Impact of sowing date on phenology and yield of lentil and faba bean

RESEARCH

C. Mariano Cossani[1, 2], Larn McMurray[3], Lachlan Lake[4] and Victor O. Sadras[4]

[1]SARDI, Port Lincoln; [2]SARDI, Minnipa Agricultural Centre; [3]SARDI, Clare; [4]SARDI, Waite

Location:
Minnipa Agricultural Centre, paddock S10
SARDI Pulse Breeding Australia
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2016 Total: 391 mm
2016 GSR: 268 mm
Yield
Actual:
4.17-1.27 t/ha (faba beans)
2.37-0.81 t/ha (lentils)
Paddock History
2015: Barley
2014: Barley
2013: Vetch
Soil Type
Clay loam
Plot Size
1 m x 1 m x 3 reps

Key messages

- **The yield of both pulse crops decreased in general when delaying sowing.**
- **Modifying sowing time produced changes in the phenology that affected main yield components and grain yield.**
- **In general, the later sowing dates reduced grain number/ m² and produced a lower thousand grain weight.**

Why do the trial?

Faba beans and lentils are two important pulse crops with growing interest from farmers in low rainfall areas of South Australia. Recent high prices of lentils together with their rotational benefits make these crops potential new options for some areas of the Eyre Peninsula, however frost and heat stress can compromise performance and 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 and the trade-off between frost and heat risk.

The objective of this work is to analyse the impact of sowing date and variety on the phenology and grain yield of faba beans and lentils on upper Eyre Peninsula.

How was it done?

A field trial was set up at Minnipa Agricultural Centre in 2016 to test the effect of the sowing date on different varieties of lentil and faba bean. The trial consisted of a combination of six sowing dates ranging from 21 April to 26 June with ten varieties of each crop chosen in consultation with Pulse Breeding Australia lentil and faba bean programs. Faba bean varieties were 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 Hurricane XT, CIPAL1422, PBA Giant, PBA Jumbo2, Nugget and Matilda.

In both crop types, three replications for each genotype and sowing date were used. Crops were hand sown in a split-plot design with sowing dates allocated to the main plot and genotypes randomized within each of them. Plots sizes were 1 m by 1 m and consisted of 3 rows, 0.27 m apart. Prior to sowing, phosphorous was applied using 60 kg/ha of MAP (11:52:0:0).

Within each experimental unit, ten plants were selected and tagged in a representative area, trying to avoid the border effect. During the growing season, an intensive assessment of the phenology dynamic was measured for each plant. The dates recorded were; the beginning of flowering, the beginning of podding, node of first flower, the node of first pod, the end of flowering and maturity date.

After maturity, a subsample of 0.5 m length was collected and dried in an oven at 70°C until constant weight was achieved. Grains were separated from the pods, cleaned, counted and weighed. The grain per shoot was also counted in the faba bean samples.

What happened?

Sowing date affected the yields and phenology of faba bean and lentils. In general, and as expected, grain yield decreased with the delay of sowing (Figure 1) although the effect was stronger after 20 May. The highest variability in grain yield of faba bean was observed for the earliest sowing date and was mostly due to the poor yield of the late maturing broad bean variety Aquadulce. The grain yield of faba bean averaged across varieties ranged between 2.98 t/ ha at the sowing date of 17 May to 1.76 t/ha at late June. The highest grain yield of faba beans (4.17 t/ ha) was observed when sowing Nura on 21 April while the lowest was obtained by Aquadulce in the latest sowing (1.27 t/ha). For lentils, the highest grain yield was 2.37 t/ha for CIPAL1301 sown on 17 May, while the lowest was for late-sown Northfield (0.81 t/ha) on 26 June.

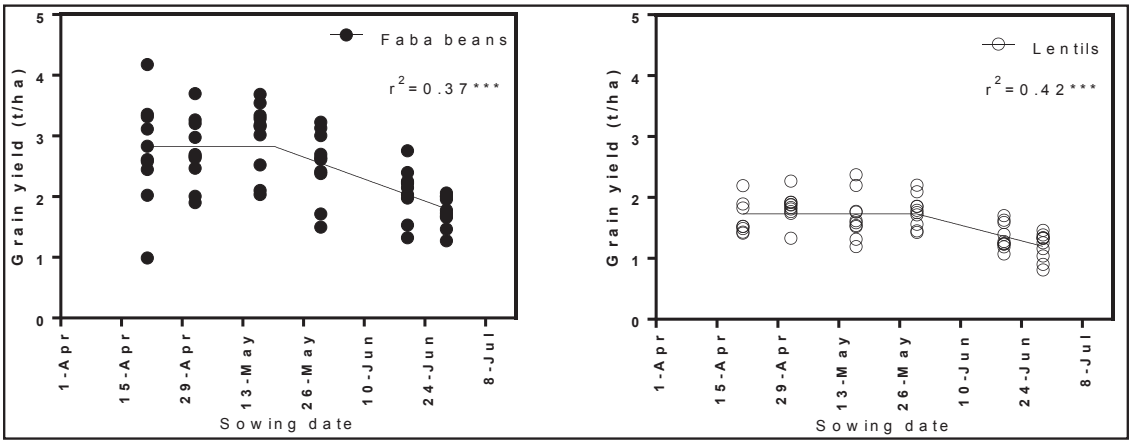

Figure 1 Grain yield of faba bean varieties (left panel) and lentil varieties (right panel) as a function of sowing date at Minnipa in 2016. *** indicates P<0.001

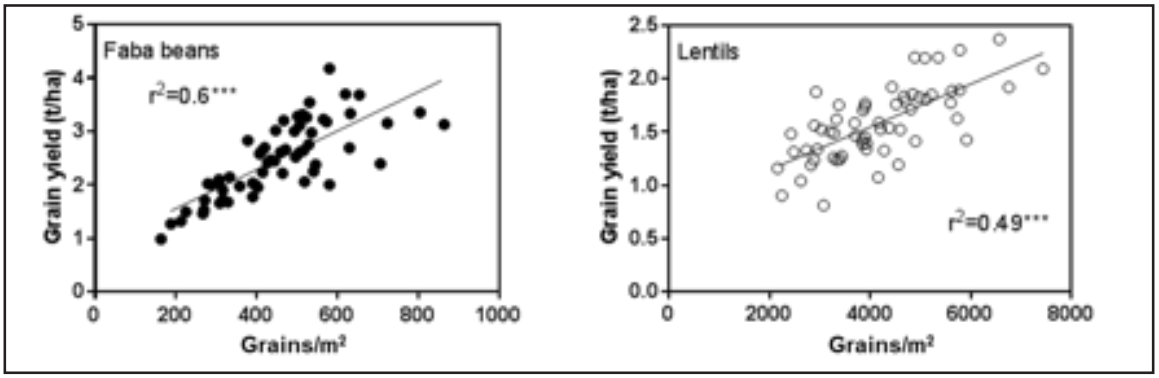

Figure 2 Grain yield of faba beans (left panel) and lentils (right panel) as a function of grain number/m² for all sowing dates and varieties at Minnipa in 2016. *** indicates P<0.001

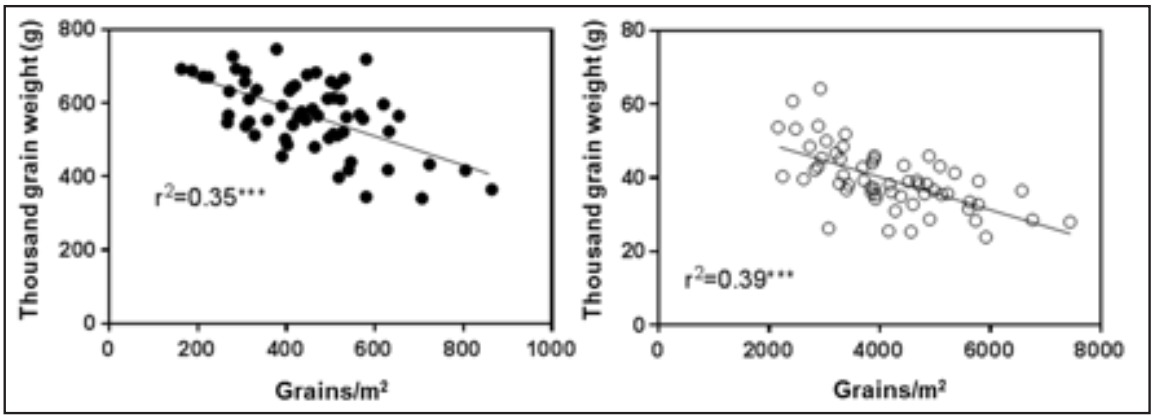

Figure 3 Thousand grain weight as a function of the grain number/m² (left panel) and lentil (right panel) for all sowing dates and varieties at Minnipa in 2016. *** indicates P<0.001

In both cases, the grain yield was positively related to the grains/m² (Figure 2), and unrelated to the thousand grain weight. In general grains/m² explained about 50% or more of the variation in grain yield. The range of variation of grain number was from 163 to 864 grains/m² for faba bean and 2163 to 7440 grains/m² for lentils.

There was a negative relationship between the grain number/m² and the thousand grain weight of the two crops (Figure 3).

Delaying sowing advanced flowering and podding in both crops (Figure 4). In faba bean, podding was advanced more (0.48 days per day) than flowering (0.31 days per day) with delayed sowing. Lentils showed a similar reduction of about 0.4 days per delayed day in sowing, in the time to flowering and podding (Figure 4). Delaying sowing after 21 April produced an average effect on both crops of 1 day reduction in the days to podding for every two days of delay in sowing. Furthermore, there was an average negative effect of sowing date by shortening the growing season at a rate of 5 days shorter per week when sowing date was postponed after 21 April.

Pooling the data showed that the higher yield of faba in comparison to lentil was partially related to longer duration of the flowering to maturity period (Figure 5). In general, the time between podding and maturity has a better capacity to explain the variation in grain yield than the days from beginning of flowering to maturity.

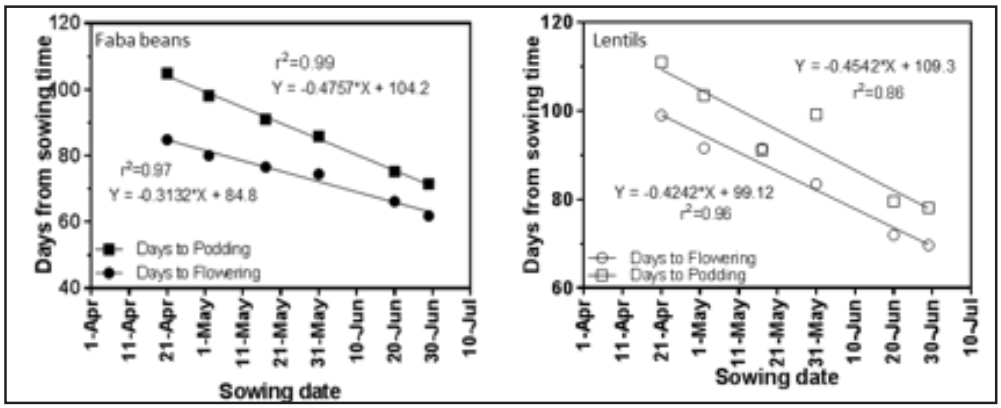

Figure 4 Average effect of sowing date on the phenology faba bean (left panel) and lentil (right panel) for all sowing dates and varieties at Minnipa in 2016. Squares represent days to podding while circles symbols represent days to flowering

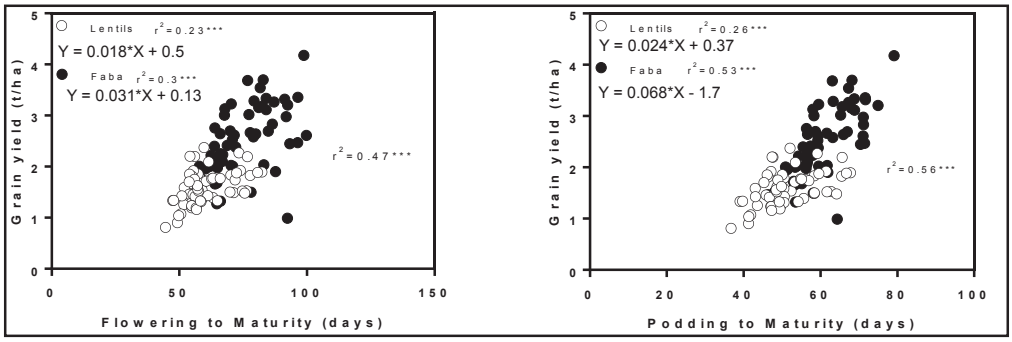

Figure 5 Average effect of sowing date on the phenology faba beans (left panel) and lentils (right panel) for all sowing dates and varieties at Minnipa in 2016. *** indicates P<0.001

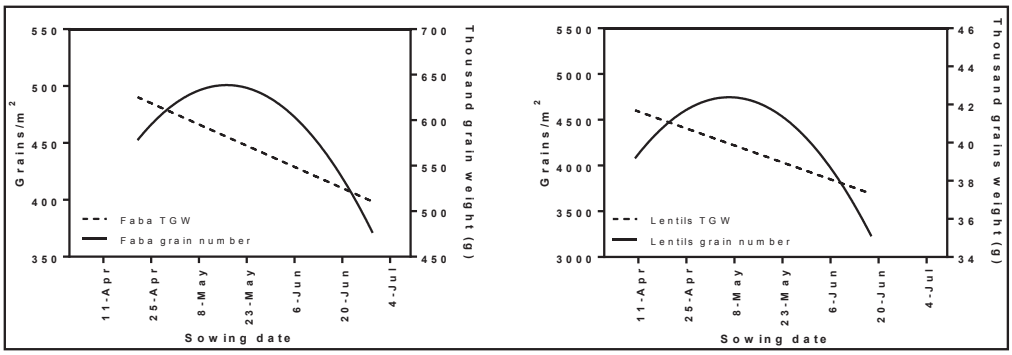

Figure 6 Relationship for the grains/m² (left Y axis) or thousand grain weight (right Y axis) and the sowing date in faba bean and lentil at Minnipa in 2016

What does this mean?

First of all, a note of caution regarding the exceptional cropping conditions in 2016. In 2016 there was 27% more rainfall from April to October, with an additional benefit of lower (20%) minimum and lower (5%) maximum temperatures from August to November than the average of Minnipa. These exceptionally good conditions could have a confounding effect by underestimating the negative impact of the hot and dry spring conditions generally experienced during the yield determination period. Considering this, our results accurately characterise the main effects of delaying sowing on the phenology and yield of pulses.

The yield of both crops decreased in general when delaying sowing, however the effect was more marked from intermediate sowing dates (Mid may) onwards. It was observed that modifying sowing time produced changes in the phenology that affected main yield components and grain yield. In general, the later sowing dates reduced grain number/m² and produced lower thousand grain weight. Regarding to the very early sowing dates, both crops experienced a reduction in grain number/m², which was partially compensated by heavier grains (Figure 6). The lower grain number/m² of the early sowing dates, together with the highest variability observed in faba bean was mainly due to the extremely low yield of Aquadulce in that environment. Additional data are required to determine the reasons for that penalty. The reductions in grain size, however, were always consistent with the increase in the delay of sowing.

Further research across variable seasons is required to produce more accurate quantifications of the yield penalties imposed by sowing time, and the reductions in grain number/m² in early sowings.

Acknowledgments

Special thanks are given to Leigh Davis, Brenton Spriggs and Sue Budarick for their collaboration with field and lab activities. This project was supported by SARDI and GRDC.