MSU’s Wheat Breeding Program; Current Status and Future Outlook
Janet Lewis, Lee Siler, Sue Hammar

55th Research Review Conference
Wooster, Ohio, March 12, 2008
Overview

• Introduction

• Current status of the MSU Wheat Breeding and Genetics program

• Recent and upcoming releases
Introduction

- Originally from Michigan (East Lansing)
- B.S. Botany, University of Michigan
- Ph.D. Plant Breeding and Genetics (Wheat Breeding Program) MSU
- Post-doctoral Research
  - University of Minnesota
  - CIMMYT: International Center for Maize and Wheat Improvement, Mexico
Fusarium Head Blight (FHB) Research – Laboratory, Field, Greenhouse
MSU Wheat Breeding and Genetics Program
Michigan Wheat

• Soft White and Red Winter Wheat
• Cereal, cookies, cakes, crackers, pie crust, biscuits, soup thickeners, . . .

• Total value of breakfast cereal, breads, bakery, cookies crackers and pasta manufacturing > $3.9 billion (2002)

(“The Economic Impact Potential of Michigan’s Agri-Food Industry”, Peterson et al., 2006)
Michigan Wheat

Wheat → Corn → Soybeans

Rotation

Important in crop rotations


4th Largest acreage among MI field crops.
~ 700,000 acres planted in 2007

Provides income and activity for farmers at a different time of year
MSU’s Wheat Breeding Program – Resources

- Wheat Research Farm
- Equipment
- Multilocation Yield Testing at 6 Sites
- Greenhouse Facilities (Sue Hammar)
- Laboratory Facilities (Sue Hammar)
- Germplasm
- Lee Siler (technician)
http://www.css.msu.edu/varietytrials/wheat/
STATE PERFORMANCE TRIALS 2008

76 – VARIETIES AND EXPERIMENTAL LINES ENTERED THIS YEAR.

14 contributing organizations, including MSU.

~45% white, 55% red lines. (MSU 13 white/1 red experimental)

2007/08 MICHIGAN STATE UNIVERSITY WHEAT STATE PERFORMANCE TRIAL

<table>
<thead>
<tr>
<th>ENTRY NUMBER</th>
<th>ENTRY NAME</th>
<th>GRAIN COLOR</th>
<th>ORGANIZATION</th>
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<tr>
<td>1</td>
<td>Branson</td>
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<tr>
<td>2</td>
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<td>6</td>
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<td>Red</td>
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<td>14</td>
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</tr>
<tr>
<td>15</td>
<td>NO. 15</td>
<td>White</td>
<td>Hyland Seeds</td>
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</table>
Agronomics -
Yield, TW, JDF, Height, Lodging
Morphology – Grain color, Chaff color, awns
Diseases – FHB, DON, Leaf/Stripe rust, PM, BYDV, WSSMV,
Quality:
Flour yield, LAR, % Protein, Softness, Sprouting, Black point

1997 and Following – Reports Online

<p>| Table 1: Multi-Year Performance Summary (Note: Tables sorted by 2007 Yield, red wheats grouped below) |
| --- | --- | --- | --- | --- | --- |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>Grain Color</th>
<th>Chaff Color</th>
<th>Awns</th>
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<th>3 YR</th>
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<td>NO</td>
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<td>90.2</td>
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<tr>
<td>MCIA CRL</td>
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<td>WHITE</td>
<td>NO</td>
<td>89.5</td>
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<td>WHITE</td>
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<td>NO</td>
<td>87.8</td>
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</tr>
</tbody>
</table>

Single and Multiyear averages (when available)
Wheat Breeding Requires Many Years

Cross

↓

Many years of
• selection
• purification (inbreeding)
• increase

↓

Yield Trials
BREEDING NURSERY
80 acres – 3 year rotation.

50 foot single plant plots
(Photo in June, 2007)

YIELD TRIALS –
6 locations, PYT, AYT, Quality, State Performance, Regional Nurseries

SAGINAW, 2007 (Right)
FHB NURSERY

~1400 entries this year
(USWBSI Regional Nurseries, F3, F4, Yield Trials, Mapping)

Pre Harvest Sprouting
Variety Development

Non-Negotiable Traits:
- Yield
- Testweight
- Quality

Traits that affect yield, testweight and/or quality
- FHB resistance (affects yield, testweight and quality) – especially lower toxin
- Pre-Harvest Sprouting resistance
- Climate change?
Crosses Spring 2007

Emphasis on FHB Resistance

Emphasis on Pre-Harvest Sprouting Resistance
Crossing Block Winter

‘07/Spring ‘08

13 planting dates over 8 weeks (Nov ‘07 – Jan ‘08)

- Elite true-breeding parents
- FHB resistant parents
- Selected F1 lines for 3-way crosses
## Molecular Marker Data

<table>
<thead>
<tr>
<th>Line</th>
<th>PEDIGREE</th>
<th>FHB1 3BS QTL</th>
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<th>FHB 2DL QTL</th>
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<td>yes</td>
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</table>
Summary of Materials in Field

Breeding Nursery
• 1799 Single Plant Progeny Plots

Yield Trials
• Preliminary Yield Trial
• Advanced Yield Trials
• State Performance Trial
• Regional Trials

FHB Nursery
• Early generation materials (165 F3 and 451 F4)
• Advanced Generation Materials (Preliminary and Advanced Yield trials, State Performance Trial)
• Regional nurseries
MSU Recent Release in Commercial Production

*Estimates of acreage 2007/08 according to certified seed sales*

D8006 (white) ~ 12,000 acres  
- “Best in Show” – Quality council meeting, Kansas City, 2008

Jewel (white) ~ 5,000 acres

Crystal (white) ~ 2,000 acres

Red Ruby (red) ~ 4,000 acres
Other Recent Release and lines Being Reviewed for Review

MSU Line E0028 - white (released)
MSU Line E2017 - white
MSU Line E1009 - white
MSU Line D8006R - red
MSU Line E0028
2007 release
MSU WHEAT BREEDING PROGRAM
MSU Line E0028 Characteristics

Cross Made in 1994:
   Pioneer 2737W/MSU D1148,


Flowers ~2 Days Earlier than Caledonia.
1 inch Taller than Caledonia.
Yield and Lodging Resistance Similar to Caledonia.
Good Winter Hardiness in comparison to Caledonia.
MSU Line E0028 Characteristics


Strengths:
- Higher yield
- Higher flour yield
- Early maturity (2 days)

Weaknesses:
- Lower than Average Test Weight.
- Susceptible to FHB (including DON).
MSU Line E2017

Being reviewed for release 2008
MSU Line E2017 Characteristics

• Cross made in 1995:
  D3913/D0331

• It is currently an $F_{6:13}$ Soft White Winter Wheat, awnless with bronze chaff.

• 95 Acres were planted for increase production in Michigan for the 2007-08 growing season.
MSU Line E2017 Characteristics

• Soft White, bronze chaff, awnless
• Strengths
  – Improved FHB resistance (visual)
  – Improved DON toxin levels compared with many high yielding white wheats.
  – Good test weight
  – Awnless

• Weaknesses
  – Powdery Mildew
  – Stripe Rust
<table>
<thead>
<tr>
<th></th>
<th>DON in grain (ppm): 3 year average: MN ('07, 2005-07)</th>
<th>DON in grain (ppm): 2 Year MSU average: 2005-06</th>
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<tbody>
<tr>
<td>Name</td>
<td>Year AVG.</td>
<td>2 YEAR AVG.</td>
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<tr>
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<tr>
<td>Caledonia</td>
<td>6.7 S+ 3.3</td>
<td>6.7 S+</td>
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<tr>
<td>Aubrey</td>
<td>3.5 3.8 4.2</td>
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</tr>
<tr>
<td>Pioneer</td>
<td>25W 7.0 S+</td>
<td>9.0 S+</td>
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<td>5.3 S+</td>
</tr>
<tr>
<td>Crystal</td>
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<td>14.0 S+</td>
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<tr>
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<td>11.6 S+</td>
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<tr>
<td></td>
<td></td>
<td>9.6 S+</td>
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</tbody>
</table>

S+ = significantly more than E2017 (LSD 0.05)
S- = significantly less than E2017 (LSD 0.05)
<table>
<thead>
<tr>
<th>Name</th>
<th>2005-07</th>
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<tr>
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<td>AVG. 1</td>
<td>AVG. 2</td>
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<td>Aubrey</td>
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<td>57.8 S+</td>
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<td>Pioneer</td>
<td>25W41</td>
<td>53.1 S+</td>
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<td>59.0 S+</td>
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<tr>
<td>MSU D8006W</td>
<td>61.4 S+</td>
<td>67.6 S+</td>
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</table>

LSD (0.05) 16.3 17.0 15.9 13.7 12.7 12.0

CV (%) 16.4 18.9 18.7 19.8 28.6 30.4

S+ = significantly more than E2017 (LSD 0.05)
S- = significantly less than E2017 (LSD 0.05)
MSU Line E1009

Being reviewed for release 2008
MSU Line E1009
Being reviewed for release 2008

Cross: 1995 DC076 / PIONEER 2552
(DC076,87F_INTCB_ENT#182/AUG//AUG)/3/(PIONEER_2555,PNR_W3 017/PNR_W521)

F4:13

Soft White Winter Wheat.

white chaff, awns
MSU Line E1009
Characteristics

Soft White, White Chaff, has awns

Strengths:
Higher Testweight
Lower DON (toxin) levels than many high yielding white wheats.
Shorter

Weaknesses
BYDV
MSU Line D8006R
Being reviewed for release 2008
MSU Line D8006R Characteristics
Being reviewed for release 2008

• Cross made in : 1991
  PIONEER 2555/LOWELL
  (P2555,PIO_2555_COKER_68-16/MOW7140//PIO_W521)/3/(LOWELL,X0467/B2141//B5250)

• It is currently an F10:17 Soft Red Winter Wheat, awned with white chaff.

• 17 Acres were planted for increase production in Michigan for the 2007-08 growing season.
MSU Line D8006R Characteristics

- Soft Red

- Strengths
  - High flour yield
  - Powdery Mildew resistance
  - Good yield

- Weaknesses
  - Leaf Blotch
Thank you!

- Michigan State University
- U.S. Wheat and Barley Scab Initiative
- Michigan Crop Improvement Association
- Soft White Wheat Endowment Group
Questions?