SMALL GRAINS BREEDING AT ILLINOIS AND TIPS FOR VARIETY SELECTION

By: Jessica Rutkoski
Outline of Presentation

• Introduction

• University of Illinois Small Grains Program Overview

• Tips on Variety Selection
The US Corn Belt is the Most Agriculturally Productive Region in the World

Based on sun-induced chlorophyll fluorescence measured from space (Guanter et al. 2014 *PNAS*)
Corn Belt Farmers Face Serious Challenges

1) Profitability

2) Environmental concerns

Average net income

Source: farmdoc
Small Grains are Part of the Solution

Rotations including small grains vs Corn-soybean rotation

- Equal overall profitability
- Greater profit stability
- 200x less freshwater toxicity
- Less agrichemical use
- Equally effective weed control

Davis et al. 2012 *Plos One*
Small Grain Production in Illinois

Wheat Acres

3% of national winter wheat production

Wheat Double Cropping with Soybean

Photo: https://www.ilsoyadvisor.com/

https://www.nass.usda.gov/
Profitability of Wheat/Soybean Double Cropping

Farmer Returns in Southern Illinois

Crop
- Corn
- Double Crop Soybeans
- Soybean
- Wheat

https://farmdoc.illinois.edu/handbook/historic-corn-soybeans-wheat-and-double-crop-soybeans
Small Grains Breeding at Illinois

Our Mission: Develop varieties that:

• Improve farm income

• Support greater cropping system diversity
Special Thanks To:

Olivia Handal - Research Specialist

Elias Handal - Senior Research Specialist

Juan Arbelaez - Assistant Professor - International Plant Breeding, leading oat and rice breeding
What Traits We Target

• High Yield
• Early maturity
• Low vomitoxin
• High test weight

Higher profits when double-cropping
Our Breeding Process

Seed multiplication:
- F5:F6 pure rows
- F5:F7 small increase
- F5:F8 large increase

Crossing block:
- F1 plants
- F2 bulk populations
- F3 bulk populations
- F3:F4 headrows
- F3:F5 single plots
- Preliminary yield trials
- Advanced yield trials
- Multi-state testing and licensing

Recombination:
- F1 plants
- DH production
- DH single plots
- Testing stage 1
- Testing stage 2
- Testing stages 3 and 4
- Dissemination

Line generation:

Year:
1
2
3
4
5
6
7
8
Varieties Keep Improving Every Year

1.09 % reduction in FDK per year

1.28 % reduction in Vomitoxin per year

Source: the author
Accelerating the Breeding Process

Seed multiplication

- F5:F6 pure rows
- F5:F7 small increase
- F5:F8 large increase

Crossing block
- F1 plants
- F2 bulks → F4 bulks
- F3:F4 headrows

Recombination
- F3:F5 single plots & genomic selection

Year
1
2
3
4
5
6

Recombination
- Line generation
- Initial seed increase
- Testing stage 1
- Testing stages 2 and 3
- Dissemination

Multi-state breeding trials
Multi-state trials and licensing
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Choosing a Variety: What to Consider Besides Yield

- What are the quality requirements of your target market?
- Is early maturity a priority?
- What diseases tend to be a problem?
- Is more or less straw desirable?
Statewide Varieties Trials for Winter Wheat

- Illinois:  
  http://vt.cropsci.illinois.edu/wheat.html
- Kentucky:  
  http://www.uky.edu/Ag/wheatvarietytest/
- Wisconsin:  
  https://coolbean.info/small-grains/variety-trial-results/
- Missouri:  
  https://varietytesting.missouri.edu/wheat/results.htm
- Ohio:  
  https://www.oardc.ohio-state.edu/wheattrails/
Emphasize Results from Your Region

Look at multi-location and multi-year performance **within your region** and at similar latitudes

Credit: USDA
Interpreting Trial Results

- **Mean or Average** - Combines data across locations, equally weighted.

- **LSD** - How different two varieties need to be in order to say that they are actually different.

- **CV** - The level of noise in the data, CV<20 is considered good.
Example: Comparing Variety Yields

- Top Yelder in Southern Illinois in 2019: CP9606 with 100.2 bu/acre
- The LSD = 6.1
- Thus, varieties 94.1 bu/acre or higher were as good as CP9606 in terms of yield
Compare Yields Within Maturity Group

- Later maturing varieties get an advantage
- Compare early varieties with other early varieties

Photo credit: @MStateCorn
Interpreting Scab Resistance Data

- Always compare the ratings with those of check varieties
- Choose varieties with Scab ratings equal or lower than the moderately resistant check
In Summary

- Small grain breeders are producing a steady stream of improved varieties for you to choose from.

- Consider multiple factors when choosing varieties.

- Statewide variety trials can help guide decision-making.
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Questions

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