Breeding Peas, Sweet Corn, Broccoli, Winter Squash, and Carrots as part of the Northern Organic Vegetable Improvement Collaborative

Jim Myers and Laurie McKenzie, OSU; Michael Mazourek, Cornell Univ.; William Tracy and Adrienne Shelton, Univ. Wisconsin; and John Navazio, Organic Seed Alliance

Session Format

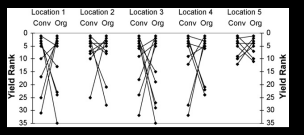
- Introduction to the NOVIC breeding effort
- Sweet corn breeding
- Pea breeding
- Carrot breeding
- Winter squash
- Broccoli breeding
- Panel Discussion

Is there a need to breed within organic systems?

- Organic production environments differs from conventional production environments
- Varietal adaptation to environment is paramount to obtaining the best varietal performance
- Contemporary varieties bred in and for conventional production systems may be less-than-optimally-adapted to organic systems

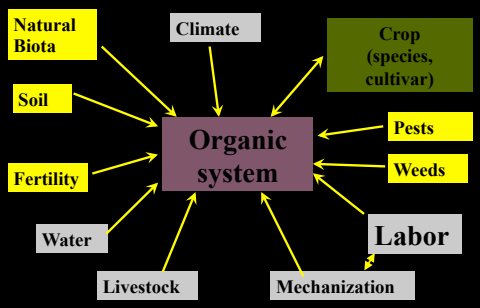
Selected studies comparing organic vs. conventional performance

- **Wheat**: no genotypic correlation among 35 lines in 4 of 5 paired org-conv. environments for yield, but correlated in all environments for test weight (Murphy et al., 2007)
- **Maize**: genotypic correlations high for dry matter content, maturity, & disease resistance, but moderate for yield (>4000 hybrids evaluated) (Burger et al., 2008; 2012)



Grain		DMC	
r_p	r_g	r_p	r_g
0.37**	0.54**	0.91**	0.94**

Major differences between organic & conventional



Comparison of traits that possibly differ for conventional vs. organic

Conventional	Organic
Above ground traits	
Performs well at high population density	Optimal performance at lower densities
Increased harvest index	Lower harvest index than conventional
Erect architecture and leaves, shortened plant stature	Taller plants, spreading canopy to be productive in low input situations
Weed competitiveness unknown	Weeds limited by competition (plant height, spreading architecture), plants tolerate cultivation, allelopathy
Pest and disease resistance to specific complex of organisms; need for resistance to diseases of monoculture systems	Pathogen and pest complex differ; induced resistance important; secondary plant compounds important for pathogen and pest defense; greater reliance on genetic resistance

Comparison of traits that possibly differ for conventional vs. organic (II)

Conventional	Organic
Rhizosphere traits	
Root architecture unknown	Exploratory root architecture; able to penetrate to lower soil horizons
Adapted to nutrients in readily available form	Adapted to nutrients from mineralization - not readily available; need for nutrient use efficiency; responsive to mycorrhiza
Legume specific traits	
Nitrogen production by rhizobia of lesser importance	Rhizobia more important; discrimination against ineffective rhizobia important for N acquisition
Harvest and marketing traits	
Improved harvest efficiency	Incorporate traits that improve working conditions
"Ecological" traits	
Genetically and phenotypically uniform	Allow genetic and phenotypic diversity

NOP regulations impacting breeding activities

- National Organic Program established in the U.S. in 2002
  - Requirement for certified organic seed
  - Allowable breeding technologies



Requirement for organic seed

- "…The producer must use organically grown seeds…except…non-organically produced, untreated seeds and planting stock may be used to produce an organic crop when an equivalent organically produced variety is not commercially available" (§ 205.204).


Need varieties adapted to organic production

- Variety trials to identify those adapted to organic systems (seed production as well as commercial production)
- Develop cultural methods for organic seed production
- Breed in and for adaptation to organic systems

Conduct variety trials to identify organically equivalent seed

- OSP - Organic Seed Partnership (OREI)
- National Organic/Conventional Broccoli Variety Trial
- OBOT - Onion and Broccoli Organic Trials (OR Organic Special Grants)
- NOVIC - Northern Organic Vegetable Improvement Collaborative (OREI)

NOVIC
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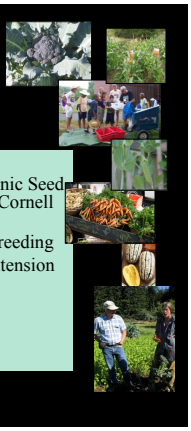


- Funding duration: 2009-2013
- OSU lead institution w/ 4 cooperators: Organic Seed Alliance (WA) Univ. Wisconsin (WI/MN), Cornell Univ. (NY), USDA-Geneva (NY)
- Four graduate students in training in plant breeding
- Adaptation to organic production; season extension
- Farmers integrated into:
  - Variety trialing
  - Plant breeding & cultivar development
- Long term: 2 four-year renewals possible

NOVIC Breeders & Crops

Plant Breeders:

- Michael Mazourek & Jim Keach (Cornell)
- Bill Tracy & Adrienne Shelton (UW-Madison)
- Jim Myers & Laurie McKenzie (OSU)
- John Navazio (OSA)

The Crops:

- Broccoli (heat tolerance)
- Carrot (overwintering & weed competition)
- Edible Podded Pea (heat tolerance)
- Sweet Corn (cold soil germ.)
- Winter Squash (storage)

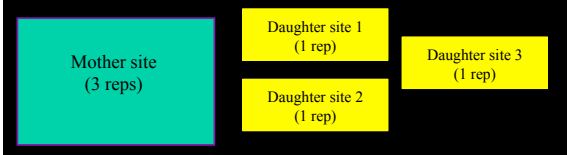
NOVIC Variety Trial Design

Mother-Daughter Experimental Design

statistically sound data that maximizes amount of information obtained from diverse environments

'Mother' sites: complete randomized block design with 3 reps

'Daughter' sites: single replicates on 3 collaborating farms



Summary

- Trial design facilitates collection of data needed for variety release
- Crops represent a portfolio of those in a fresh market grower's system
- Provides training & education for future plant breeders in organic plant breeding
- Flexible approach to meet needs of participating farmers & crop breeding systems

For more information and data:

eorganic.info/NOVIC