Participatory Variety Trials to Assess Response to Environment in Organic Vegetable Crops

Alexandra Lyon, University of Wisconsin

March 3, 2015

Welcome to the webinar!

- The webinar will start at the top of the hour.
- Find a handout of the slides and a fact sheet at http://www.extension.org/pages/71272
- To type in a question, use the question box on your control panel. We will read the questions aloud after the c. 45 minute presentation.
- The webinar is being recorded and you can find it in our archive in the coming week at http://www.extension.org/pages/25242

Alexandra Lyon



PARTICIPATORY VARIETY TRIALS TO ASSESS RESPONSE TO ENVIRONMENT IN ORGANIC VEGETABLE CROPS

Alex Lyon, M.S.
Professor Erin Silva
University of Wisconsin-Madison

PRESENTATION OUTLINE

- NOVIC Project Overview
- Understanding response to environment
- Evaluating response to environment
- Conclusions and recommendations

NOVIC
Northern Organic Vegetable Improvement Cooperative

FARMER USES FOR VARIETY TRIALS

- **Motivations:**
  - Look for needed traits
  - Replace unavailable varieties
  - Satisfy curiosity
  - Begin on-farm variety improvement
- **Challenges:**
  - Multi-site and multi-year trials
  - Replications
  - Data collection and analysis

RESEARCHER USES FOR VARIETY TRIALS

- **Motivations:**
  - Beginning and end of plant breeding process
  - Selection
  - Education/demonstration
- **Challenges:**
  - Research stations are not "target environment"
  - Lack of farming expertise
  - Guessing at what farmers want

WHAT IS NOVIC?

Participatory variety trials on organic farms

Funding through USDA OREI

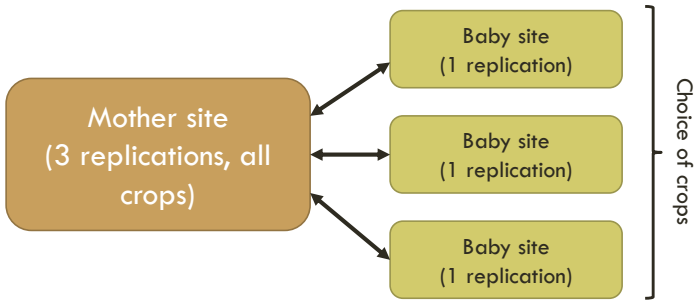
Research partners & plant breeders:

- Oregon State University (Jim Myers)
- University of Wisconsin-Madison (Bill Tracy)
- Cornell University (Michael Mazourek)
- Organic Seed Alliance (John Navazio, Laurie McKenzie)
- Organic farmers in OR, WA, NY, WI, MN

Organic Variety Trials Reports

- varietytrials.eorganic.info

MOTHER-BABY TRIAL DESIGN



- Facilitates farmer participation/on-farm evaluation
- Minimizes space and labor for farmers
- Provides replicated data on research stations
- Modified from Snapp et al. 2002
  - eOrganic: Participatory On-Farm Research Webinar

	NOVIC I	NOVIC II
Growing seasons	2010-2013	2015-2017?
Crops	• Sweet corn • Squash: butternut • Broccoli • Snap peas • Carrots • Regional choice	• Sweet corn • Squash: acorn & delicata • Cabbage • Tomatoes • Peppers • Regional choice
Data collection	• Same on research station and farms	• Stations: Full dataset • Farms: Focus on qualitative data and farmer ratings

IMPORTANCE OF RESPONSE TO ENVIRONMENT

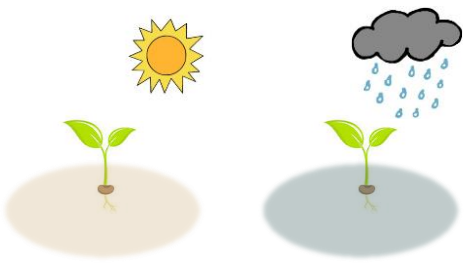
- Types of adaptation
- Adaptation and organic farms
- Implications for breeding

RESPONSE TO ENVIRONMENT

Wide adaptation	Specific adaptation	Stability
• Variety does well over large areas • High mean yields across environments	• Variety ranks among the highest yielders at some locations, but not others • (Abidin et al. 2005)	• Yields vary relatively little around the average yield (Shukla 1972)

SPECIFIC (LOCAL) ADAPTATION

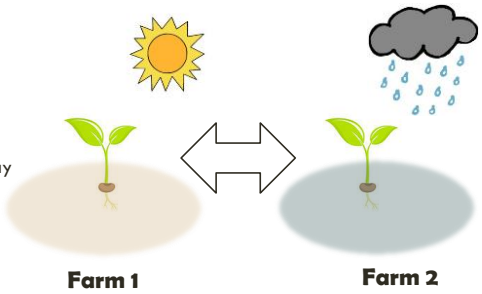
- On-farm/decentralized selection
  - Ceccarelli 2003 (barley)
- Dedicated organic breeding
  - Murphy 2007 (wheat)
  - Renaud 2014 (broccoli)
  - Drinkwater et al. 1995 (tomatoes)
- Addressing farm-to-farm variation
  - Wolfe et al., 2008



WIDE ADAPTATION

- Benefits:
  - High yielding across different environments
  - More efficient use of plant breeding resources
- Drawbacks:
  - Best overall performer in all locations may not be the best in specific locations
  - Fewer varieties grown, less biodiversity

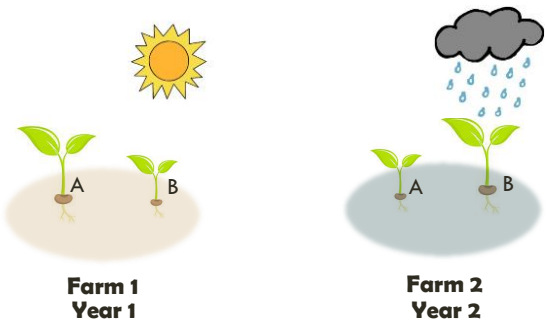
Atlin et al. 2000



GENETICS X ENVIRONMENT INTERACTIONS

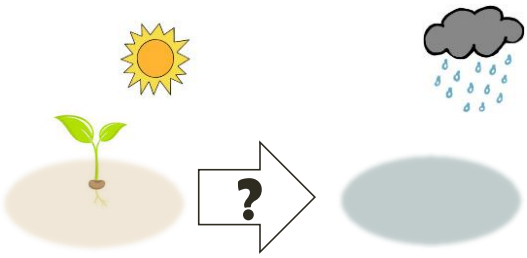
Large G x Location interaction (predictable)
→ specific adaptation

Large G x Year interaction (unpredictable)
→ wide adaptation



(Allard 1964)

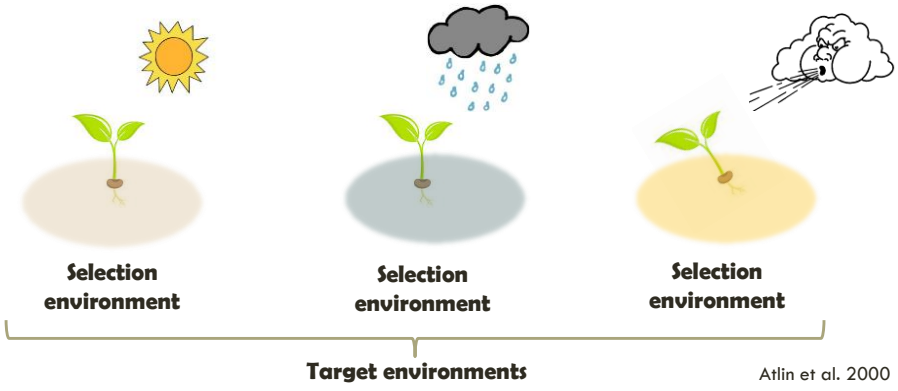
INDIRECT SELECTION



DIRECT SELECTION

Selection environment = Target environment

BREEDING FOR WIDE ADAPTATION



Atlin et al. 2000

EVALUATING RESPONSE TO ENVIRONMENT

RESEARCH OBJECTIVES

- Determine response of varieties to diverse year x location environments; detect GxE interactions.
- Assess feasibility of simple graphic methods to analyze stability and performance.
- Make recommendations to improve participatory trialing.

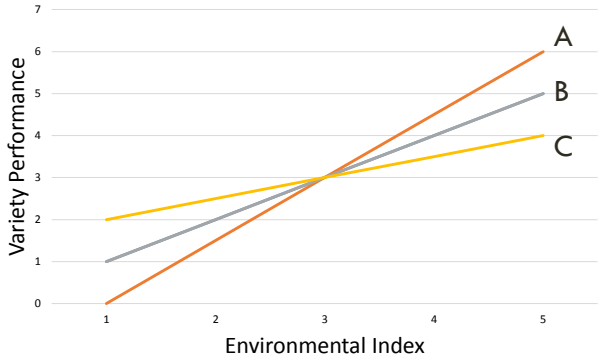
METHODS - VARIABLE SELECTION

1. Identified crops with most complete quantitative data
   - Looked for yield variables
2. Selected variables
   - Broccoli head diameter (cm)
   - Squash marketable weight per plant (kg)
   - Squash marketable number per plant
3. Selected environments and varieties
   - Environments = Year x Location
   - Found optimal varieties x environments to maximize data

SELECTED VARIETIES FOR ANALYSIS

Broccoli	Squash
• Solstice (OP) • Common Ground Population (OP) • OSU Composite (OP) • Windsor (F1) • Arcadia (F1) • Gypsy (F1) • Belstar (F1)	• Bugle (OP) • Early (F1) • JWS 6823 (F1) • Pilgrim (F1) • Metro (F1) • Waltham (OP) • Tiana (F1)

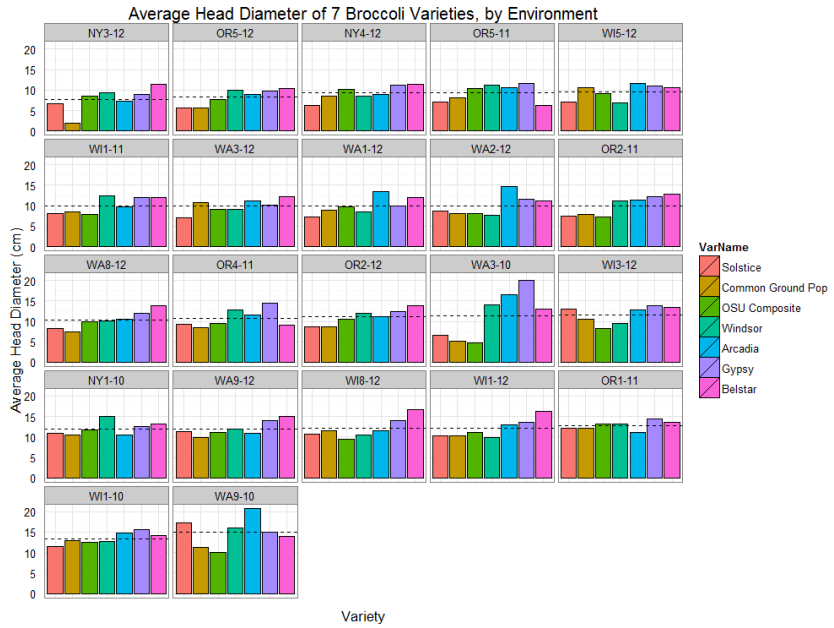
METHODS - ADAPTABILITY ANALYSIS



A: Adaptation to good environments ($\beta > 1$)
B: Average performance ($\beta = 1$)
C: Adaptation to poor environments ($\beta < 1$)

Adapted from
Hildebrand & Russell 1996

BROCCOLI: HEAD DIAMETER



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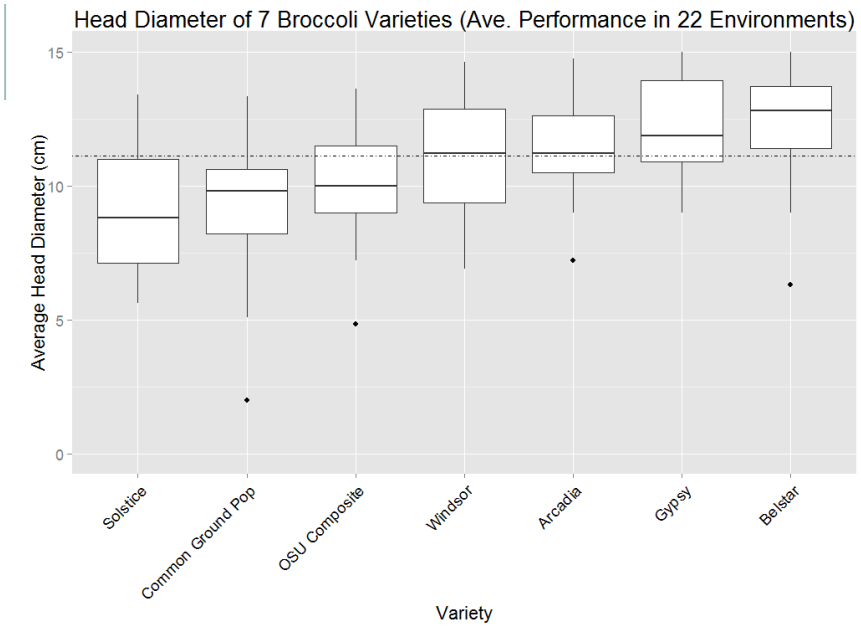

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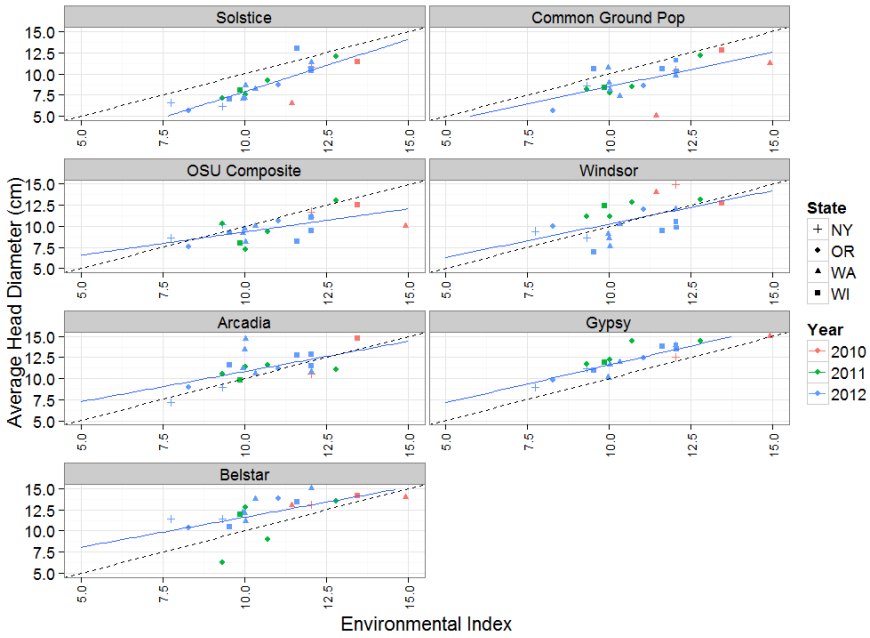
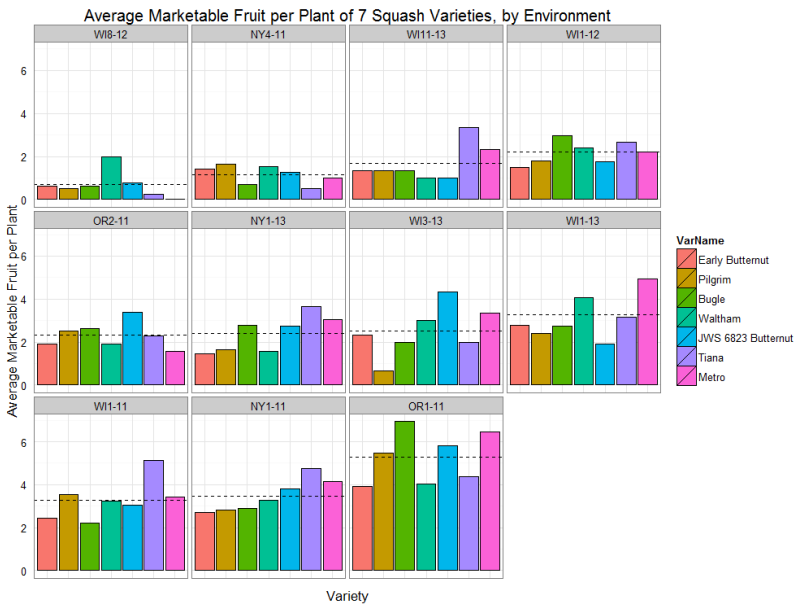


SQUASH: MARKETABLE FRUIT PER PLANT



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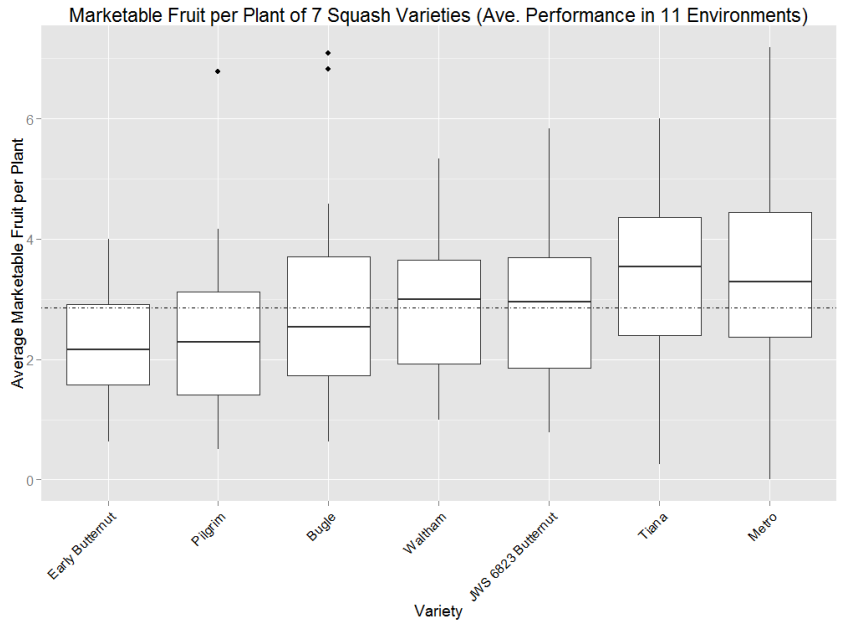

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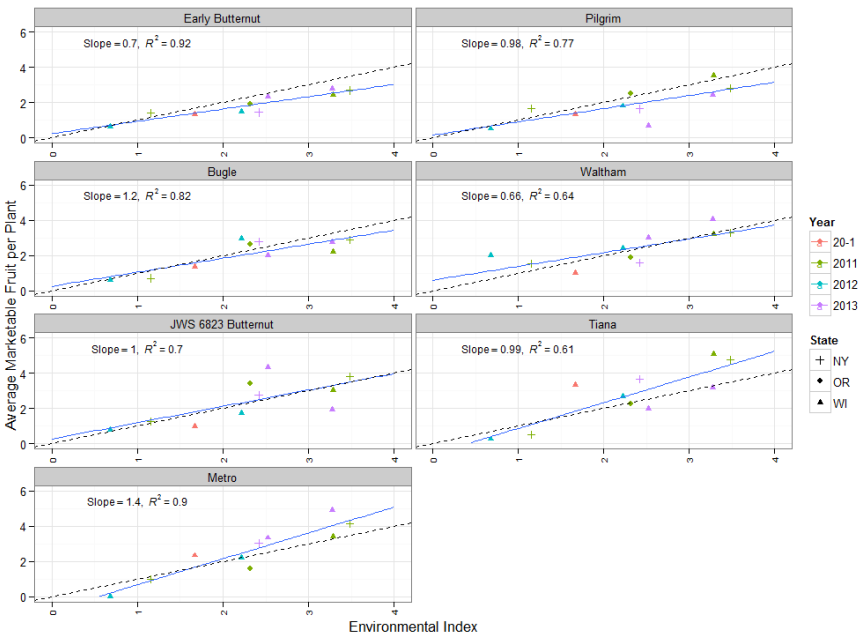

SQUASH: MARKETABLE WIEGHT PER PLANT

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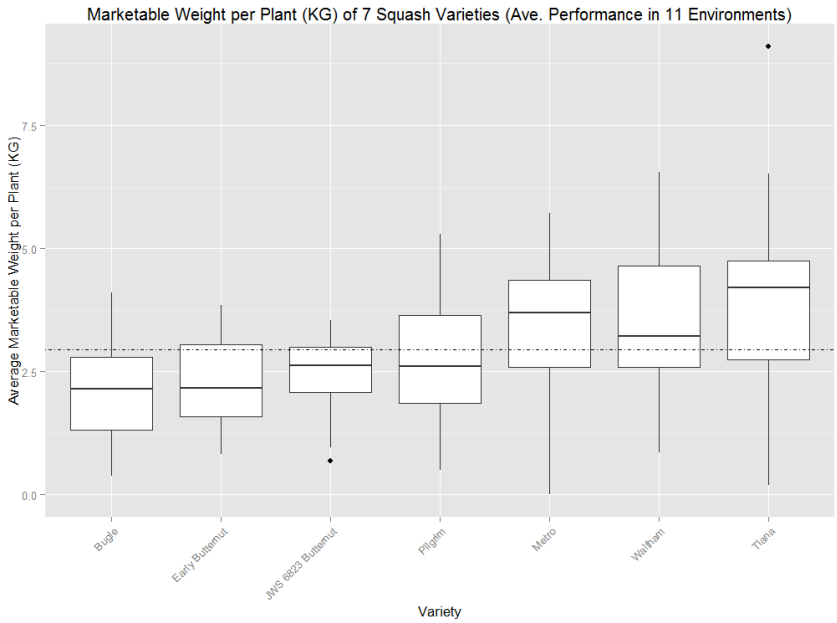
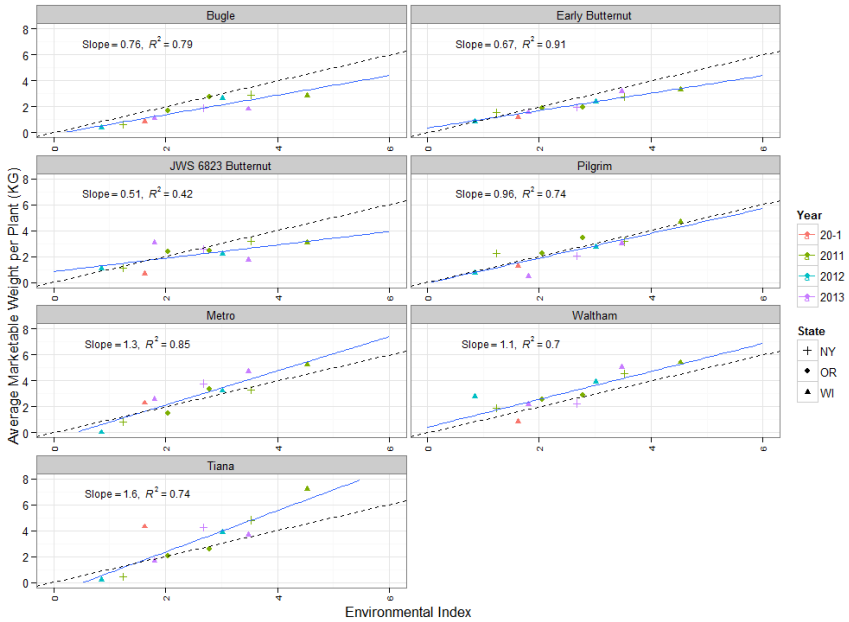


SQUASH: MARKETABLE WEIGHT PER PLANT



CONCLUSIONS

Broccoli

- Gypsy shows wide adaptation while Belstar is better adapted to poor environments.

Squash

- Metro F1 and Tiana F1were better adapted to good environments.
- Waltham OP was better adapted to poor environments in terms of fruit number, and showed wide adaptation in terms of weight.

Adaptability analysis

- Useful for visual interpretation of response to environment.
- Does not require the same sites for multiple years.
- Can be used to identify varieties with broad or specific adaptation.

RECOMMENDATIONS

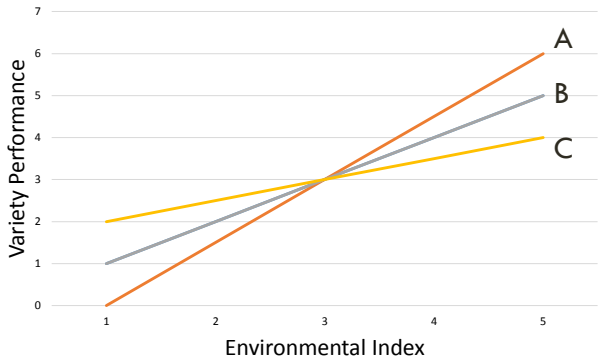
For participatory trialing:

- Communicate importance of multi-year data
- Trialing network can ensure a minimum number of varieties x environments
- With multiple research teams, consistent records are key
- Strategic data collection

For further research:

- Adaptability analysis for other crops, traits, and varieties
- Direct measures of environmental variation to partition environments

WHAT KIND OF ADAPTATION?



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PRIORITIES FOR ORGANIC FARMERS

Wisconsin Organic Seed and Plant Breeding Survey
(Lyon, Silva, Zystro and Bell, n.d. *Agroecology and Sustainable Food Systems)*

"TRIED-AND-TRUES"

"You know, we can have a cold, wet spring like last year, or we can have a rather dry and hot-and-cold spring like we're having this year—same thing with the summers. **There are some varieties…that we've just honed in on. These are gonna be reliable for us regardless of what happens while they're in the field.**"

THANK YOU

- **Farmer Participants**
- **USDA Organic Research & Education Initiative**
- **Ceres Trust**
- **Annie's Homegrown**
- **Advisor: Erin Silva (UW-Madison)**
- **Committee members: Bill Tracy, Irwin Goldman (UW-Madison)**
- **Other NOVIC Collaborators: Jim Myers (OSU); Micaela Colley, Jared Zystro, Laurie McKenzie, Lane Selman (OSA); Michael Mazourek (Cornell), and many more!**

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Contact me: ahlyon@wisc.edu

More on NOVIC: eorganic.info/novic

Organic Variety Trials Reports: varietytrials.eorganic.info

Erin Silva's Research Program: uworganic.wisc.edu

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