Impact of sowing date on phenology and yield of lentil and faba bean – season 2

RESEARCH

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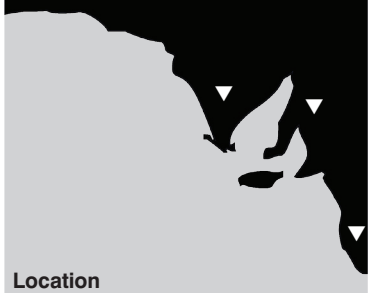
Searching for answers



Location
Roseworthy
Rainfall
Av. Annual: 400 mm
2017 crops were supplementarily irrigated to ensure crop establishment
Yield
Actual: 4.0 t/ha (beans) and 2.75 t/ha (lentils)
Paddock History
2016: Wheat
2015: Wheat
2014: Chickpea
Soil Type
Sandy clay loam
Plot Size
1 m x 1 m x 3 reps
Yield Limiting Factors
Frost, snails, early finish, late sowing, moisture and heat stress

Location
Bool Lagoon
Rainfall
Av. Annual: 550 mm
2017 crops were supplementarily irrigated to ensure crop establishment
Yield
Actual: 0.0 t/ha
Soil Type
Black clay
Plot Size
1 m x 1 m x 3 reps
Yield Limiting Factors
Waterlogging, frost, snails, early finish, late sowing, moisture and heat stress

Key messages

- **Lentil and faba bean accelerated their development and flowered earlier when sowing was delayed.**
- **Delayed sowing reduced yield in both pulses.**
- **Results should be considered with regard to the trade-off between early sowing and frost risk.**

Why do the trial?

Lentil and faba bean are two important pulse crops with growing interest from farmers in low rainfall areas of South Australia. Good prices, together with rotational benefits make these crops valuable options, however frost and combinations of water and heat stress at critical growth stages can compromise crop yield. Sowing date and variety choice are the two main tools to manipulate time of flowering and pod-set, and thus manage the risk of extreme temperatures, water stress and the trade-off between frost and heat risk.

The aim of this work is to analyse the impact of sowing date and variety on the phenology and grain yield of lentil and faba bean across different South Australian cropping environments, including the upper Eyre Peninsula.

How was it done?

Field trials have been conducted at Minnipa Agricultural Centre (2016 and 2017), Hart (2016), Roseworthy (2017) and Bool Lagoon (2016 and 2017) to test the effect of sowing date on phenology and yield of lentil and faba bean varieties. The trials combined six sowing dates ranging from 20 April to 9 July, with ten varieties of each crop chosen in consultation with breeders and industry experts. Faba bean varieties included Icarus, AF03001-1, PBA Rana, PBA Samira, Farah, PBA Zahra, Aquadulce, 91-69, Fiord, and Nura. Lentil varieties were PBA Blitz, Northfield, CIPAL901, CIPAL1301, PBA HurricaneXT, CIPAL1422, PBA Giant, PBA Jumbo2, Nugget, and Matilda.

For each species at each location, three replications were sown for each genotype and sowing date. Crops were sown by hand in a split-plot design with sowing dates allocated to the main plot and varieties randomized within each subplot. Plot size was 1 m by 1 m and consisted of 3 rows, 0.27 m apart. Prior to sowing, P was supplied by applying 80 kg/ha of MAP.

During the growing season, we measured phenology twice weekly within the central rows of the plots. We recorded the date when 50% of plants within the central row had reached flowering, pod emergence, end of flowering and maturity.

At Minnipa (2016 and 2017) and Roseworthy (2017), yield was measured from a subsample of 0.5 m length from the central rows of all plots. Samples were dried at 70^{o}C until constant weight was achieved and then grains were separated from the pods, cleaned, counted and weighed.

Location
Minnipa Agricultural Centre, paddock N10
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2016 Total: 281 mm
2016 GSR: 155 mm
2017 crops were supplementarily irrigated to ensure crop establishment - variable for each site and time of sowing
Paddock History
2016: Wheat
2015: Pasture
2014: Wheat
Soil Type
Clay loam
Plot Size
1 m x 1 m x 3 reps
Yield Limiting Factors
Frost, snails, early finish, late sowing, moisture and heat stress

What happened?

The difference between environments in 2017 was extreme, with drought affecting yields at Minnipa while waterlogging caused crop failure at Bool Lagoon. However, the trends in phenology and yield associated with sowing time have been consistent between environments. Across crops and species, the time to flowering and yield both decreased with delayed sowing (Figure 1). The relationship between sowing date and degree days to flowering was more scattered in lentil than in faba bean, possibly reflecting different roles of photoperiod and temperature as drivers of development.

In terms of yield, faba bean reductions associated with delayed sowing from mid/late April to late June was over 2.5 t/ha (2 fold decrease) at Roseworthy, 0.7 t/ha (~ 6 fold decrease) at Minnipa in 2017 and 1-1.3 t/ha (almost 2 fold decrease) in 2016. For lentil the yield penalty associated with delayed sowing was less severe; at Roseworthy, yield loss was 1.3 t/ha (almost 2 fold decrease), while at Minnipa in 2017 it was 0.4 t/ha (~ 3 fold decrease) and in 2016 was 0.4–0.6 t/ha (1.5 fold decrease). As is common with pulses, yield variation was explained by changes in seed number rather than seed size (Figure 2).

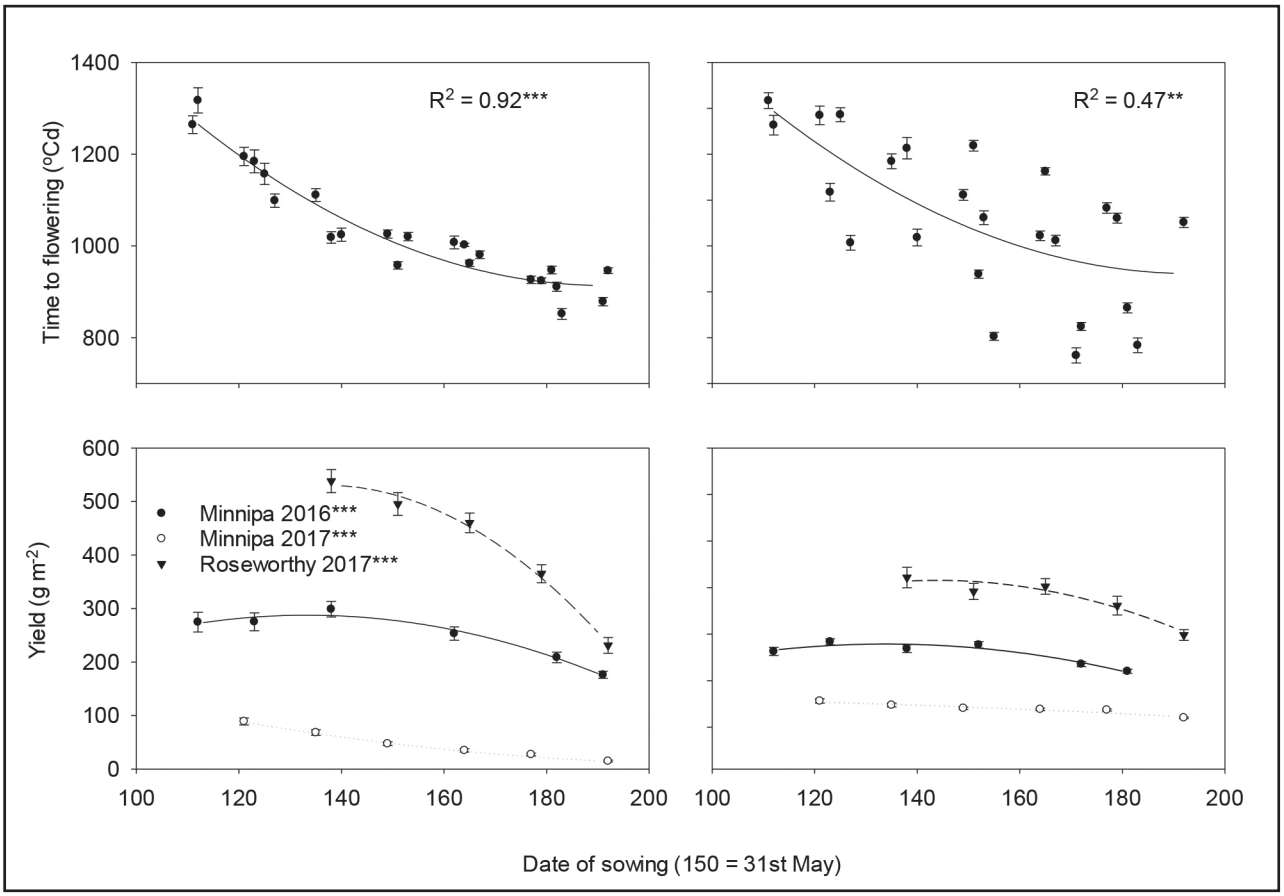


Figure 1. Phenology (top panels) and grain yield (bottom panels) of faba bean (left panels) and lentil (right panels) as a function of sowing date. Yield has been separated by environment while phenology is pooled across environments.

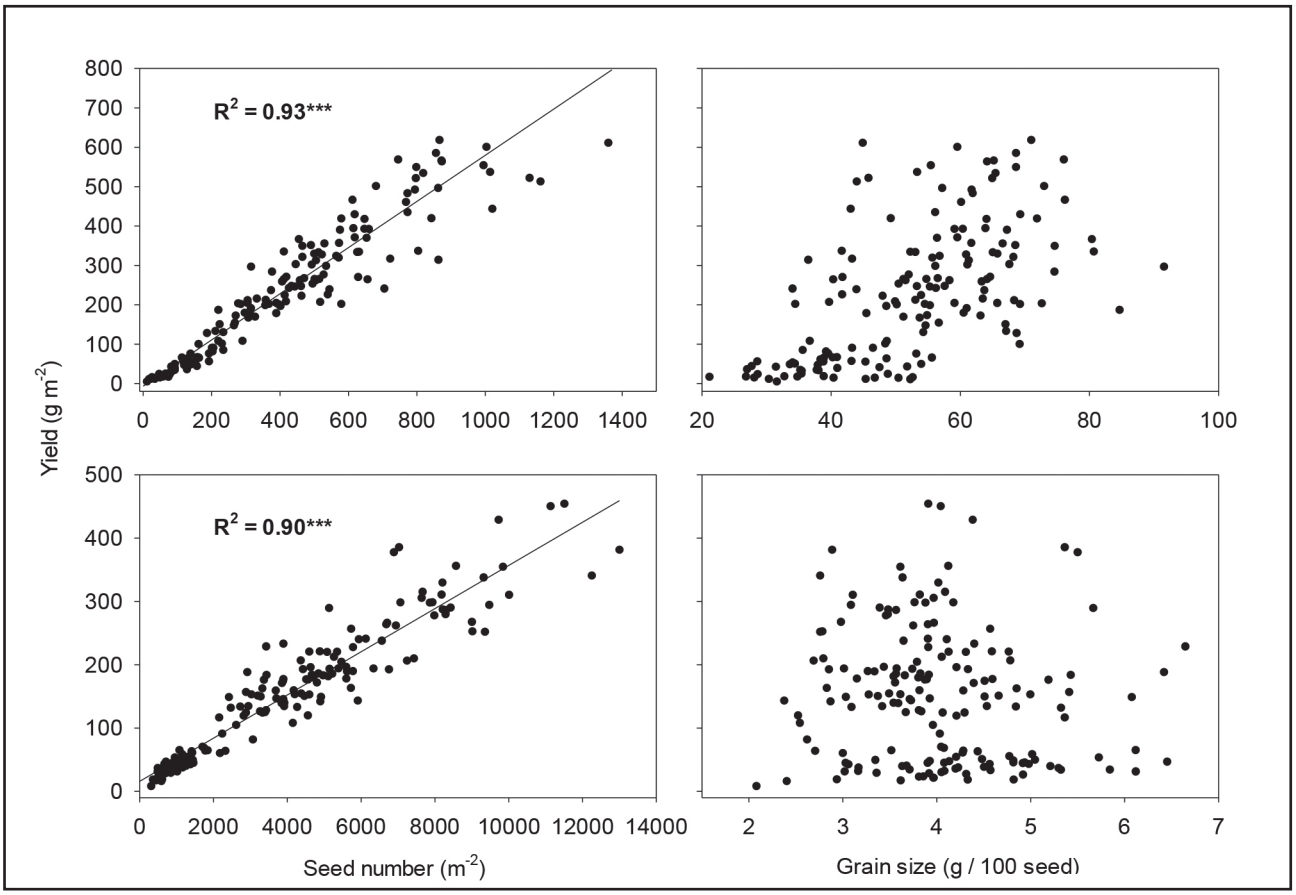


Figure 2. Yield as a function of seed number (left panels) and grain size (right panels) of faba bean (top panels) and lentil (bottom panels) as a function of sowing date. Lines are linear regression and are only presented where significant.

Table 1. Variation in days to flowering of the different lentil and faba bean lines.

Beans	Mean	Minimum	Maximum	Lentils	Mean	Minimum	Maximum
AF03001-1	76	51	117	PBABlitz	94	71	138
Fiord	79	55	93	CIPAL901	97	71	138
AF009169	81	57	99	PBAGiant	99	72	142
Farah	82	57	125	PBAJumbo2	100	71	146
PBAZahra	86	59	113	CIPAL1301	101	76	149
PBARana	86	60	110	CIPAL1422	102	71	150
Nura	87	61	115	PBAHurricaneXT	103	77	150
PBASamira	88	60	116	Matilda	104	73	149
Aquadulce	89	59	122	Nugget	107	76	150
Icarus	100	66	133	Northfield	111	82	170

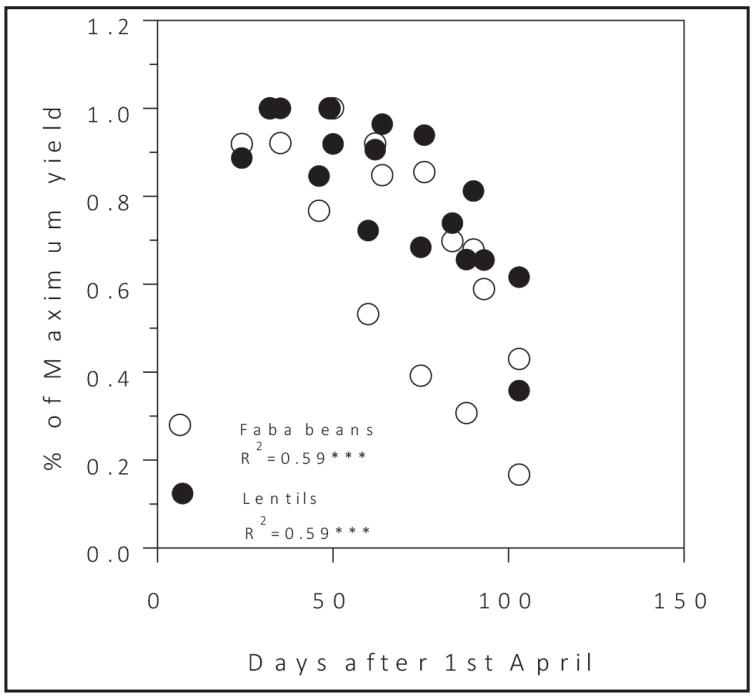


Figure 3. Yield penalty as a function of sowing delay from 1 April. Yield penalty is presented as a proportion of maximum yield.

What does this mean?

The second year of data has reinforced the trends seen in the first year showing a yield penalty associated with delayed sowing (EPFS Summary 2016), this is despite the contrasting environmental conditions, particularly between Minnipa which in 2016 was a good year compared to 2017. These results reinforce that the yield of both lentil and faba bean are reduced when sowing is delayed, particularly after late April. On average, the penalty for both pulse crops is 6.7% of their maximum yield per 10 days that sowing is delayed after 1 April (Figure 3). The yield penalty is a partially a result of a shorter time to flowering, caused by accelerated development; this results in reduced seed set.

We have demonstrated the variability in phenology that is available for growers who wish to target a specific growth window to avoid both frost and heat stress, whilst maximising yield. In the absence of frost, sowing early will be more likely to provide the maximum yield for the environment.

This research will be repeated in the 2018 growing season with the aim of producing high quality quantifications of both phenology and yield in response to variety, environment and sowing time.

Acknowledgments

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