MANAGEMENT OF FLOWERING TIME AND EARLY SOWN SLOW DEVELOPING WHEATS

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TAKE HOME MESSAGES

- Best yields of winter wheats sown early are similar to Scepter sown in its optimal window.
- If sowing early use the right winter cultivar for the right yield and flowering environment.
- Highest yields for winter wheats come from early/late April establishment.
- Mid – slow developing spring varieties are less suited to pre April 20 sowing.

BACKGROUND

Timely operations are key to maximising farm profit, and sowing is one of the most time-critical operations. This is because there is only a short period (~10 days) in spring during which crops can flower and yields be maximised. This period is referred to as the *optimal flowering period* and its timing and length varies with location and climate. During the optimal flowering period, combined yield loss from drought, heat, frost and insufficient radiation are minimised, and yield maximised. Increasing farm sizes and cropped area, and declining autumn rainfall have made it increasingly difficult to get crops flowering during the optimal period.

Sowing early with appropriate cultivars is one management strategy to increase the amount of farm area that flowers during the optimal period and thus farm yield can be maximised. Sowing earlier requires cultivars that are slower developing to take advantage of early establishment opportunities. They are ideally sown into a moist seed bed following breaking rain or preceding a convincing forecast of enough rain to allow germination. This should not be confused with dry sowing which will typically use fast developing cultivars sown into dry seed beds that will establish when breaking rains fall.

Prior to the start of the project in 2017, the low – medium rainfall environments had little exposure to the new winter cultivars, particularly at really early sowing dates (mid-March). This work has aimed to answer questions around management of these cultivars when sown early.

AIM

To determine which of the new generation of winter cultivars have the best yield and adaptation in different environments and what is their optimal sowing window.

PADDOCK DETAILS

Locations: SA – Minnipa, Booleroo Centre, Loxton, Hart
Vic. – Mildura, Horsham*, Birchip* and Yarrawonga
NSW – Condobolin, Wongarbon, Wallendbeen (*Table 1)

Table 1. BCG managed trial locations and paddock details across the life of the project.

Location and year	2017 Birchip (Curyo)	2017 Horsham (Longerenong)	2018 Birchip (Narraport)	2018 Horsham (Rupanyup)	2019 Birchip (Karyrie)	2019 Horsham (Kalkee)
Crop year rainfall (Nov-Oct)	297mm	424mm	200mm	310mm	418mm	363mm
GSR (Apr-Oct)	215mm	303mm	138mm	226mm	197mm	254mm
Soil Type	Sandy clay loam	Clay	Clay	Clay	Clay loam	Clay
Paddock history	Fallow	Lentil	Fallow	Lentil	Fallow	Lentil

TRIAL DETAILS

Treatments: Time of sowing x Cultivar

Target sowing dates: 15 March, 1 April, 15 April and 1 May
(10mm supplementary irrigation to ensure establishment).

Up to ten wheat cultivars: The new winter wheats differ in quality classification, development speed and disease rankings (Table 2).

Table 2. Summary of winter cultivars, including Wheat Australia quality classification and disease rankings based on the 2020 SA Crop Sowing Guide.

Cultivar	Release Year	Company	Development	Quality	Disease Rankings#			
					Stripe Rust	Leaf Rust	Stem Rust	YLS
Kittyhawk	2016	LRPB	Mid winter	AH	RMR	MS	MRMS-S	MRMS
Longsword	2017	AGT	Fast winter	Feed	RMR	MSS	MR	MRMS
Illabo	2018	AGT	Mid winter	AH/APH*	RMR	S	MS	MS
DS Bennett	2018	Dow	Slow winter	ASW	RMR	S	MRMS	MRMS
ADV15.9001	?	S & W Seed Co.	Fast winter	?	-	-	-	-
Nighthawk	2019	LRPB	Very slow spring	?	RMR	MSS	RMR	MS
Cutlass	2015	AGT	Mid spring	APW/AH*	MS	RMR	R	MSS
Trojan	2013	LRPB	Mid-fast spring	APW	MR	MRMS	MRMS	MSS
Scepter	2015	AGT	Fast spring	AH	MSS	MSS	MR	MRMS

*SNSW only

Trials were managed as per best practice.

METHOD

Experiments have been conducted in the southern region in low to medium rainfall environments during 2017 to 2019, including collaboration in NSW for additional datasets presented in this paper. Trials were sown at sites using a randomised split plot design. Assessments included growth staging, NDVI measurements, maturity biomass, harvest index, yield and quality assessments.

RESULTS AND INTERPRETATION

Flowering time

Flowering time is a key determinant of wheat yield. Winter cultivars are very stable in flowering date across a broad range of sowing dates, this has implications for variety choice as flowering time cannot be manipulated with sowing date in winter wheats like spring wheats. This means that different winter varieties are required to target different optimum flowering windows. The flowering time difference between winter cultivars are characterised based on their relative development speed into three broad groups fast, mid and slow for medium-low rainfall environments (Table 2 and Figure 1).

For example at Birchip each winter variety flowered within a period of 7-10 days across all sowing dates, whereas spring cultivars were unstable and ranged in flower dates over one month apart (Figure 1). In this Birchip example the fast – mid developing winter wheats with development speeds similar to Longsword and Illabo are best suited to achieve the optimum flowering period 10-20 September for Birchip. In other lower yielding environments such as Loxton, Minnipa, and Mildura the faster developing winter cultivar ADV15.9001 and Longsword were better suited to achieve flowering times required for the first 10 days in September.

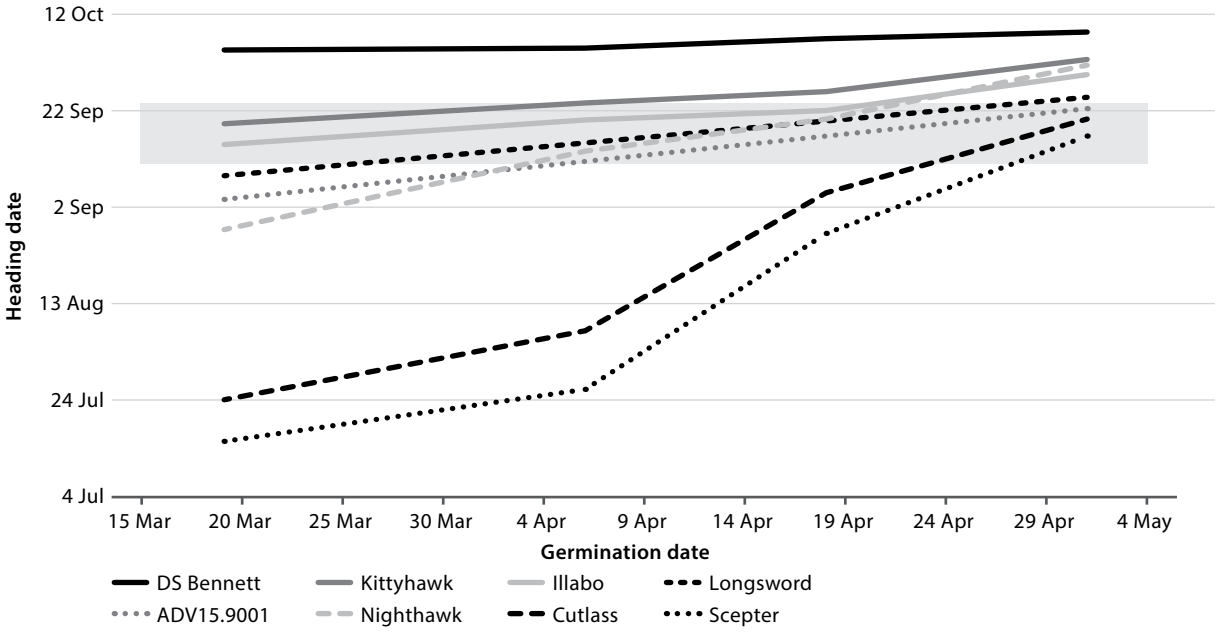

Figure 1. Mean head emergence date responses from winter and spring cultivars at Birchip in 2018 and 2019 across all sowing times, grey box indicates the optimal period for heading at Birchip. Head emergence dates are a proxy for flowering which usually occurs a few days later.

Yield

Across all experiments the best performing winter wheat yielded the same as the fast developing spring variety Scepter sown at the optimal time (last few days of April or first few days of May, used as a best practice control) in 21 out of 28 sites, greater in five and less than in two environments (Figure 2).

The best performing winter wheat yielded similar to the best performing slow developing spring variety (alternative development pattern) at 24 sites, greater at two and less than at two sites (Table 3).

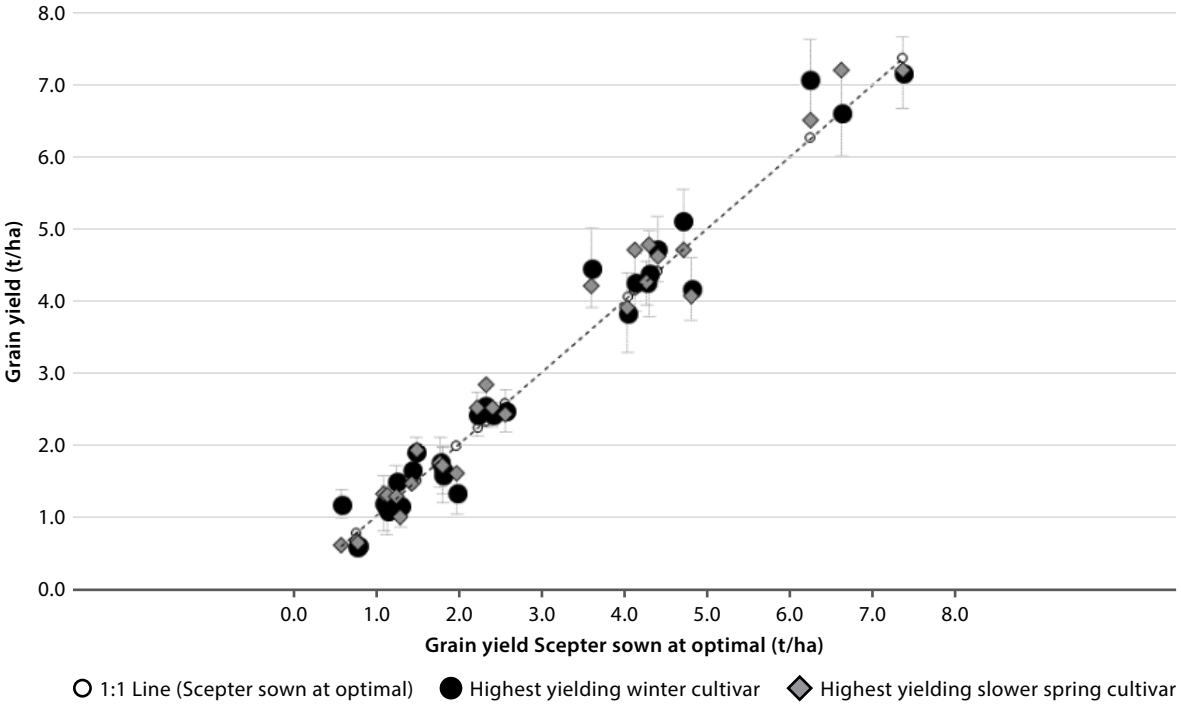

Figure 2. Grain yield performance of Scepter wheat sown at its optimal time (late April-early May) in 28 environments (2017-2019) compared to the performance of the best performing winter wheat and slower spring wheat. Error bars indicate LSD (P<0.05).

Table 3. Summary of grain yield performance of the best performing winter and alternate spring cultivar in comparison to Scepter sown at the optimum time (late April-early May). Different letters within a site indicate significant differences in grain yield.

Site	Year	Grain yield of Scepter sown ~1 May (t/ha)		Highest yielding winter cultivar				Highest yielding slower spring cultivar			
				Grain Yield (t/ha)		Cultivar#	Germ Date	Grain Yield (t/ha)		Cultivar#	Germ Date
Yarrawonga*	2018	0.6	b	1.2	a	DS Bennett	16-Apr	0.6	b	Cutlass	16-Apr
Booleroo	2018	0.8	a	0.6	a	Longsword	4-Apr	0.7	a	Trojan	2-May
Booleroo	2019	0.8	a	0.6	a	ADV15.9001	05-Apr	0.6	a	Cutlass	01-May
Loxton	2018	1.1	a	1.2	a	Longsword	19-Mar	1.3	a	Cutlass	3-May
Loxton*	2019	1.1	a	1.1	a	ADV15.9001	15-Mar	1.3	a	Cutlass	01-May
Minnipa	2018	1.3	a	1.5	a	Longsword	3-May	1.3	a	Trojan	3-May
Mildura	2019	1.3	a	1.2	a	ADV15.9001	29-Apr	1.0	a	IGW6566	15-Apr
Mildura*	2018	1.4	b	1.7	a	DS Bennett	1-May	1.5	ab	Nighthawk	1-May
Mildura	2017	1.5	b	1.9	a	Longsword	13-Apr	1.9	a	Cutlass	28-Apr
Minnipa	2019	1.8	a	1.8	a	ADV15.9001	05-Apr	1.7	a	Cutlass	05-Apr
Horsham*	2018	1.8	a	1.6	a	DS Bennett	6-Apr	1.7	a	Trojan	2-May
Hart	2019	1.8	a	1.6	a	Illabo	05-Apr	1.7	a	Nighthawk	18-Apr
Booleroo	2017	2.0	a	1.3	b	DS Bennett	4-May	1.6	b	Cutlass	4-May
Minnipa	2017	2.2	a	2.4	a	Longsword	18-Apr	2.5	a	Cutlass	5-May
Loxton	2017	2.3	a	2.6	ab	Longsword	3-Apr	2.8	b	Nighthawk	3-Apr
Hart	2018	2.4	a	2.4	a	Illabo	17-Apr	2.5	a	Nighthawk	17-Apr
Condobolin	2018	2.6	a	2.5	a	DS Bennett	19-Apr	2.4	a	Trojan	7-May
Yarrawonga	2019	3.6	b	4.5	a	ADV15.9001	15-Mar	4.2	a	Nighthawk	05-Apr
Birchip	**2018**	**4.0**	**a**	**3.8**	**a**	**Longsword**	**30-Apr**	**3.9**	**a**	**Trojan**	**30-Apr**
Hart	2017	4.1	a	4.3	a	Illabo	18-Apr	4.7	b	Nighthawk	18-Apr
Yarrawonga	2017	4.3	a	4.2	a	DS Bennett	3-Apr	4.3	a	Cutlass	26-Apr
Wongarbon	2017	4.3	a	4.4	a	DS Bennett	28-Apr	4.8	a	Trojan	13-Apr
Tarlee	2018	4.4	a	4.7	a	Illabo	17-Apr	4.6	a	Nighthawk	17-Apr
Birchip	**2019**	**4.7**	**a**	**5.1**	**a**	**DS Bennett**	**01-May**	**4.7**	**a**	**Nighthawk**	**01-May**
Horsham	2019	4.8	a	4.2	b	Longsword	05-Apr	4.1	b	Nighthawk	05-Apr
Wallendbeen	2017	6.2	b	7.1	a	DS Bennett	28-Mar	6.5	b	Cutlass	1-May
Birchip	**2017**	**6.6**	**b**	**6.6**	**b**	**DS Bennett**	**15-Apr**	**7.2**	**a**	**Trojan**	**15-Apr**
Horsham	2017	7.4	a	7.2	a	DS Bennett	16-Mar	7.2	a	Trojan	28-Apr

*stem and/or reproductive frost substantially affected yield

#Cultivars ADV15.9001, Trojan and IGW6566 were not included at all sites

Cultivar performance in different yield environments

The best performing winter wheat cultivars depended on yield environment, development speed and the severity and timing of frost (Table 2). The rules generally held up that winter cultivars that are well-adjusted to a region yielded similar to Scepter sown in its optimal window, these results demonstrate that different winter wheats are required for different environments and there is genetic by yield environment interaction.

- In environments less than 2.5t/ha the faster developing winter cultivars Longsword and ADV15.9001 were favoured (Table 3, Figure 3).
- In environments greater than 2.5t/ha the mid – slow developing cultivars were favoured; Illabo in the Mid North of SA, and DS Bennett at the Vic and NSW sites (Figure 4).
- The poor relative performance of Longsword in the higher yielding environments was explained by a combination of flowering too early and having inherently greater floret sterility than other cultivars irrespective of flowering date.

Sites defined by severe September frost and October rain included Yarrawonga, Mildura, and Horsham in 2018, in this scenario the slow developing cultivar DS Bennett was the highest yielding winter wheat and had the least amount of frost induced sterility. The late rains also favoured this cultivar in 2018 and mitigated some of the typical yield loss from terminal drought (ie Birchip 2019). Nonetheless the ability to yield well outside the optimal flowering period maybe a useful strategy for extremely high frost prone areas for growers wanting to sow early.

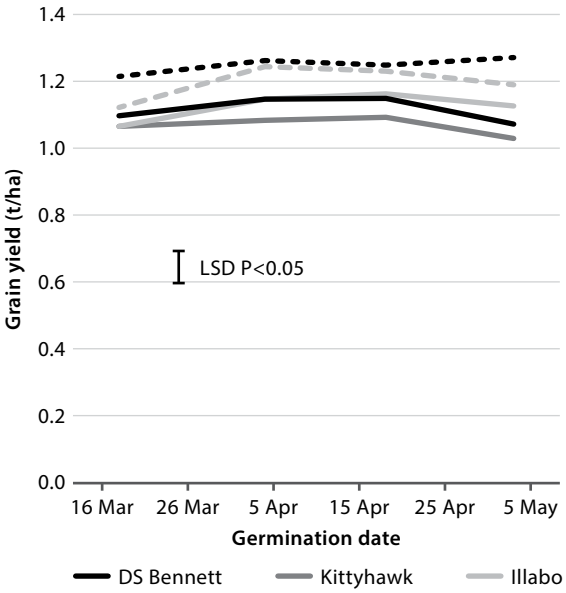

Figure 3. Mean yield performance of winter wheat in yield environments less than 2.5 t/ha (n=16 sites in SA/Vic).

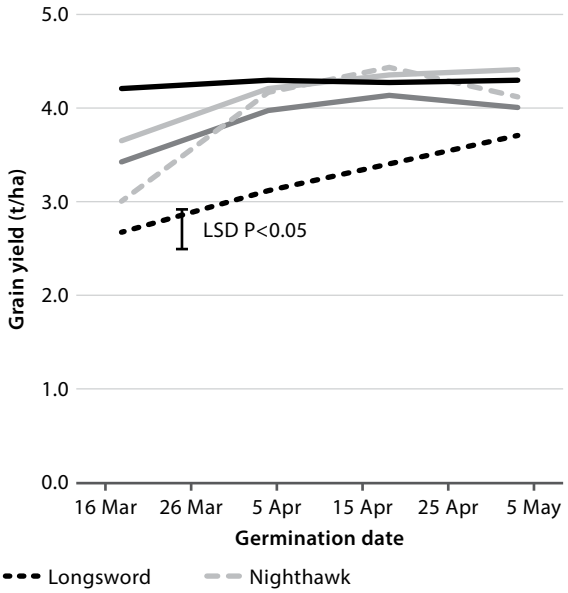

Figure 4. Mean yield performance of winter wheat in yield environments greater than 2.5 t/ha (5 sites in SA/Vic).

Sowing time

- Across all environments the highest yields for winter wheats generally came from early – late April establishment and results suggested that the yields may decline from sowing dates earlier than April as these dates may be too early to maximise winter wheat performance (Table 3, Figure 3 and Figure 4). The cultivar DS Bennett maintained yield better than other cultivars from March establishment.
- Mid – Slower developing springs (ie Cutlass) performed best from sowing dates after April 20, and yielded less than the best performing winter cultivars when sown prior to April 20. This reiterates slow developing spring varieties are not suited to pre April 20 sowing in low – med frost prone environments.
- The very slow developing spring Nighthawk yielded similar to the best performing winter cultivar in both yield environments from mid-April establishment dates.

COMMERCIAL PRACTICE

For sowing prior to April 20, winter cultivars are required, particularly in regions of high frost risk. Winter wheats will not progress to flower until their vernalisation requirement is met (cold accumulation) whereas spring cultivars will flower too early when sown early. The longer vegetative period of winter varieties also opens opportunities for grazing. Winter wheat cultivars allow wheat growers in the southern region to sow much earlier than currently practiced, meaning a greater proportion of farm can be sown on time.

Growers in the low-medium rainfall zones of the southern region now have winter wheat cultivars that can be sown over the entire month of April and are capable of achieving similar yields to Scepter sown at its optimum time. However, grain quality of the best performing cultivars leaves something to be desired (Longsword=feed, DS Bennett=ASW). Sowing some wheat area early allows a greater proportion of farm area to be sown on time. Growers will need to select winter wheats suited to their flowering environment (fast winter in low rainfall, mid and mid-slow winter in medium rainfall) and maximum yields are likely to come from early – mid April planting dates.

REFERENCES

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