Agronomic Evaluation of Narrow Leaflet Soybeans

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Creative Component
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February 2016
Contents

- Personal Background
- Introduction
- Materials & Methods
- Results & Discussion
- Summary
- Conclusion
- Future Plans
- Acknowledgements
Personal Background

- Raised on small livestock and row-crop farm in southwest Iowa – Greenfield, Iowa
- Undergraduate at Iowa State University
  - Major: Agricultural Business & Economics
  - Minor: Agronomy
- Iowa State University Research Farm (Neely-Kinyon)-3 summers
- Began career at DuPont Pioneer following graduation
  - Soybean Product Development (Dallas Center, Iowa)-6 month internship
  - Soybean Trait Characterization & Development (Johnston, Iowa)-Research Associate
Personal Background – Family

Greg, Kristi, Kenzie (5), Brice (2)
Personal Background - Family
Current Soybean Production Problems

- Increased demand
- Slow yield gain
- Very narrow genetic pool
- High disease pressure caused by fungal pathogens
  - Light penetration limited in lower canopy with ovate leaflets
  - Air movement restricted in dense canopy
- Limited management practices due to similar phenotypes of all commercial soybeans
Narrow Leaflet Soybeans

• Typically associated with wild-type *Glycine soja*

• Possible advantages
  • Better air movement in canopy (Grau and Radke, 1984)
  • Intercept more photosynthetically active radiation (PAR) lower in canopy (Wells et al., 1993)
  • Increased genetic diversity (Chen and Nelson, 2004)

• Possible disadvantages
  • Yield reduction and smaller seed size (Dinkens et al., 2002)
  • Weed control (Place et al., 2011)
Question

- Would leaflet shape influence the productivity of soybeans?

Hypothesis

- Productivity of soybeans would not be influenced by leaflet shape based on a three year trial with populations of distinct leaf shapes.
Objectives

- Design and execute field experiments in multiple environments and years to compare leaflet types for several agronomic parameters including yield, grain composition, and growth characteristics
- Analyze & present findings
- Complete requirements for Creative Component
Materials & Methods

- Two biparental populations ($F_3$ derived)
  - Narrow Leaflet x Elite 1 (NL × E1): RM 3.4
  - Narrow Leaflet x Elite 2 (NL × E2): RM 3.8

- Narrow Leaflet Parent
  - Progeny variety of line obtained from Soybean Research Foundation (SRF)
  - RM 3.2

- Elite Parents
  - DuPont Pioneer glyphosate tolerant ovate leaflet varieties
  - Good host plant resistance for diseases
  - Exceptional plant standability
  - High yield potential
  - RM
    - Elite 1: 3.4
    - Elite 2: 4.2
Experiment Design

- 3 years testing (2012-2014)
- Complete Randomized Block Design
- Multiple high-yielding environments across Iowa, Kansas, Illinois
  - 2012 & 2014-6 locations
  - 2013-4 locations
- Replications
  - 2012-1 replication/location
  - 2013 & 2014-2 replications/location
- Analysis
  - Multiple-year mixed model utilizing ASREML software
  - Best Linear Unbiased Predictions (BLUPs)
  - Spatial variation
Experiment Design

- Leaflet shape entries
  - NL x E1
    - 2012-451 entries (91 NL, 274 OVT, 62 HET, 12 CK, 12 PAR)
    - 2013-105 entries (50 NL, 50 OVT, 3 CK, 2 PAR)
    - 2014-95 entries (45 NL, 45 OVT, 3 CK, 2 PAR)
  - NL x E2
    - 2012-254 entries (61 NL, 129 OVT, 52 HET, 8 CK, 4 PAR)
    - 2013-105 entries (50 NL, 50 OVT, 3 CK, 2 PAR)
    - 2014-95 entries (45 NL, 45 OVT, 3 CK, 2 PAR)

- Plot dimensions
  - 12 feet 2-row plot with 3 feet alley
  - 30 inch rows

- Seeding Rate-220 seeds/plot
- Planter-ALMACO Cone
- Combine-ALMACO SPC-40 and SHP-90
Experiment Design
Agronomic Parameters

- Emergence (1-9 scale)-2013, 2014
- Seedling Vigor (1-9 scale)-2013, 2014
- Agronomic* (1-9 scale)-2012
- Final plant height (inches)-2012, 2013, 2014
- Maturity (days)-2012, 2013, 2014
- Protein grain concentration (percentage)-2013, 2014
- Oil grain concentration (percentage)-2013, 2014
- Seed size (grams/100 seed)-2014

*Not used in final analysis
Yield BLUP Predicted Value (bu/a)

* Significant at $\alpha = 0.05$
Emergence & Seedling Vigor

**4a**

<table>
<thead>
<tr>
<th>Emergence BLUP Predicted Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN x E1</td>
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<tr>
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* Significant at $\alpha = 0.05$

**4b**

<table>
<thead>
<tr>
<th>Seedling Vigor BLUP Predicted Value</th>
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<td>7.42</td>
</tr>
</tbody>
</table>

* Significant at $\alpha = 0.05$
Plant Height at Maturity & Days to Maturity

* Significant at $\alpha = 0.05$

### 5a
- Height (Inches) BLUP Predicted Value
- 37.13
- 37.35
- 39.20
- 39.85

### 5b
- Maturity (Days) BLUP Predicted Value
- 131.00
- 130.98
- 133.68
- 134.35
- 131.67
- 142.02
- 131.67
- 130.41
- 132.14

Error bars: Avg(SED_VALUE)

Color by FACTOR:
- CK
- LN
- LN Parent
- OVT
- OVT Parent

Marking:
- Marking
Oil & Protein Concentration in Grain

**6a**

<table>
<thead>
<tr>
<th>Oil Percentage BLUP</th>
<th>Predicted Value</th>
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<tr>
<td>LN</td>
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<tr>
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<td>LN</td>
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<td>OVT Parent</td>
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**6b**

<table>
<thead>
<tr>
<th>Protein Content (%) BLUP</th>
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<td>LN</td>
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<td>OVT Parent</td>
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<tr>
<td>CK</td>
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* Significant at $\alpha = 0.05$
Seed Size (Grams/100 seed) - 2014

* Significant at $\alpha = 0.05$
## Multi-Year Analysis

<table>
<thead>
<tr>
<th>TRAIT</th>
<th>FACTOR</th>
<th>COMP_FACTOR</th>
<th>CONTEXT_FACTOR</th>
<th>SED_VALUE</th>
<th>BLUP_DIFF</th>
<th>SED_LSD05</th>
<th>P_VALUE</th>
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<tbody>
<tr>
<td>YIELD</td>
<td>LN</td>
<td>OVT</td>
<td>NL x E1</td>
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<td>YIELD</td>
<td>LN</td>
<td>OVT</td>
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<tr>
<td>EMGSC</td>
<td>LN</td>
<td>OVT</td>
<td>NL x E1</td>
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<td>0.61345</td>
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<td>EMGSC</td>
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<td>OVT</td>
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<td>SDVIG</td>
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<td>OVT</td>
<td>NL x E1</td>
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<td>HGT_R8</td>
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<tr>
<td>MATABS</td>
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<td>OILPCT</td>
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<td>NL x E1</td>
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<td>PROTN</td>
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<tr>
<td>PROTN</td>
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<td>OVT</td>
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</table>

## One Year Analysis – Seed Size 2014

<table>
<thead>
<tr>
<th>TRAIT</th>
<th>FACTOR</th>
<th>COMP_FACTOR</th>
<th>CONTEXT_FACTOR</th>
<th>STD_ERR</th>
<th>BLUP_DIFF</th>
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<tbody>
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</table>
Summary

- **Yield**: Narrow leaflet lines less by about 1 bushel/acre
- **Seed size (by weight)**: Narrow leaflet lines smaller by 6%
- **Seedling vigor**: Narrow leaflet lines reduced vigor by score of 0.5
- **Protein concentration**: Narrow leaflet reduced by 0.20-0.24%
- **Plant height**: Narrow leaflets for population NL x E2 shorter; NL x E1 NS
- **Emergence rating**: NS
- **Maturity**: NS
- **Oil percentage**: NS

NS=Not significant $\alpha = 0.05$
Conclusion

- Even though mean values of yield and agronomics are slightly reduced for narrow leaflet varieties, there are lines with comparable or superior values that warrant future testing.
Future Selections?

2014 NL x E1 Yield Scatter Plot
Future Testing

- Additional population testing with different genotypes
- Evaluation of fungal diseases
- Interactions with management practices
  - Row width
  - Population density
- More research needed
Acknowledgements

• Family

• Committee
  • Dr. Andrew Lenssen
  • Dr. Kenneth Moore
  • Dr. Thomas Loynachan

• Iowa State University Agronomy Graduate Staff

• DuPont Pioneer
References

Any questions?