Key Points

- Germination tests determine the maximum germination potential of a seed line.
- The primary purpose of a vigour test is to indicate whether or not trouble may be expected from high germinating seed lines when placed under environmental stress in the field.
- The use of low vigour seed may result in reduced plant numbers and reduced grain yields.
- In a FAR 2005 trial seed treatments applied to a low vigour seed line gave significant increase in plant population and yield when compared to the nil treatment, contrary to current best practice.
- Both seed vigour and seed treatment had a significant effect on grain yield.

Background

Growers are familiar with the concept of germination testing and the percentage value assigned to a seed line as one of the indicators of the quality of the seed they are purchasing. Germination tests determine the maximum germination potential of a given seed line. This information can be used to compare the quality between seed lines and also estimate field planting value. Under certain conditions in the field it is often noted that laboratory germination results overestimates seedling emergence. Although there are many factors that may influence final plant population, the differences are also a result of the physiological quality of a seed line and its tolerance to stress. A vigour test can more closely estimate field emergence or performance of a seed line. As stated by the Seed Vigour Test Committee of the Association of Official Seed Analysts (AOSA), “the underlying reason for testing vigour is to determine the true value of a seed line”.

The Concept of seed vigour

Seed vigour describes several characteristics associated with various aspects of performance irrespective of whether the seed is in storage or under field conditions. The aspects of performance associated with seed vigour include: rate and uniformity of seed germination and seedling growth, field performance, including extent, rate and uniformity of seedling emergence and performance after storage and transport, particularly the retention of germination capacity. Seed vigour decreases as the level of deterioration increases.

Significance of seed vigour

If favourable conditions prevail the germination test correlates well with field emergence. Therefore, seed vigour tends to be less important. However, in practice optimum conditions are not often encountered and stresses such as soil crusting, high or low soil temperature and/or moisture stress will lead to varying field performance depending on the seed vigour. Seed lines that have high vigour may perform better in environmental conditions that vary greatly from the optimum than those that possess low vigour, even though the germination value for the two seed lines is of a similar value.

Current Project Update

The results presented here are from year two of a trial investigating the effect of seed vigour on the field performance of wheat. Initial results from year one showed only slight reductions in plant population with low seed vigour, but no effect on plant growth or subsequent grain yield. Year two was to investigate this further.

Methods

Two European feed wheat seed lines of the same cultivar where selected based on different vigour scores (Bayer CropScience cold vigour test), the germination results and thousand grain weight was also recorded (Table 1).

<table>
<thead>
<tr>
<th>Line No</th>
<th>Vigour score</th>
<th>Germination %</th>
<th>TGW (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1</td>
<td>3.6</td>
<td>94</td>
<td>60.3</td>
</tr>
<tr>
<td>Line 2</td>
<td>2.6</td>
<td>94</td>
<td>44.9</td>
</tr>
</tbody>
</table>

The Bayer CropScience cold test measures the coleoptile length after the seed has been exposed to 10 degrees C for 10 days. A score is given on a scale of 1-5, with 5 being high and 1 being low. A seed line with a score of 3 or above is considered high vigour. The seed lines were either treated with nil, Raxil (1ml/kg) or Baytan Universal (1ml/kg) seed treatments and sown at two sowing depths targeting 2-4cm and
6-8cm over two sowing dates at a sowing rate of 175plants/m². The trial was a split split plot design. Measurements included time to emergence, seedling height (to gauge vigour), growth at tillering/stem extension, plant population, ear number and grain yield.

Results

Emergence
Due to better than expected conditions at sowing date two the effect of soil condition/sowing date was removed as a negative factor in this trial.

Plant population
The high vigour seed line gave a significantly higher plant population compared to the low vigour seed line. The high vigour seed line had a mean plant population of 140plants/m², which equated to 80% field emergence. This was significantly greater than the low vigour seed line at 118plants/m² or 67% field emergence. There was a significant interaction between seed line and seed treatment. It was shown that when both seed treatments were applied to the low vigour seed line there was a significant increase in plant population when compared to the nil treatment. Baytan Universal was noted to improve establishment of the low vigour line over both the nil and Raxil treatments. This was expressed as a plant population increase of 20plants/m². However there was no significant benefit in applying a seed treatment to the high vigour seed line when compared to the low vigour seed line. This may indicate the presence of a seed borne disease.

Tiller and ears/m²
Although there was a significant increase in plant population from the application of a seed treatment, this did not translate into an increase in tillers/plant for either seed vigour or seed treatment. However, when ears/m² were measured the Baytan Universal treatment produced significantly more ears/m² (513) than the Raxil treatment (486) over both seed lines due to an increase in plant number. This increased the grain yield of the low vigour seed line (Table 2).

Sowing depth
The sowing depth had a small significant effect on the time the seed lines took to emerge and tiller number. However there was no effect on the grain yield of both seed lines.

Grain Quality
None of the treatments had a significant effect on any of the grain quality parameters. The grain quality recorded from the trial was poor with low grain weights and low test weights.

This was possibly due to the late sowing time of a true winter wheat, moisture stress during summer and high incidence of BYDV, despite insecticide application.

Grain yield
Both seed vigour and seed treatment had a significant effect on grain yield. Line 1 had a mean yield of 5.6t/ha compared to 5.1t/ha for line 2. The application of both seed treatments increased the grain yield of both seed lines compared to the untreated seed lines by 0.5t/ha. The effect of seed treatment on the low vigour line is interesting given that both Raxil and Baytan Universal significantly improved grain yield of line 2 by an average of 0.7t/ha when compared with the nil treatment (Table 2). It is possible that the yield increase may have been linked to the presence of seed borne disease loading of the seed stocks, unfortunately this was not tested.

Table 2. The effect of seed vigour and seed treatment on grain yield

<table>
<thead>
<tr>
<th>Seed treatment</th>
<th>Line 1</th>
<th>Line 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>5.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Raxil</td>
<td>5.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Baytan Uni</td>
<td>5.5</td>
<td>5.4</td>
</tr>
</tbody>
</table>

LSD 0.05 within seed lines 0.38
LSD 0.05 between seed lines 0.45

Conclusions

- The results gained in this trial are surprising. It is clear that a low vigour seed line produced lower grain yields as bare seed. But once a seed treatment was applied to the low vigour seed line, yields improved significantly.
- The high vigour seed line produced a higher plant population and higher grain yield, except when Baytan Universal was applied (when comparing seed treatment/seed line).
- This is contradictory to current advice as it is not recommended to treat low vigour seed lines with Baytan.
- Whilst the initial seed borne infection was not tested, the results are consistent with previous work investigating seed treatment on seed borne disease.

Definitions

Seed vigour is defined by the International Seed Testing Association (ISTA) as "the sum of those total properties of the seed which determine the level of activity and performance of the seed or seed line during germination and seedling emergence". The AOSA definition, although somewhat different from the definition of the ISTA, states that "seed vigor comprises those seed properties which determine the potential for rapid, uniform emergence, and development of normal seedlings under a wide range of field conditions" (Seed Vigor Testing Handbook, 2002).

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