Potential for early sowing of current barley varieties

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Key Messages
- Fathom (3.97t/ha) and RGT Planet (3.89t/ha) were the highest yielding varieties sown on April 20
- Rosalind was the highest yielding variety (3.36t/ha) sown on May 8
- The relative yield of Compass was improved by May 8 sowing, whereas RGT Planet suffered a yield penalty
- Slow developing varieties Oxford and winter barley Urambie sown on April 20 yielded similar to the best performing spring barley sown on May 8
- Early sowing improved total crop biomass, and subsequently crop yield

Background
The aim of this trial was to evaluate flowering time and yield performance of new barley varieties sown earlier than current practice in the low rainfall zone.

To maximise grain yield and quality it is important to ensure the variety flowers and fills grain within an optimum period to avoid plant stress (frost, heat and moisture). This can be done by matching sowing time to variety. Barley varieties differ in their flowering time depending on their sensitivity to photoperiod (day length) and vernalisation (cold accumulation) factors. Varieties with increased vernalisation or photoperiod sensitivity may be required for sowing times prior to May.

About the trial
A two way factorial time of sowing by variety experiment was located at Loxton in 2017. The two sowing dates were the 20th of April and the 8th of May. Varieties included:

- Australian fast developing spring barley varieties: Compass, LaTrobe, Rosalind and Spartacus CL
- Fast – medium developing spring varieties: Commander, RGT Planet, and Fathom
- Slow developing spring varieties: Oxford and Westminster
- Winter barley variety: Urambie that requires vernalisation.

The site was managed for pest and disease throughout the season, 50 kg/ha of MAP fertiliser was applied in furrow at sowing, and 20 kg/N/ha applied as urea at stem elongation. Plots were sown in six row 5 m plots at 22.8 cm row spacing. Measurements included flowering time, frost induced sterility, total above ground biomass at maturity, harvest index, grain yield and grain quality.

Results & Discussion

Flowering time responses
Commander flowered 14 – 18 days later than Compass, LaTrobe, Rosalind and Spartacus CL, when sown in late April (Figure 1). In frost prone environments, the fast developing group of varieties may be less suited to pre-May sowing as they flower too early. Whereas Fathom and Commander have a greater photoperiod sensitivity than the faster developing varieties mentioned above and might provide opportunity for slightly earlier sowing.
The European introduced RGT Planet flowered later than fast developing varieties and similar to Commander from earlier sowing suggesting it may also have a better flowering behaviour for these sowing opportunities. Slower developing varieties Westminster, Urambie, and Oxford sown in April flowered at a similar time to the fast developing springs sown in May. This group of varieties is likely to be better suited to earlier sowing opportunities prior to 20th April, particularly in frost prone environments. Urambie and Oxford are two slow developing feed varieties, however, there has been limited yield evaluation in SA. Urambie is the only genuine winter variety available that has a vernalisation requirement to prolong the duration of the vegetative phase, which gives opportunity for grazing.

Yield and quality responses

A large rain event occurred in late April allowing good plant establishment of greater than 120 plants/m². There were a number of frost events throughout the season during the start of the flowering period and extreme heat events above 30°C near the end of the flowering period. There was a significant variety x TOS interaction for grain yield. Fathom and RGT Planet sown on April 20 were the highest yielding varieties in the trial. RGT Planet yielded higher than Westminster and Commander within a similar flowering time which highlights its improved yield potential compared to these varieties. RGT Planet yielded less than the yield benchmark Rosalind with May sowing and was similar to all other Australian spring varieties. Considering the flowering behaviour and yield, the results suggested that RGT Planet and Fathom are more suitable to be sown earlier in an environment like this. Most varieties experienced a yield penalty with delayed sowing, with the exception of Compass which yielded the same for both sowing dates, in which its yield was better optimised by later sowing due to its short vegetative phase. Urambie does not typically have the yield potential of the most adapted spring barleys. This data highlights that Urambie and Oxford sown early can yield similarly or higher than well adapted spring varieties sown later (Figure 1). Given the lack of frost damage in this trial, it should be noted that the risk of frost induced sterility associated with early sowing was not realised in 2017 as all plots were assessed for sterility and it was found to be negligible. This may be due to the elevation of the trial site.

With an above average yield at a low fertility sandy site, grain proteins were low in all varieties due to yield dilution. All varieties except for the winter feed variety Urambie achieved good grain size, with retention (grain >2.5mm) between 86 - 97% at TOS 1, and 77 – 92% at TOS 2. Urambie consistently produced the smallest grain size, 55% at TOS 1 and 39% at TOS 2 whilst Compass showed superior grain size stability across sowing dates with retention between 92 and 97% at TOS 2 and 1.

Biomass and Harvest Index responses

There was a positive correlation ($r^2= 0.69$) between crop biomass and grain yield (Figure 2). The earlier time of sowing (TOS) produced greater crop biomass and yield than the later TOS, however variety differences in biomass were not significant. This suggests that differences in yield between varieties is due to partitioning of biomass to yield (harvest index; Table 1). The most striking example of this is between Urambie and Compass. Despite similar biomass at maturity, Urambie yielded more than 0.5t/ha above Compass.
Varieties differed in harvest index (conversion of crop biomass to yield) between the two TOS. Rosalind and Spartacus CL increased whilst Urambie decreased in harvest index when sowing was delayed. A decrease in harvest index partly explained the yield penalty from the later time of sowing in some varieties. Reductions in harvest index for TOS 2 were likely due to the later flowering time of mid-September (Figure 1). Flowering in mid-September exposed the crop to heat and moisture stress during this important plant developmental stage, reducing total grain number and grain weight. In contrast, Rosalind was able to maintain 20 – 21 grains per spike and grain weight (42-45 g per 1000 grains) whereas other varieties were more sensitive. This is one of the reasons Rosalind maintained its yield and harvest index across sowing dates.

Table 1. Harvest index data for 10 barley varieties sown at two different dates 20th April (TOS 1) and 8th May 2017 (TOS 2) at Pata, SA.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Commander</th>
<th>Compass</th>
<th>Fathom</th>
<th>LaTrobe</th>
<th>Oxford</th>
<th>RGT Planet</th>
<th>Rosalind</th>
<th>Spartacus CL</th>
<th>Urambie</th>
<th>Westminster</th>
</tr>
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<tbody>
<tr>
<td>TOS 1</td>
<td>0.53</td>
<td>0.46</td>
<td>0.56</td>
<td>0.55</td>
<td>0.54</td>
<td>0.51</td>
<td>0.52</td>
<td>0.48</td>
<td>0.59</td>
<td>0.50</td>
</tr>
<tr>
<td>TOS 2</td>
<td>0.49</td>
<td>0.50</td>
<td>0.58</td>
<td>0.56</td>
<td>0.54</td>
<td>0.50</td>
<td>0.60</td>
<td>0.55</td>
<td>0.54</td>
<td>0.49</td>
</tr>
<tr>
<td>l.s.d.</td>
<td>0.05 (p &lt;0.01)</td>
<td></td>
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</tbody>
</table>

Implications for commercial practice

While improved yields came from fast developing varieties sown in April in this trial, these results should be treated with some caution as the varieties flowered early in a period of known frost risk in the Mallee in a season with no frost. Based on the flowering time results there are number of slow developing barley varieties such as RGT Planet, Westminster, Urambie and Oxford and to a less degree Fathom and Commander that may be more suited to early sowing than current fast spring varieties. When sown in April, these varieties demonstrated a yield similar to the best performing spring variety sown in May.

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