Advances in Pasture Seed Production

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Seed Yield Potential vs. Actual Yield

An example for perennial ryegrass

Yield Potential

- Florets not pollinated, fertilized, or aborted: 3,500 kg/ha
- Shattered Seeds: 1,000 kg/ha
- Light Seeds: 3,500 kg/ha

Actual Yield: 2,000 kg/ha

- Grass seed crops are biologically inefficient in the production of seed.
- Many flowers are produced by grasses yet relatively few of the flowers become seed.
- Our research efforts are aimed at capturing a greater proportion of yield potential in our grower’s harvests.
Plant Growth Regulators

Trinexapac-ethyl treated
• Spike Length = 18.8 cm
• Spikelets/Spike = 22.3
• Seeds/Spike = 48.3

Untreated
• Spike Length = 21.6 cm
• Spikelets/Spike = 23.0
• Seeds/Spike = 40.8

Effect of trinexapac-ethyl (TE) on perennial ryegrass spike morphology (Chastain et al, 2003)
Plant Growth Regulators

TE effects on perennial ryegrass seed production in 9 years of trials (Chastain et al., 2014).

<table>
<thead>
<tr>
<th>TE rate (g ai/ha)</th>
<th>Seed yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1462 a</td>
</tr>
<tr>
<td>200</td>
<td>1831 b</td>
</tr>
<tr>
<td>400</td>
<td>2090 c</td>
</tr>
<tr>
<td>600</td>
<td>2303 c</td>
</tr>
</tbody>
</table>

Perennial ryegrass seed (USDA photo)
TE effects on tall fescue seed production in 6 years of trials (Chastain et al., 2015).

<table>
<thead>
<tr>
<th>TE rate (g ai/ha)</th>
<th>Seed yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1455 a</td>
</tr>
<tr>
<td>200</td>
<td>2052 b</td>
</tr>
<tr>
<td>400</td>
<td>1984 b</td>
</tr>
<tr>
<td>600</td>
<td>2079 b</td>
</tr>
</tbody>
</table>

Tall fescue panicle (TG Chastain photo)
Plant Growth Regulators

TE timing effects on perennial ryegrass (9 years) and tall fescue (6 years) seed yield (Chastain et al., 2014, 2015).

<table>
<thead>
<tr>
<th>BBCH scale</th>
<th>Perennial ryegrass</th>
<th>Tall fescue</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>1770 b</td>
<td>--</td>
</tr>
<tr>
<td>32</td>
<td>1981 c</td>
<td>1988 a</td>
</tr>
<tr>
<td>37</td>
<td>1814 bc</td>
<td>2109 a</td>
</tr>
<tr>
<td>51</td>
<td>1958 c</td>
<td>2105 a</td>
</tr>
<tr>
<td>59</td>
<td>1518 a</td>
<td>--</td>
</tr>
</tbody>
</table>

TE timing effects on perennial ryegrass (9 years) and tall fescue (6 years) seed yield (Chastain et al., 2014, 2015).
Nitrogen Management

- Nitrogen - most important nutrient in grass seed production.
- Spring is most important N application timing.
- Daily N use peaks for both crops during early stem elongation (BBCH 30).
- For best N use efficiency, N application should precede stem elongation.
- Spring N uptake in tall fescue is complete prior to inflorescence emergence (BBCH 50) while perennial ryegrass N use continues later in the season.

Anderson et al. (2014)

Fertilizer application tall fescue (TG Chastain photo)
Nitrogen Management

- Optimum spring N application for perennial ryegrass ranged from 130-180 kg N/hectare. Values are averaged over 12 site years.
- Stimulation of spike production accounted for most of the variation in seed yield due to N application.
- Seed weight was increased by N.

Spring N application effects on seed weight in perennial ryegrass (Chastain et al., 2014)
Interaction of Plant Growth Regulators and Nitrogen

TE and N effects on perennial ryegrass seed production (Chastain et al., 2013)

180 kg N/ha

0 kg N/ha

Seed Yield (kg/ha)

Seed yield (kg/ha⁻¹)

Nitrogen Rate (kg/ha)

Seed number m⁻² (x 10⁴)

y = 189.31x - 34.838

R² = 0.9946
Irrigation

- Most grass seed crops have been produced without irrigation in the Willamette Valley.
- Recent increases in the amount of irrigated land (now 113,850 hectares).
- Spring irrigation is beneficial and increases seed yield in perennial ryegrass and tall fescue.
- Fall irrigation does not affect seed yield.

Seasonal irrigation timing effects on seed yield in perennial ryegrass (Chastain et al, 2014).

<table>
<thead>
<tr>
<th>Seasonal Irrigation Timing</th>
<th>Water application (mm)</th>
<th>Seed yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>1620a</td>
</tr>
<tr>
<td>Fall</td>
<td>127</td>
<td>1591a</td>
</tr>
<tr>
<td>Spring</td>
<td>102</td>
<td>1726b</td>
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</tbody>
</table>
Spring irrigation frequency effects on seed yield in perennial ryegrass (Chastain et al, 2014).

<table>
<thead>
<tr>
<th>Spring Irrigation Frequency</th>
<th>Water application (mm)</th>
<th>Seed yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>1639a</td>
</tr>
<tr>
<td>Single</td>
<td>92-95</td>
<td>1903b</td>
</tr>
<tr>
<td>Multiple</td>
<td>113-219</td>
<td>2042c</td>
</tr>
</tbody>
</table>
Spring Irrigation

- Seed yield responses to irrigation varied among cultivars and year.
- Spring irrigation increased yield in all tall fescue cultivars and in all but one of the cultivars of perennial ryegrass tested.
- Derby Supreme perennial ryegrass seed yield remained the same across irrigation environments that increased yield of other cultivars.

Regression of seed yield in perennial ryegrass cultivars on spring irrigation environments (Chastain et al, 2014).
Spring Irrigation

- Seed number increased at the same rate regardless of irrigation treatment, cultivar, or year.
- Irrigation-induced seed yield increases were likely the result of reduced seed abortion.

Spring irrigation effects on seed number and seed yield in tall fescue (Huettig et al, 2013).

![Graph showing the relationship between seed number and seed yield with regression line and annotations.]

\[ y = 187x + 481 \]

\[ R^2 = 0.86 \]
Stand Age

- Seed yield declines as the stand ages in grass seed crops.
- Reductions in the number of florets and seeds produced account for some of the decline in seed yield in perennial ryegrass.
Stand Age and Roots in Perennial Ryegrass

Perennial ryegrass roots
(TG Chastain photo)
The Next Big Challenge - Seed Shattering

- The loss of seed as a result of shattering can be an important constraint to yield.
- In perennial ryegrass, shattering is estimated to cause seed yield losses of 10-20% or more.
- Much work has been done to solve this problem, but to date, only harvest timing strategies using seed moisture as a guide, have shown efficacy and even with the best timing, seed shattering is still too high.

Shattered grass seed on the ground (TG Chastain photo)