or kernel weight stability.

In contrast to GY, grain protein concentration (GPC %) increased with decreasing plant population. The 50 plants/m^2 achieved a higher GPC than the targeted 200 plants/m^2, principally due to a yield dilution response where protein concentration in the grain is diluted by the extra starch accumulation (data not shown). Although GPC differed across varieties, there was no interaction between population and variety. Averaged across treatments, LRPB Spitfire[PBR] had the highest GPC, with varieties tending to be ranked inversely to their grain yield ranking (Table 1). It is, however, interesting to note that LRPB Lancer[PBR], although comparable in yield to both Suntop[PBR] and EGA Gregory[PBR], achieved a significantly (P<0.05) higher GPC than either of these varieties when averaged across treatments (Table 1).

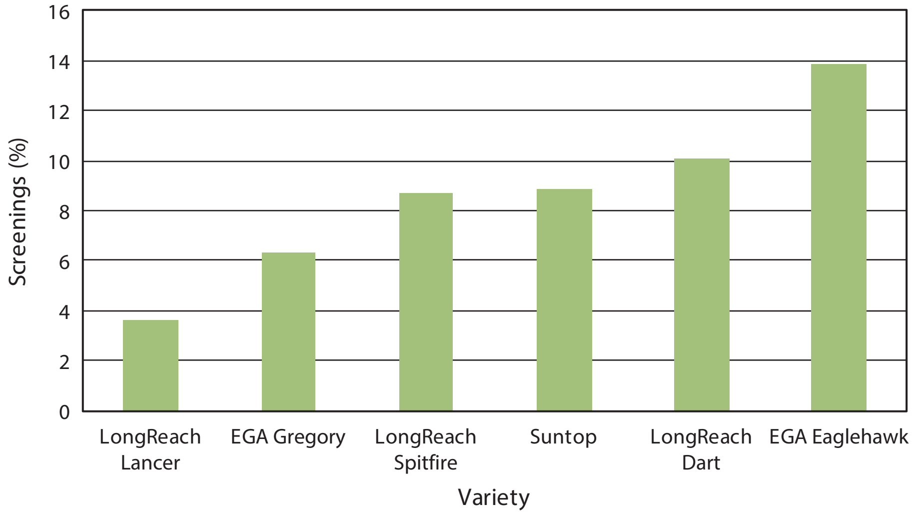

Figure 1. Mean grain screening (%) for wheat varieties, SD1 (8 May) Terry Hie Hie 2015. l.s.d. (P = 0.05) = 1.7%.

Although variety and variety by population differences were evident in the test weight data, the levels did not affect the minimum grain receival standard achieved. All varieties and population treatments exceeded the minimum test weight specification of 76.0 kg/hl.

Plant population had a significant effect on GY potential for SD 2. The 50 plants/m^2 treatment was significantly (P<0.05) lower yielding than both the 100 and 200 plants/m^2 treatments, with approximately 600 kg/ha difference between the 50 and 200 plants/m^2. Unlike SD 1, there was a yield difference between the 100 and 200 plants/m^2 treatments (Figure 2). This supported the accepted principal of increasing targeted plant populations with delayed sowing to maximise yield.

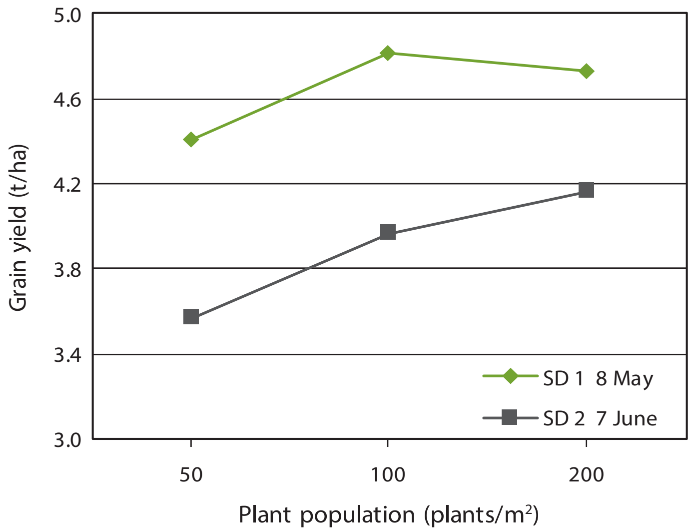

Figure 2. Mean grain yield (t/ha) response of wheat to plant population and sowing date, Terry Hie Hie 2015. SD1 l.s.d. (P = 0.05) = 0.18 t/ha, SD2 l.s.d. (P = 0.05) = 0.20 t/ha.

As per the SD 1 findings, there were no variety by population interactions; there were, however, significant differences in GY between varieties. Averaged across treatments, Suntop⟮D at 4.47 t/ha was the highest yielding variety significantly out yielding the next best performing, the early-maturing variety LRPB Dart⟮D by ~0.40 t/ha. Variety rankings differed in comparison with SD 1 (Table 2).

Table 2. Grain yield (t/ha), screening (%) and grain protein concentration (%) for six wheat varieties averaged across populations for 7 June sowing date.

Variety	Grain yield (t/ha)	Screening (%)	Grain protein concentration (%)
Suntop	4.47^{a}	14.4^{b}	12.5^{d}
LRPB Dart	4.06^{b}	19.2^{c}	13.1^{c}
LRPB Lancer	3.97^{bc}	11.4^{a}	13.5^{b}
EGA Gregory	3.77^{c}	13.9^{b}	12.6^{d}
LRPB Spitfire	3.73^{c}	17.9^{c}	13.9^{a}
EGA Eaglehawk	3.38^{d}	23.9^{d}	13.5^{b}
l.s.d. ($P = 0.05$)	0.28	2.3	0.2

Values within columns with the same letters denote no significant difference

When looking at grain quality parameters for SD 2, plant population had no effect on screenings (% grain below the 2.0 mm screen). There were, however, significant differences between the varieties, with screenings ranging from 11.4% for LRPB Lancer$^{(\phi)}$ averaged across treatments up to 23.9% for EGA Eaglehawk$^{(\phi)}$. Importantly, delayed sowing resulted in a significant increase in screenings % for all varieties, with all exceeding the critical 5% level (Table 2). Thousand grain weight for all varieties was considerably lower when SD was delayed, with the reduced target plant population resulting in an increase in TGW (data not shown).

In contrast to yield, GPC increased when SD was delayed, highlighting the inverse relationship between GPC and GY, with lower yield potential and hence higher GPC associated with delayed sowing.

Conclusions

Results from this experiment highlight the importance of timely sowing, particularly for mid–late maturing varieties. Yield reductions of approximately 1.3 t/ha averaged across plant population treatments were recorded for the mid–late maturing varieties LRPB Lancer$^{(\phi)}$ and EGA Gregory$^{(\phi)}$ with delayed sowing, which equates to a 25% and 26% yield decline, respectively. Similarly, the late maturing variety EGA Eaglehawk$^{(\phi)}$ suffered a yield penalty of around 22% (0.98 t/ha) whilst the mid maturing variety Suntop$^{(\phi)}$ suffered a 14% (0.70 t/ha) yield reduction due to delayed sowing. In comparison, the earlier maturing varieties LRPB Dart$^{(\phi)}$ and LRPB Spitfire$^{(\phi)}$ suffered only minimal yield reductions when SD was delayed. Importantly however, the earlier maturing varieties did not exhibit any yield advantage over the later maturing varieties in SD 2 and were significantly lower yielding than these varieties at SD 1.

Temperature and plant available water during anthesis/grain fill would also have affected both yield potential and grain quality parameters, with limited effective in-crop rainfall in September/October, and temperatures exceeding 35 °C for an extended period from 4 October. The longer season variety EGA Eaglehawk$^{(\phi)}$ in particular had high screenings for both SDs, and also produced a low yield in SD 2, reinforcing the need to sow this variety early due to its lack of adaptability under unfavourable conditions.

Increasing plant population had a greater influence on GY when SD was delayed, with yield potential optimised at 200 plants/m^2 in SD 2 vs. 100 plants/m^2 in the earlier SD 1, supporting the principal of increasing targeted plant populations with delayed sowing. These findings further emphasise the advantage of planting early in the sowing window compared to delayed sowing just simply in terms of input seed requirements.

Variety selection and sowing date particularly affected grain quality parameters and screenings. There was a significant increase in the level of screenings for all varieties when sowing was delayed. LRPB Lancer$^{(\phi)}$ was the only variety in this experiment that achieved screenings of <5%, but only at SD 1. All other varieties, including LRPB Lancer$^{(\phi)}$ in SD 2, exceeded the critical 5% screenings receival standards level. LRPB Lancer$^{(\phi)}$ appears to have excellent grain stability with significantly lower screenings than either EGA Gregory$^{(\phi)}$ or Suntop$^{(\phi)}$. Findings from this experiment indicate that there were differences between varieties in terms of grain stability, due possibly to variations in kernel shape/plumpness and or kernel weight stability. These results also highlight the adaptability of some of the mid–late season varieties, and the yield and quality advantages of sowing these varieties early, compared with sowing earlier maturing varieties later.

Acknowledgements

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