Development of High Yielding Kentucky Bluegrass For Non-thermal Seed Production


ABPRTF Washington State Department of Ecology
February 10, 2005  Spokane, WA
Development of high yielding, turf-type Kentucky bluegrass for sustainable seed production under non-burn management.

**Justification**

Field burning to enhance yield is being limited.

Current production practices are environmentally unsound and threatening to growers income.

**Need**

Development of high yielding, turf-type Kentucky bluegrass for sustainable seed production under non-burn management.
Phase I

Diversity evaluation of USDA-ARS Kentucky bluegrass collection
Kentucky bluegrass nursery
(228 accessions and 17 commercial checks, replicated 1-m rows)
Diversity among PI accessions
Agronomic Characterization for 17 Parameters

Emergence  Herb. damage  Biomass
Spring green-up  Powdery mildew  Canopy height
Leaf texture  Uniformity  Harvest height
Genetic color  Growth habit  Harvest date
Leaf habit  Heading date  Seed yield
Turf potential  Anthesis date
Agronomic core
Molecular Core
Summary Phase I
Bluegrass Collection Evaluation

• Agronomic and molecular data could differentiate among accessions.

• Correlation between agronomic and molecular data was highly significant ($r=-0.32^{**}$), although relatively weak.

• A Kentucky bluegrass core was developed for use in future research.
Phase II
Utilization of the Agronomic Core
- to select bluegrass accessions having high seed yield without burning and good turf quality
- to relate seed production to turf quality factors
Seed production plot treatments: Burned, Baled, and Full Residue across bluegrass Accessions and Controls

- 20 Core collection accessions
- 16 “Free Picks”
- 9 commercial cultivars

Turf plots
Seed production plots
## Seed production and developmental attributes

<table>
<thead>
<tr>
<th>Heading date</th>
<th>Agressivity</th>
<th>Harvest index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthesis date</td>
<td>Panicle ht.</td>
<td>Wt. per seed</td>
</tr>
<tr>
<td>Harvest date</td>
<td>Biomass</td>
<td>Seed per panicle</td>
</tr>
<tr>
<td>Leaf habit</td>
<td>Yield</td>
<td>Panicles m⁻²</td>
</tr>
</tbody>
</table>
## Yield and yield components

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Full</th>
<th>Baled</th>
<th>Burned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass, g m(^{-2})</td>
<td>335.5a</td>
<td>425.6b</td>
<td>390.1ab</td>
</tr>
<tr>
<td>Yield, g m(^{-2})</td>
<td>23.4a (37%)</td>
<td>46.4b (73%)</td>
<td>63.2c (100%)</td>
</tr>
<tr>
<td>Harvest Index</td>
<td>0.09a</td>
<td>0.13b</td>
<td>0.17c</td>
</tr>
<tr>
<td>Wt. Seed, mg</td>
<td>0.31a</td>
<td>0.31a</td>
<td>0.31a</td>
</tr>
<tr>
<td>Seeds panicle(^{-1})</td>
<td>258.7a</td>
<td>197.6b</td>
<td>202.5b</td>
</tr>
<tr>
<td>Panicles m(^{-2})</td>
<td>378.5a</td>
<td>780.6b</td>
<td>1095.5c</td>
</tr>
</tbody>
</table>
Turf Attributes

**Texture:** Rated 1-9, with 9 the finest texture

**Color:** Rated 1-9, with 9 the darkest color

**Spring green-up:** 1 – 9 (1 = dormant and 9 = entirely non-dormant and green on 1 April)

**Turf quality:** Rated 1-9, with 9 the best, integrating factors such as turf color, leaf texture, and turf density
<table>
<thead>
<tr>
<th>Entry</th>
<th>Turf quality</th>
<th>Full yield</th>
<th>Baled yield</th>
<th>Burned yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI 230132</td>
<td>5.2</td>
<td>55</td>
<td>119</td>
<td>163</td>
</tr>
<tr>
<td>PI 368241</td>
<td>5.0</td>
<td>56</td>
<td>127</td>
<td>137</td>
</tr>
<tr>
<td>PI 539059</td>
<td>5.3</td>
<td>50</td>
<td>85</td>
<td>89</td>
</tr>
<tr>
<td>Kenblue</td>
<td>5.3</td>
<td>33</td>
<td>64</td>
<td>79</td>
</tr>
<tr>
<td>PI 349188</td>
<td>5.9</td>
<td>36</td>
<td>62</td>
<td>74</td>
</tr>
<tr>
<td>PI 371775</td>
<td>6.0</td>
<td>24</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td>Midnight</td>
<td>7.2</td>
<td>23</td>
<td>44</td>
<td>41</td>
</tr>
<tr>
<td>PI 372742</td>
<td>5.4</td>
<td>16</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>PI 371768</td>
<td>6.6</td>
<td>15</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>PI 574523</td>
<td>6.6</td>
<td>3</td>
<td>13</td>
<td>8</td>
</tr>
</tbody>
</table>
### Correlation between turf and yield factors

<table>
<thead>
<tr>
<th></th>
<th>Turf quality</th>
<th>Biomass</th>
<th>Yield</th>
<th>HI</th>
<th>Weight seed(^{-1})</th>
<th>Seed panicle(^{-1})</th>
<th>Panicles m(^{-2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texture</td>
<td>-0.33*</td>
<td>0.32*</td>
<td>0.37*</td>
<td>-0.12ns</td>
<td>-0.20ns</td>
<td>0.30ns</td>
<td>0.25ns</td>
</tr>
<tr>
<td>Color</td>
<td>0.67**</td>
<td>-0.56**</td>
<td>-0.40*</td>
<td>0.43**</td>
<td>0.23ns</td>
<td>-0.56**</td>
<td>-0.17ns</td>
</tr>
<tr>
<td>Green-up</td>
<td>-0.38*</td>
<td>0.51**</td>
<td>0.37*</td>
<td>-0.47**</td>
<td>-0.14ns</td>
<td>0.61**</td>
<td>-0.19ns</td>
</tr>
<tr>
<td>Turf qual.</td>
<td>---</td>
<td>-0.53**</td>
<td>-0.48**</td>
<td>0.22ns</td>
<td>0.15ns</td>
<td>-0.55**</td>
<td>-0.26ns</td>
</tr>
<tr>
<td>Yield</td>
<td>-0.48**</td>
<td>0.84**</td>
<td>---</td>
<td>0.12ns</td>
<td>0.05ns</td>
<td>0.76**</td>
<td>0.66**</td>
</tr>
</tbody>
</table>
Summary Phase II
Core Utilization

- Accessions were identified that maintained seed production when baled and possessed good turf quality.
- Turf quality was negatively correlated with seed production.
- Panicles m\(^{-2}\) increased yield, but did not affect turf quality; thus, presenting a potential selection opportunity.
Phase III
Selection within Accessions for diversity in seed yield components
Nursery for individual plant agronomic and molecular characterization

10 entries (8 PI and 2 checks); 28 plants per entry; 3 replications
Agronomic variation within accessions

PI 349188
Variation for plant height within PI 349188
Variation for color within Midnight
The Molecular Guys
Ted Kisha extracting DNA

Federico Bertoli eating gelato
AFLP gel of *Poa pratensis*

PI 371775  PI 371768  Belturf  Kenblue
Selection for yield components

• “Current Dogma” - there is limited variability within Kentucky bluegrass accessions due to their apomictic nature.

• Variation within accessions was quite prevalent, so the potential exists for selection and enhancement.
Harvested bluegrass space plants 2003 and 2004
Counted panicles and Threshed panicles

1680 plants:
10 entries
28 plants per entry
3 replications
2 years
Counted Seed and recorded Seed Weight
Based on the data: for each entry (accession), 100 seed were obtained from 5 selected plants:

A. plant with highest yield
B. plant with high seed weight
C. plant with high seed per panicle
D. plant with high panicles per unit area

Also:
F. 100 seed from the original population

TOTAL = 5,000 plants
(10 entries, 5 selections, 100 seed)
Seed germination and seedling growth
Grow out of bluegrass seedlings in flats
5,000 space plants established at Central Ferry, WA

Seed increase for on-farm seed production testing and university turfgrass trials in 2006
Results and Expected Outcomes

• USDA Kentucky bluegrass collection has been evaluated for diversity and a core collection was developed.
• Accessions with high seed yield without burning and good turf quality were identified.
• Variation within accessions has been identified.
• Seed increase is underway for future on-farm seed production and university turfgrass trials.
• Research is expected to lead to high yielding turf-type bluegrasses that do not require burning.