Sow on-time or early: getting the best out of current wheat varieties

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Take home messages

- Maximise wheat yields by ensuring as much crop flowers during the optimal period as possible – sow on time or early!
- Early sown, slow maturing varieties (winter and spring) yield as well as or better than faster maturing varieties sown later.
- Including an early sown variety in a cropping program can greatly increase whole-farm yield.
- Extra management needs to be considered for disease and nutrition, particularly *Septoria tritici.*

Introduction

The dry autumn and frosty spring of 2013 continues the pattern of the last 17 years, and is likely to continue into the future (Cai et al. 2012). Getting wheat to flower during the optimal period in a given environment is a huge driver of yield and water-use efficiency, particularly with the recent pattern of late frosts and early heat - and dry autumns make achieving this very difficult. The majority of current wheat varieties need to be sown in the first half of May in order to flower during the optimal period for yield in most environments, which unfortunately coincides with the period of recent rainfall decline.

Growers wishing to maximise farm water-use efficiency need to adopt strategies that will allow them to get as much of their wheat crop as possible flowering during the optimal period in their environment. This means having the varieties, rotations, equipment and level of organisation required to take advantage of any sowing opportunity that arises from late summer onward. This article reports results from an experiment at Inverleigh, Victoria, investigating the potential for earlier sowing to increase wheat yields in the face of autumn rainfall decline.

Optimal Flowering Periods

Every production environment has an optimal period in which wheat crops need to flower in order for yield and water-use efficiency to be maximised (Figure 1). This period is defined by an optimal balance between temperature, radiation and water availability, and also decreasing frost risk and increasing heat risk. Optimal flowering periods vary for different locations e.g. the optimal flowering period for the northern Mallee is at the start of September, whilst in SW Victoria it is at the end of October. Growers and advisors should have firm understanding of the optimal flowering period in their environment, and how to achieve it from different sowing dates with different varieties.

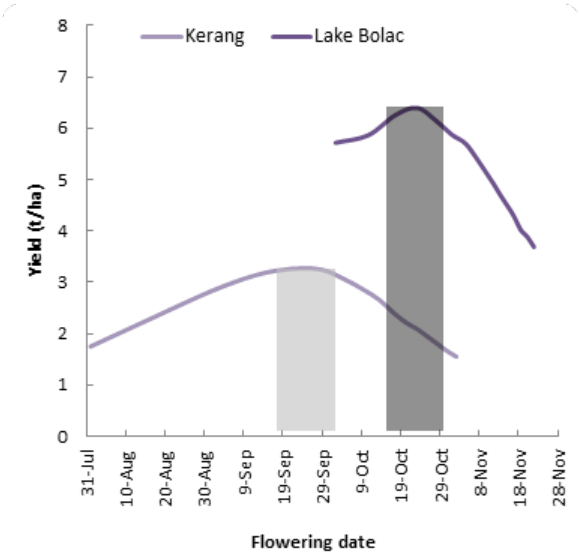

Figure 1. The relationship between flowering time and yield at Kerang and Lake Bolac – optimal flowering periods are highlighted by grey boxes. Curves are derived from APSIM from 120 years of climate and with a yield reduction for frost and extreme heat events. Optimal flowering periods are mid-September at Kerang, and late October at Lake Bolac.

They key challenge for growers wanting to maximise whole-farm yield and WUE is to have as much of their wheat crop as possible flowering during the optimal period. This has become increasingly difficult for three reasons;

1. Autumn rainfall has declined significantly in the last 17 years as a direct consequence of anthropogenic climate change.
2. Recently released varieties for most environments have a very narrow range of maturities and unstable flowering times and are only flower during the optimal period if sown between late April and late May.
3. Farm sizes and cropping programs are getting bigger.

For these reasons, growers increasingly need to be able to take advantage of whatever sowing opportunities they can get, and there are three strategies that can be employed in order to ensure as much wheat crop as possible flowers during the optimal period.

4. Sow winter wheats from late February through to April.
5. Sow slower maturing spring wheats from mid-April to early May.
6. Sow mid-fast wheats from late-April onward - including dry sowing if the break has not arrived by this time.

Currently most growers are comfortable with the third strategy, and this has been the principal adaption to the drying autumns. However, there is great potential for the first two strategies to complement May sowing and further increase farm yield.

Achieving optimal flowering periods – experiments 2013

February-March rainfall has not declined over the past 17 years, and in some areas it has increased (Hunt and Kirkegaard 2011). This rain can be used in lieu of the traditional autumn break to establish crops, but winter wheats are required to achieve this. Winter wheats have a vernalisation or cold requirement which means they will not develop beyond tillering until they have been exposed to a certain duration of low temperatures (~4-18 °C). This gives them a very stable flowering date from a broad range of sowing dates (Table 1). They can even be sown in summer, and not flower until the optimal flowering period in spring. They are often only thought of as 'dual purpose' (grain and graze) varieties, and have been undervalued as grain-only varieties, particularly in drier areas of the country.

Unfortunately, Australian breeding programs stopped selecting for milling quality winter wheats early last decade. There are very few cultivars available, particularly for medium-low rainfall zones with alkaline soils. Commercial breeding companies have now resumed selection for winter wheats, and it is likely that they will play a greater role in our future farming systems as modern, adapted varieties are released.

Early sowing in the HRZ

Early sowing has huge potential in the high rainfall zone of SW Victoria, as it overcomes many of the constraints of that environment e.g. water logging and damage by invertebrate pests. It also creates crops capable of achieving the high yield potentials which are frequently on offer.

As part of GRDC's new early sowing project, SFS, FAR Australia and CSIRO set up an experiment at Inverleigh in 2013 investigating the potential for early sowing in SW Victoria. Constrained by the dry autumn, we used 15 mm of irrigation applied via drippers to press-wheel furrows to establish each time of sowing. Winter and spring were very favourable at this site (water limited yield potential was 8.2 t/ha), and Yield Prophet was used to match N inputs to yield potential (300 kg/ha N applied in total). The trial was planted on a pea-hay stubble, but there was significant take-all observed in the trial. *Septoria tritici* was also present despite in-furrow flutriafol and three foliar applications of fungicide.

Despite the disease pressure, yields were exceptional with the highest yields (>9 t/ha) coming from slow maturing red wheat varieties Revenue (winter) and Beaufort (slow maturing spring) sown at the end of April (Table 1). Defoliating Revenue at Z30 (to simulate grazing) increased yield such that it out-yielded Beaufort (Table 2). There is some evidence that this could have been related to the effect of grazing on severity of *Septoria tritici*. Grazing increased yield of Revenue by 3.3 t/ha in a block of the trial that inadvertently missed one of the foliar fungicides (Figure 2), and was excluded from the other analyses.

It is important to point out that whilst grazing can be used as a management tool, it doesn't mean that winter wheats must be grazed in order to manage their canopy and achieve good yields. Winter wheats are highly flexible grain only varieties in their own right, and a very important tool for managing climate variability.

Figure 2. The effect of defoliation on the severity of *Septoria tritici* infection. The photo on the left shows Revenue defoliated at GS30, photo on the right is un-defoliated Revenue which also missed an important foliar fungicide (had received two). Due to this, yield was reduced by 3.3 t/ha.

Forrest was the highest yielding milling wheat, particularly at the early times of sowing. Due to the very kind spring experienced at this location, overall there was very little effect of sowing time on yield. However even the latest time of sowing (10 May) is still considered 'early' in SW Victoria. The results could have been very different had a more hostile spring (e.g. 2009) been experienced.

Table 1. Yield results from the experiment conducted by SFS, FAR Australia and CSIRO at Inverleigh in 2013. Results analysed with take-all score as a co-variate.

Variety	Season length	Time of sowing			
		26-Mar	8-Apr	24-Apr	10-May
Beaufort	Slow maturing, spring	8.3	8.8	9.4	8.9
Bolac	Slow maturing, spring	6.2	6.6	7.3	7.6
Derrimut	Mid maturing, spring	-	-	6.9	7.1
Einstein	Slow maturing, winter	7.6	7.4	-	-
Forrest	Slow maturing, spring	7.4	7.7	7.4	7.2
Frelon	Slow maturing, winter	7.4	7.3	8.7	7.2
Kellalac	Slow maturing, spring	5.3	5.0	5.5	6.3
Lincoln	Fast maturing, spring	-	-	5.4	6.6
Revenue	Slow maturing, winter	8.0	8.2	9.3	8.4
Wedgetail	Slow maturing, winter	6.3	6.3	6.3	6.8
P-value		**0.015**			
LSD $_{(P=0.05)}$		**1.1**			

Table 2. Yield and take-all scores for Revenue (with different agronomy treatments intended to maximise yield of early sown crops) and Beaufort. There was no significant main effect of time of sowing or interaction with these treatments, and values are combined means from 26 March and 8 April sowing. Yield results were analysed with take-all score as a co-variate.

Variety	Seed density (seeds/m²)	Defoliation	N strategy	Yield (t/ha)	Take-all score (% white heads)
Beaufort	250	nil	grain	8.3	0
Revenue	125	nil	grain	8.1	12
Revenue	250	nil	grain	8.1	18
Revenue	250	Z30	grain	9.0	13
Revenue	250	Z30	forage*	8.7	7
P-value				**0.029**	**0.026**
LSD $_{(P=0.05)}$				**0.7**	**11**

* more early N to promote dry matter growth and recovery

Putting it into practice

Growers wishing to sow early in 2014 need to get themselves in a position to take advantage of early sowing opportunities should they arise. Early sown wheat needs weed and disease free paddocks – a double break (e.g. pulse/legume pasture/hay crop followed by a canola crop) is an ideal set-up for early sown wheat, particularly in higher rainfall areas.

Growers also need to have a good idea of what their optimal flowering period is, and how to achieve it from different sowing dates with a range of varieties most suited to their environment. If growers keep 2-3 varieties (one winter, one or two spring wheats), they are able take advantage of any sowing opportunity that may arise over a three month period (Table 3). It does require growers to be tactical in how much of each variety they grow in a given year, but the potential yield benefits well outweigh the logistical hassles.

Table 3. Wheat maturity groups, sowing windows to achieve optimal flowering windows and examples of best-bet varieties within groups for different regions in Victoria.

	Winter wheats	Slow maturing spring wheat	Mid maturing spring wheat	Fast maturing spring wheat
Sowing window	Late February – late April	Mid-April – early May	Late-April – mid May	Mid May onward
Mallee & Wimmera	Rosella, Wedgetail, Wylah, Whistler	NA	Phantom, Harper, Yitpi, Magenta	Corack, Mace, Scout, Shield
North East & North Central	Wedgetail, Wylah, Whistler	Bolac, Lancer, Chara	Phantom, Gregory	Suntop, Scout, Corack, Young
South West	Revenue, Manning	Beaufort, Bolac, Forrest	Derrimut, Trojan	Scout, Elmore CLF, Lincoln

Early sown crops do require different management to later sown crops. In SW Victoria *Septoria tritici* is a very serious pathogen of early sown crops, and it is recommended that flutriafol in-furrow and earlier foliar sprays are used when sowing early. Barley Yellow Dwarf Virus can be a threat in all environments, and it is recommended that seed be treated with imidicloprid, or crops closely monitored for aphid infestation and sprayed accordingly.

Nitrogen inputs should be deferred until Z30 to avoid excessive early growth, and if initial soil N is high, sowing rates should be reduced. Yield effects of grazing are variable – sometimes positive and sometimes negative but the effect size is rarely more than 0.5 t/ha if grazed in the safe window (prior to Z30). It is certainly not necessary to graze early sown crops to maximise grain production, but they can offer significant amounts of forage at a time when feed can be scarce.

References

Cai W, Cowan T, Thatcher M (2012) Rainfall reductions over Southern Hemisphere semi-arid regions: the role of subtropical dry zone expansion. Nature Scientific Reports 2.

Hunt JR, Kirkegaard JA (2011) Re-evaluating the contribution of summer fallow rain to wheat yield in southern Australia. Crop & Pasture Science 62, 915-929.

Figure 3. Early sown wheat at Inverleigh. There were four sowing dates ranging from 26th March to 10th May