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Longer-season wheat to achieve higher yield in the high rainfall area

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Purpose:	**Exploring the potential of longer-season wheat to achieve higher yield in the high rainfall zone**
Location:	**Dandaragan**
Soil Type:	**Red clay**
Soil Test Results:	**Soil available N: 90 kg N/ha at the 0-40 cm profile,**
	Colwell P: 50 mg/kg; soil pH (CaCl2): 5.3.
Moisture profile:	**8% cm^3 cm^{-3}**
Rotation:	**Canola-wheat**
Growing Season Rainfall (April- October 2015):	**321** mm.

BACKGROUND SUMMARY

The yield gap between the current yield and the water-limited potential yield is about 1 to 2 tonnes per hectare in the high rainfall area. The wheat varieties bred for traditional wheatbelt with the low and medium rainfall may limit yield potential when grown in the high rainfall area. Lengthening the construction period duration (CPD) of the spike growth may increase the sink size and therefore potential yield. The aim of this study was to i) evaluate the relationships between yield, flowering time and the duration of spike growth period and ii) investigate whether yield can be improved by lengthening CPD.

Trial design, management and measurements

The trial was replicated 3 times with a column (6) by row (12) design (below). The number of wheat line tested was 72, consisting of 10 commercial varieties, 8 breeding lines, 12 isogenic lines and 42 F-lines from the Multiparent advanced generation intercross (MAGIC) populations generated by CSIRO. Plot size: 6 m x 1.54 m. The trial was sown on 17/05/2015 with a seeding rate of 80 kg/ha. At sowing, 80 kg/ha Agras treated with Impact was drilled. Sixty liter/ ha of UAN was sprayed on 9/6/2015 and further 240 kg urea/ha was top-dressed on 27/6/2015. At seeding, 200 ml/ha Lorsban, 200 ml/ha Dominex, 1.5 Lt/ha Sprayseed, and 1.5 Lt/ha Treflan were sprayed to control weeds. On 9 June 2015, 800 mL/ha Velocity was applied and 0.4 Lt/ha MCPA 600 LVE and 700 mL/ha Velocity on 23 June 2015. On 14 July 2015, 1000 ml/ha Jaguar and 300 ml/ha Prosaro was sprayed to control yellow leaf spot. A further 300 ml/ha Prosaro was applied on 29 July 2015. We measured the terminal spikelet initiation by microscope dissection and recorded the time to terminal spikelet initiation and flowering. At maturity, biomass and yield were measured and harvest index was calculated.

Trial layout

Rep 1	1001	ADV09-0480	2001	Trojan	3001	Beaufort	4001	W2A	5001	F0492	6001	F0685
	1002	F0879	2002	F1445	3002	W13A	4002	W46A	5002	W4A	6002	F0840
	…	….	…	…	…	…	…	…	…	…	…	…
	1012	F0349	2012	F1479	3012	ADV07.0099	4012	ADV08-0062	5012	F1629	6012	F1498
Rep 2	1013	AGT1	2013	Beaufort	3013	F1651	4013	F1153	5013	F0996	6013	F1629
	…	….	…	…	…	…	…	…	…	…	…	…
	1024	ADV08-0062	2024	Magenta	3024	F1302	4024	F0887	5024	F1308	6024	ADV09-0480
Rep 3	1025	F1613	2025	F0879	3025	F0744	4025	W21A	5025	F0232	6025	F1651
	1026	Gregory	2026	IGW4012	3026	F0949	4026	F1308	5026	F0444	6026	Lancer
	…	….	…	…	…	…	…	…	…	…	…	…
	1036	F1445	2036	W6A	3036	Beaufort	4036	W46A	5036	Forrest	6036	F0853

RESULTS

The optimum flowering time was 117 days after sowing (DAS) beyond which yield decreased with delaying of flowering. This was at around 10 September. Yield tended to increase with days to flowering of 85 to 120 DAS. A few F lines (F0742, F1055, F0165, F437 and F0130) had higher yield despite they flowered early. Mace flowered on 24 August, 3 days earlier than Trojan and 7 days earlier than Magenta (Fig. 1b). Breeding line VO-6069-09 flowered 17 days later than Mace and produced the highest yield 6.7 t/ha. Mace produced 1 t/ha lower yield than Trojan and Magenta (Fig. 1b). F lines from the MAGIC population flowered earlier than the commercial check varieties and breeding lines, indicating that these F lines could be too early for the region.

Fig. 1: The relationship among yield, terminal spikelet initiation and flowering time at Dandaragan in 2015

Fig. 2: Relationships between the time to anthesis and time to terminal spikelet initiation, between yield and construction period of spike growth

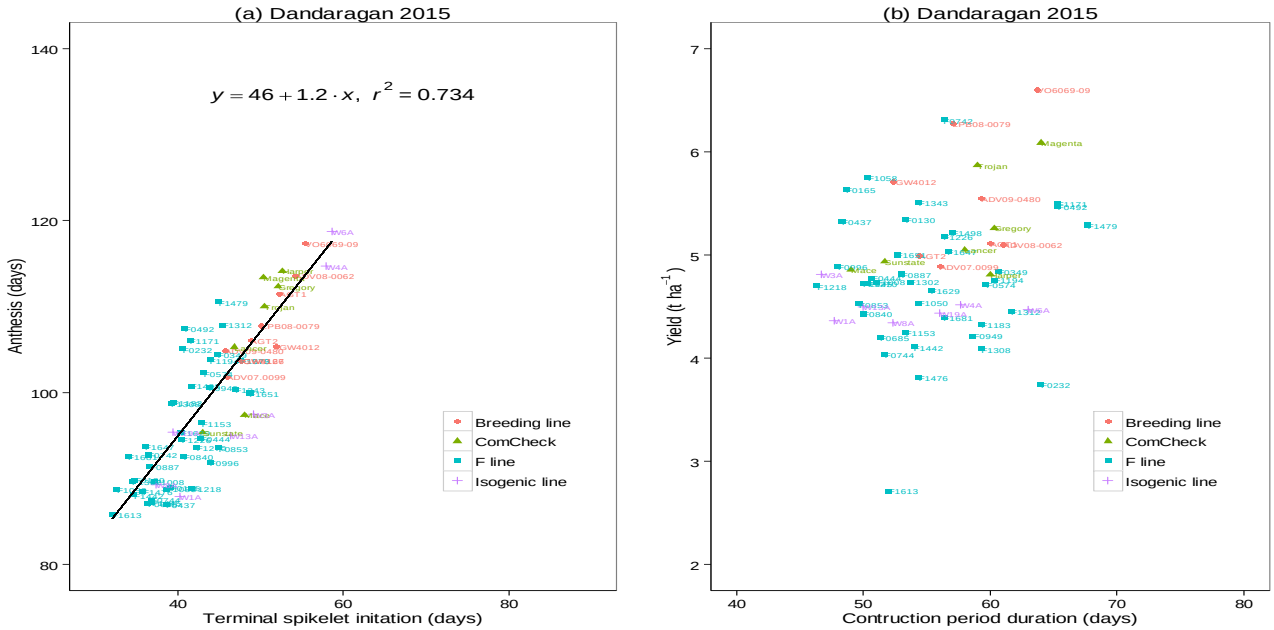
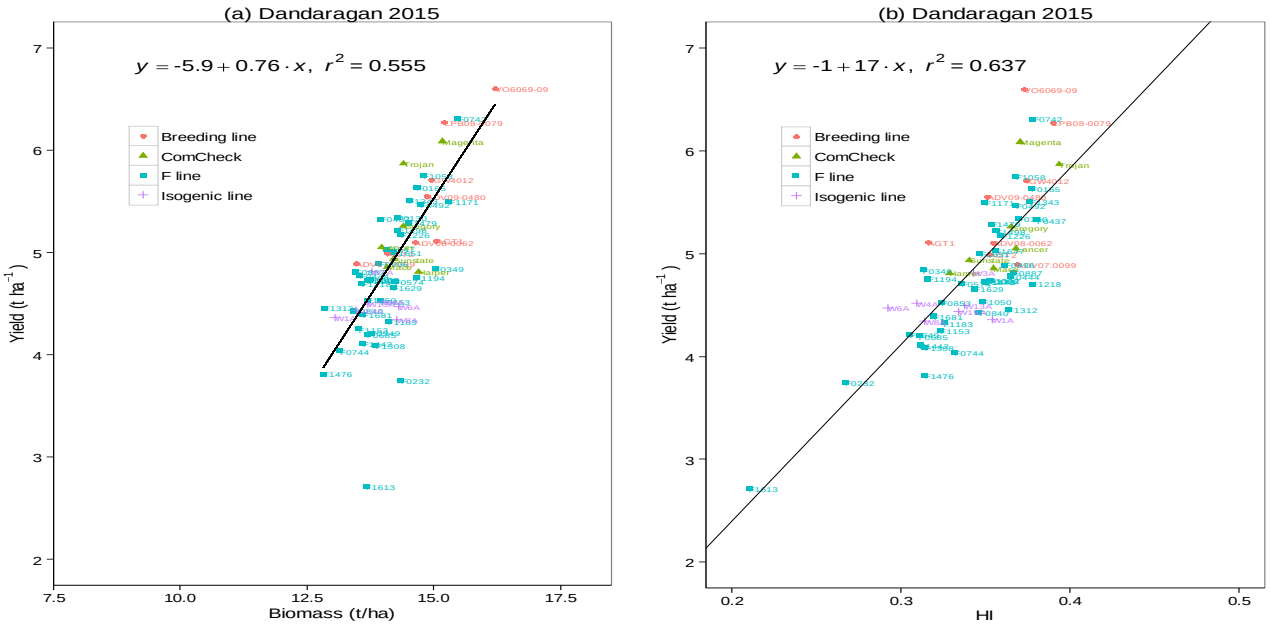


Fig. 3: Relationship between yield and biomass and harvest index (HI) at Dandaragan in 2015



Days to anthesis was highly related to the days to terminal spikelet initiation (Fig. 2a). It indicated that genotypes reached terminal spikelet initiation earlier also flowered earlier and vice versa. There was no clear trend between yield and the construction period duration (Fig. 2b).

Yield was significantly correlated with biomass (Fig. 3a) and harvest index (Fig. 3b). For the breeding lines and commercial check varieties, HI remained stable across a wide range of biomass, indicating that it is important to achieve high biomass to realize the water-limited potential. More importantly, the high yielding wheat varieties and breeding lines had not only high biomass but also greater HI. This suggests that they established a greater sink size and were able to fill the increased sink size.

Discussion

Longer-season wheat with later flowering time produced higher yield than early flowering wheat. However, the high correlation between the time to anthesis and the time to terminal spikelet initiation makes it difficult to evaluate the relationship between yield and CPD independently. Increasing biomass from longer-season wheat is probably more promising trait than lengthening CPD to achieve higher yield in the high rainfall area.

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