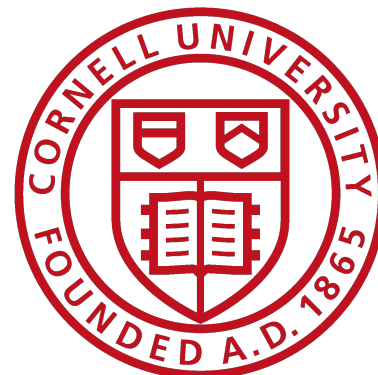


The National Association of Plant Breeders in partnership with the
Plant Breeding Coordinating Committee and The Plant Breeding
Genomics Community of Practice presents

How to breed new plant varieties: imagining and engineering crops

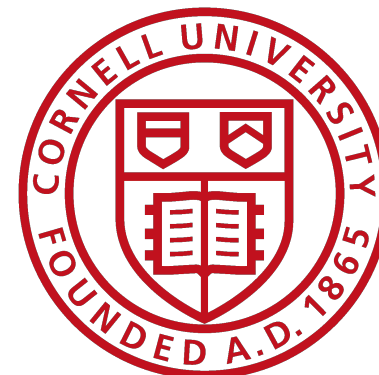
Michael Mazourek,
Cornell University
Department of Plant Breeding
and Genetics



The National Association of Plant Breeders in partnership with the
Plant Breeding Coordinating Committee and The Plant Breeding
Genomics Community of Practice presents

Cuckoo for Cucurbit Vine Crop Breeding

Michael Mazourek,
Cornell University
Department of Plant Breeding
and Genetics



Cucurbits - Introduction

- Refers to plants in the Cucurbitaceae family
- Also called “vine crops”



Germplasm and Genetic Resources

- Cucumber (*Cucumis sativus*): 1308 NPGS accessions
- Melon (*Cucumis melo*): 2230 NPGS accessions
- Watermelon (*Citrullus lanatus*): 1442 NPGS accessions
- jack o'lantern, pie pumpkin, zucchini, winter squash
 - *Cucurbita pepo*: 737 NPGS accessions
 - *Cucurbita moschata*: 327 NPGS accessions
 - *Cucurbita maxima*: 505 NPGS accessions

Gene lists maintained by Cucurbit Genetics Cooperative

<http://cuke.hort.ncsu.edu/cgc/cgcgenes/genelists.html>

Conserved Need in Cucurbits

- Powdery mildew
- Downy mildew
- *Phytophthora capsici*
- Gummy stem blight/black rot
- *Cucumber mosaic virus* and Potyviruses
- Cucumber beetles



Similar Breeding Approach

- **Self-compatible**
- **Diploids**
- **Little inbreeding depression**
- **Pedigree breeding or recurrent selection**
- **Often monoecious**
 - **Gynoecious common in high yielding cucumbers**
 - **Andromonoecious found in melon and watermelon**

Nuts & Bolts of Cucurbits



Pollination

- **Day before:**
 - Close buds to be crossed
 - Full petal color in bud
 - Skip if in greenhouse with good insect control
 - If any perfect flowers, emasculate first
- **Morning of:**
 - Transfer pollen
 - Use multiple male flowers for cucumber
 - Cover pollinated female flower with bag or gel cap
 - Pollen timing depends on season and weather



Chemical Control of Sex Expression

- **Ethephon induces/increases femaleness**
- **Silver induces/increases maleness**
 - **GA can be used instead of silver for organic seed increases of gynoeocious lines**
 - **Important for cucumber hybrid seed production**
 - **Important for yield**
- **Some watermelons andromonoecious in field, monoecious in greenhouse**

A Year in the Life -

- **Mid-May: sow seed in 50 cell trays**
- **Early June: transplant hardened-off seedlings**
- **Early July – Mid-August: pollinations**
- **Harvest fruit for seed after 6 weeks (8 weeks for winter squash)**
- **Fruit data analysis**
- **Plant smaller winter generation in greenhouse**
 - **Avoid selecting for traits with GxE**

Uncertainty Principle and **Cucurbit Breeding**

- **OP fruit must be stripped until targeted pollinations are complete**
- **Yield, quality and resistance scores are biased if plants are:**
 - **stripped of fruit (for cucurbits consumed as mature fruit)**
 - **not stripped of fruit (for cucurbits consumed as immature fruit)**

Cuttings

- Much effort spent on pollinations in the field
- Recurrent selection with open-pollination selects only for maternal genetics
- Most cucurbits, especially vine types, root readily from cuttings
- Cuttings allow larger populations
- Fewer generations per year, more gain per generation with less effort
- Vulnerable to disease

Opportunities

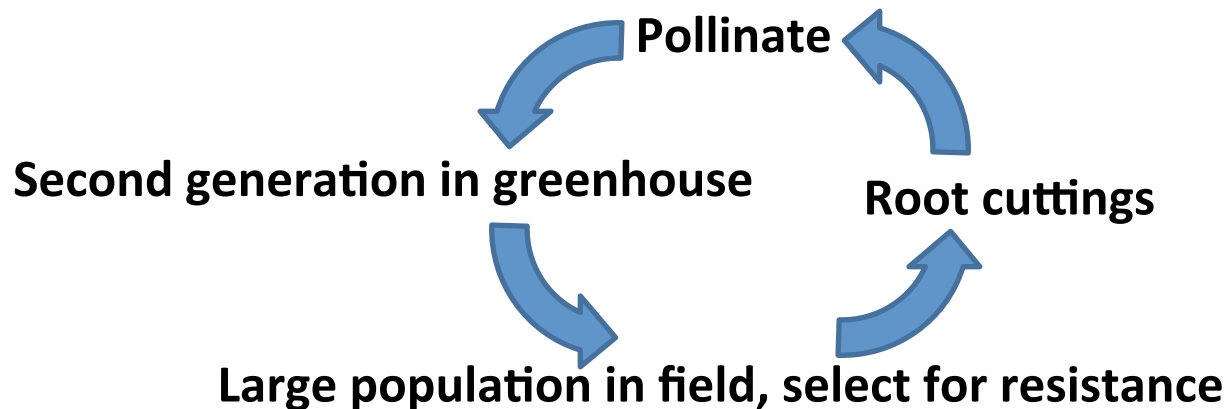


Downy Mildew



Downy Mildew Resistance Breeding

- Screen available germplasm
- Create biparental F_2 populations
- Sow seed one month before spore arrival



Downy Mildew Resistance Breeding

NY-DMR264



12-257



'Marketmore 97'



'Ivory Queen'



WI2238



'Picolino'



Striped Cucumber Beetle Non-preference

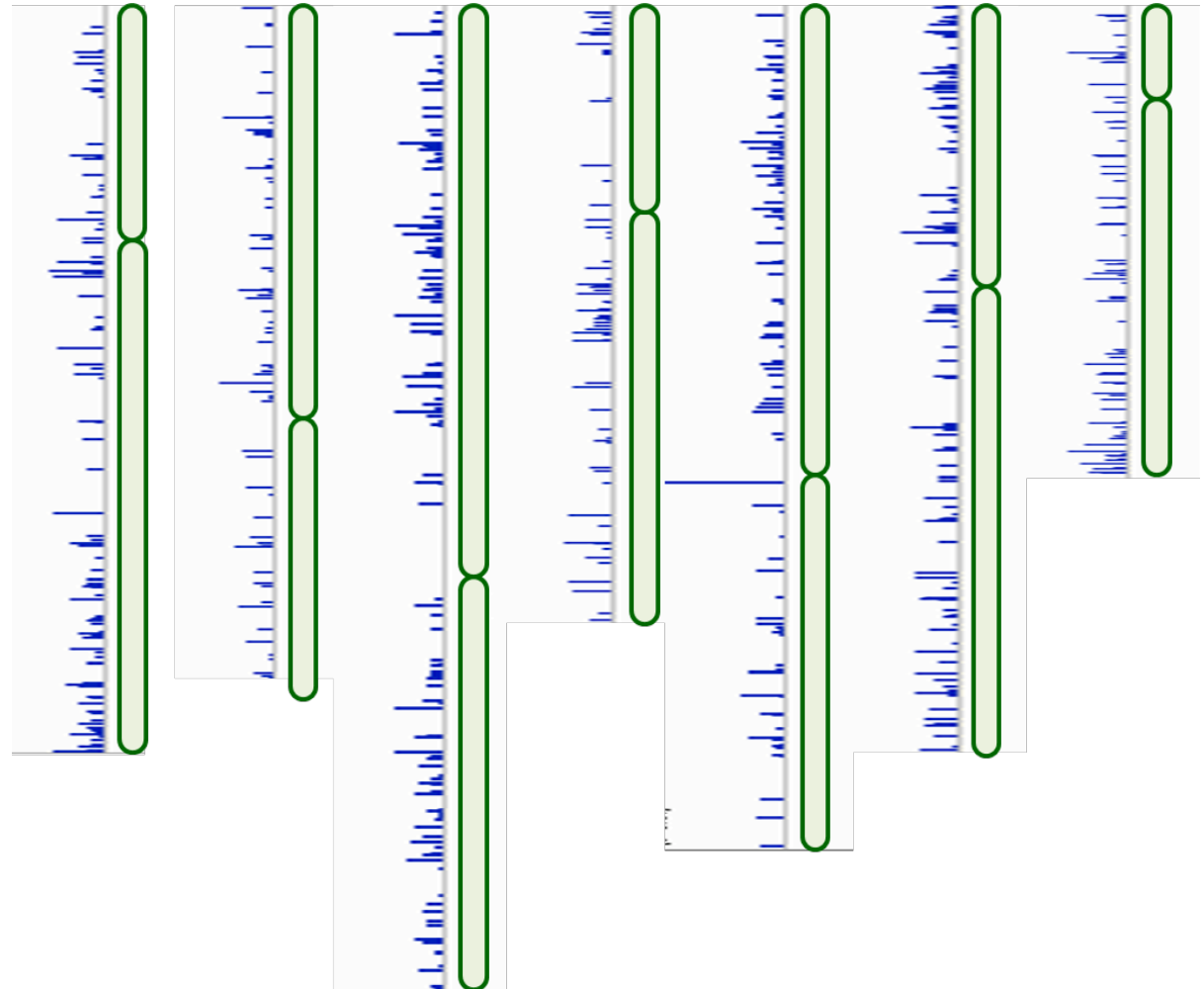




Genotyping Resources

- Cucumber, watermelon and melon have sequenced genomes and much investment
- *Cucurbita* species less developed but rapidly catching up
- Genotyping-by-sequencing
 - ApeKI
 - Thousands of markers
- Limited by genetic diversity

Genotyping-by-Sequencing Coverage in Cucumber



Seed Production



Quality

- **°Brix**
 - Freeze winter squash chunk in baggie
 - Thaw
 - Snip corner of bag and squeeze out liquid
- **Dry matter**
 - Thinly sliced samples in food dehydrator overnight
- **Color**
 - Colorimeter

Winter Squash Curing and Storage



Future Trends

- **Smaller, diversity**
- **Organic, regionally adapted**
- **Focus on nutrition**
- **Culinary quality**
- **Resilient to unpredictable seasons**

Introducing Variation



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- ESO-Cuc, NOVIC projects
- Seed Matters

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