Varieties: New innovations in Pumpkins, Winter Squash, Summer Squash, Gourds, and Melons

Brent Loy
NH Agricultural Experiment Station
My Work on Variety Development is Totally Dependent on Collaboration with Several Seed Companies

Johnny’s Selected Seeds

Hollar Seeds

Rupp Seeds

Hybrid Seeds NZ

Dr. Jodi Smith
High Mowing Organic Seeds

Seneca Vegetable Research
Hybrid Melons for New England

(Containing NH Breeding Lines)

\[ F_1 \text{ hybrids are comprised of two parental strains that are genetically pure.} \]

Breeding lines released to seed company.
Seed increase of these lines by seed company.
Hybrid seed produced – hand pollination

\[ \text{Strain A} \times \text{Strain B} \]

Hybrid Seed
Halona
Produced by Hollar Seeds.

Classic eastern cantaloupe

Early maturity with large size.

Good vine vigor and some tolerance to sudden wilt.

Disease package:
PMR 1,2
FR 0,2

Performs well as grafted plant.
Diplomat
Produced by Hollar Seeds.

Galia/Passport type

Maturity: as early as Passport – ca. 70 d

Disease package:
PMR 1,2
Ambassador
Produced by Seneca
Vegetable Research.

Galia/Passport type
Early maturity
Disease package:
PMR 1,2
FR 0,1,2
Honey Sak
Produced by Seneca Vegetable Research

Early Golden Crenshaw – magnificent flavor.

Second early – 75 to 77 d

Disease package:
PMR 1, 2
FR 0,1,2
Sugar Cube
Joint development with Seneca Vegetable Research

Attractive and productive small variety

Size: 2-3 lbs.

Disease package:
PMR 1, 2
FR 0, 1, 2
ZYMV, PRSV, WMV
First Kiss
Produced by High Mowing Organic Seeds.

First early
PMR 1,2
FR 0,1,2
True Love
Produced by High Mowing Organic Seeds.

Scheduled for release in fall 2017

Athena type – very nice melon.

Disease package:
PMR 1, 2
FR 0,1,2
Shockwave
Produced by Seneca Vegetable Research

Long shelf life variety: harvest when yellow rind flecks appear.

Disease package: PMR 1,2 FR 0,1,2

Maturity: ca. 80 d
On the Horizon

NH5414

Athena
NH5425

Early

Firm, excellent flavor

Long harvest window

Very Productive

PMR 1,2; FR 0,2
Yellow Summer Squash Breeding

Breeding work inspired by two observations:


2. Terrible quality of yellow summer squash being marketed, largely caused by extreme spininess on stems.
UNH Contribution to Yellow Summer Squash – eliminate prickly nature of foliage.

Slick Pik® YS26
Introduced in 2009
Blond Beauty – Rupp Seeds
PMR, Non-warty Rind, Upright Growth Habit, Early

Blonde Beauty

Supermarket

Fortune
Introductions for Fall, 2017

Smooth Operator
High Mowing Organic Seeds

NH2130
Seneca Vegetable Research
Chilling injury (B gene)

Fortune

Blonde Beauty

NH2130
NH2170

High Yielding Crooknecks

NH2143
Developments in Fresh Market
Winter Squash

Acorn group – *Cucurbita pepo* spp. *ovifera*

Kabocha group – *Cucurbita maxima*

Butternut group – *Cucurbita moschata*
Honey Bear – AAS
Winner – Johnny’s

Outstanding eating quality
bush growth habit
PMR
small size 1-1.4 lbs
Sugar Bush
PMR, 650 to 750 g

Sugar Dumpling
500 to 600 g

High Mowing Organic Seeds
Prospects for achieving ‘Sugar Bush’ quality in an acorn in the 1000 g size class?

<table>
<thead>
<tr>
<th>Treatment per plot</th>
<th>Ave fr. no.</th>
<th>Ave fr wt.</th>
<th>Ave. fr. wt. (kg)</th>
<th>% DW</th>
<th>% SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2612</td>
<td>17.6</td>
<td>15.6</td>
<td>0.87± 0.14</td>
<td>14.0</td>
<td>12.4</td>
</tr>
<tr>
<td>2621</td>
<td>17.3</td>
<td>13.1</td>
<td>0.76± 0.16</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>2628 L-2</td>
<td>14.5</td>
<td>16.5</td>
<td>1.14± 0.22</td>
<td>17.5</td>
<td>15.2</td>
</tr>
<tr>
<td>2629 L-2</td>
<td>17.0</td>
<td>17.5</td>
<td>1.03± 0.14</td>
<td></td>
<td>16.3</td>
</tr>
<tr>
<td>2631</td>
<td>16.0</td>
<td>16.7</td>
<td>1.04± 0.18</td>
<td></td>
<td>12.2</td>
</tr>
</tbody>
</table>
For Squash Connoisseurs
Kabocha type

Thunder –
restricted vine
high yields
excellent eating
quality

Rupp Seeds
Bagheera Kabocha Squash
restricted vine, small blossom scar

High Mowing Organic Seeds
What about Butternut?
Appeal to the butternut peeling market.
Kabocha type fruit in species *C. moschata*
‘Naked Bear’
hull-less pumpkin seeds

Seneca Vegetable Research
Changing Direction in Ornamental Pumpkins
Cargo

Joint development with JSS

Bayhorse Gold

Joint development with Rupp.
Initial Focus on Novel Rind Color
Bianco

Snowball

Seneca Vegetable Research

Hybrid Seeds NZ
Creating a diversity of striped/color phenotypes
Long Term Project Funded by JSS
Acknowledgements
Dean Jon Wraith

Hua Cui - Research Technician
Renee Cantara - Research Technician
Kaitlyn Orde - Research assistant
Janel Martin - Graduate student
John McLean - Farm Manager
Evan Ford - Farm Manager
David Goudreault - Greenhouse Manager
Questions
New Variety Introductions
nz540
NZ557
2501**
Wbn1-8
Prob wbn
NZ557
### Three Major Species of Winter Squash (Cucurbita species)

<table>
<thead>
<tr>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. pepo</em></td>
<td>Table Queen (acorn)</td>
</tr>
<tr>
<td><em>C. maxima</em></td>
<td>Buttercup/kabocha</td>
</tr>
<tr>
<td><em>C. moschata</em></td>
<td>Butternut</td>
</tr>
<tr>
<td><em>C. moschata</em></td>
<td>Delicata</td>
</tr>
<tr>
<td></td>
<td>Hubbard</td>
</tr>
<tr>
<td></td>
<td>Dickinson Field</td>
</tr>
<tr>
<td></td>
<td>Sweet Dumpling</td>
</tr>
<tr>
<td></td>
<td>Golden Delicious</td>
</tr>
<tr>
<td></td>
<td>Large Cheese</td>
</tr>
</tbody>
</table>
**C. pepo**

- Will sometimes cross with good seed, **F₁** sterile.
- Will rarely cross, but gene transfer possible.
- Good luck!
Interspecific *C. maxima* x *C. moschata* $F_1$ hybrids have found some market niches.

- Afford a good root system and graft union for watermelon, melon, and some *Cucurbita pepo* cvs.

- A few varieties have become popular in scattered regions of the globe.

- In general, currently available cultivars are not considered to have good eating quality.

- No previous attempt to use interspecific hybrids for a processing squash.
Potential Benefits of Interspecific F$_1$ Hybrids

1) Semi-bush growth habit, with upright leaf canopy and rapid development of leaf canopy.

2) Wider adaptability due to maxima/moschata parentage.

3) Improved disease and/or stress resistance.

4) Higher mesocarp yield due to availability of photosynthate typically allocated to seed development.
Bush *C. maxima* breeding lines developed at the NHAES deemed useful for producing interspecific processing hybrids.
NH65 found to be compatible with most C. moschata cultigens in terms of fruit set, seed yield and seed fill.

Available C. moschata processing lines

Dickinson Field strain, SC936 Rupp Seeds

Dickinson Field

Long Island Cheese
NH65 x 204-3-9-16BN
Research Objectives

1) Evaluate growth traits of bush *C. maxima* x vine *C. moschata* hybrids compared with parental cultigens, including main stem and internode length, leaf areas and flowering habit.

2) Compare yield parameters of standard processing cultivars or cultigens and interspecific hybrids.

3) Determine components of fruit yield contributing to productivity.
Growth of Interspecific Hybrids

- Growth rates of *C. moschata* vine cultigens and interspecific hybrids is similar.

- Leaf canopy development in semi-bush interspecific hybrids is compact, with long petioles and cupped leaves, resulting in a dense, erect leaf canopy.

- Leaf area of interspecific hybrids is about double that of vining *C. moschata* cultivars because large leaf size.
2011 Study

• Compared four processing cultigens:
  – Golden Delicious (C. maxima)
  – Dickinson Field (C. moschata)
  – NH65 x Long Island Cheese (NH65xLIC)
  – NH65 x Dickinson Field (NH65xDF)

• Plant Spacing: 0.6 m x 2.4 m; transplanted onto raised beds, fitted with black plastic mulch and drip irrigation.

• Four replications of 16 plants per plot, surrounded by two guard rows and 2 plants on the front and back of each plot. No pollinator cultigen – relied on adjacent plants of C. maxima and moschata.
# Fruit Yields in 2011

<table>
<thead>
<tr>
<th>Cultigen</th>
<th>Fruit size (kg)</th>
<th>Fruit No.</th>
<th>Yield kg/plot</th>
<th>Yield t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD</td>
<td>2.8</td>
<td>16.3</td>
<td>45.6 a</td>
<td>20.1 a</td>
</tr>
<tr>
<td>DF</td>
<td>12.1</td>
<td>11.8</td>
<td>107.6 b</td>
<td>48.1 c</td>
</tr>
<tr>
<td>NH65xLIC</td>
<td>4.1</td>
<td>26.8</td>
<td>102.7 b</td>
<td>46.6 bc</td>
</tr>
<tr>
<td>NH65xDF 32.0 ab</td>
<td>7.1</td>
<td>10.8</td>
<td>72.4 ab</td>
<td></td>
</tr>
</tbody>
</table>
Yield Components of Fruit Harvested in 2011
(harvest at 60 to 70 days after pollination)

<table>
<thead>
<tr>
<th>Cultigens</th>
<th>% DW</th>
<th>Mesocarp</th>
<th>% Fruit composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD</td>
<td>11.0 c</td>
<td>84.1 a</td>
<td>13.2 c</td>
</tr>
<tr>
<td>DF</td>
<td>5.6 a</td>
<td>89.3 b</td>
<td>8.5 b</td>
</tr>
<tr>
<td>NH65xLIC</td>
<td>9.3 bc</td>
<td>95.7 c</td>
<td>0.2 a</td>
</tr>
<tr>
<td>NH65xDF</td>
<td>7.7 b</td>
<td>95.8 c</td>
<td>1.0 a</td>
</tr>
</tbody>
</table>
# Yield Components of Fruit Harvested in 2011

*(harvest at 60 to 70 days after pollination)*

<table>
<thead>
<tr>
<th>Cultigens</th>
<th>Fruit</th>
<th>Meso FW</th>
<th>Meso DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF</td>
<td>48.1 c</td>
<td>43.0 c</td>
<td>2.4 b</td>
</tr>
<tr>
<td>NH65xLIC</td>
<td>46.6 bc</td>
<td>44.6 c</td>
<td>4.2 c</td>
</tr>
<tr>
<td>NH65xDF</td>
<td>32.0 b</td>
<td>30.7 b</td>
<td>3.6 bc</td>
</tr>
</tbody>
</table>
## Partitioning of Dry Weight (g) Biomass per kg of Fresh Fruit Weight

<table>
<thead>
<tr>
<th>Cultigen</th>
<th>g DW/kg fruit FW</th>
<th>Percent</th>
<th>Seed/total DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF</td>
<td>53.8 a</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>NH65xLIC</td>
<td>84.9 c</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>NH65xDF</td>
<td>72.7 b</td>
<td>1.1</td>
<td></td>
</tr>
</tbody>
</table>
Photosynthetic Glucose Energy Equivalents Allocated to Mesocarp and Seeds

<table>
<thead>
<tr>
<th>Cultigen</th>
<th>Kj/kg fruit FW</th>
<th>Percent</th>
<th>Seed/total kj</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF</td>
<td>675</td>
<td>110</td>
<td>14.0</td>
</tr>
<tr>
<td>NH65xLIC</td>
<td>1065</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>NH65xDF</td>
<td>912</td>
<td>17</td>
<td>1.8</td>
</tr>
</tbody>
</table>
Field Experiment in 2012

Three Cultigens:
- SC936 – C. moschata inbred line (Rupp Seeds).
- NH65xLIC
- NH65xSC936

Experimental plots:
- Spacing: 0.9 m between plants; rows 2.4 m apart
- Raised, mulched beds with drip irrigation
- Two gourd rows on both sides of plots and 2 guard plants at front and back of plots.
- Three replications, 12 data plants per plot
## Productivity of Interspecific Hybrids in 2012

<table>
<thead>
<tr>
<th>Cultigen</th>
<th>Fruit FW (kg)</th>
<th>Mesocarp %DW</th>
<th>Fruit No./plot</th>
<th>Fruit FW t/ha</th>
<th>Mesocarp FW t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC936</td>
<td>4.3 b</td>
<td>5.8 a</td>
<td>30.5 a</td>
<td>50.3 a</td>
<td>40.7 a</td>
</tr>
<tr>
<td>NH65xLIC</td>
<td>3.9 a</td>
<td>10.8 c</td>
<td>31.5 a</td>
<td>47.3 a</td>
<td>40.2 a</td>
</tr>
<tr>
<td>NH65xSC936</td>
<td>5.8 c</td>
<td>8.0 b</td>
<td>31.5 a</td>
<td>70.1 a</td>
<td>59.6 c</td>
</tr>
</tbody>
</table>
Early Fruit Set Perceived as Problem

<table>
<thead>
<tr>
<th>Fruit Set</th>
<th>Fr Wt (kg)</th>
<th>% DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit on bed</td>
<td>5.5 a</td>
<td>8.0 A</td>
</tr>
<tr>
<td>Fruit off bed</td>
<td>7.2 b</td>
<td>9.0 B</td>
</tr>
</tbody>
</table>
Objective: Determine flowering and fruiting patterns in NH65xSC936 in control plants and those in which female flowers initiated during the first 10 nodes were pruned.

Rationale: Data needed on uniformity of fruit quality and the possible adverse effect of precocious fruit set on fruit yield.
Effect of pruning pistillate flowers prior to node 11 on fruit set

<table>
<thead>
<tr>
<th>Treatment</th>
<th>% fruit on laterals</th>
<th>Ave Node 1st flower</th>
<th>Average node 1st Fr</th>
<th>2nd Fr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>17.5</td>
<td>10.6</td>
<td>13.7</td>
<td>19.2</td>
</tr>
<tr>
<td>Pruned</td>
<td>19.2</td>
<td>10.4</td>
<td>16.4</td>
<td>21.0</td>
</tr>
<tr>
<td>Anova 0.05</td>
<td>ns</td>
<td>ns</td>
<td>*</td>
<td>ns</td>
</tr>
</tbody>
</table>
Fruit yields in 2012 and 2013

<table>
<thead>
<tr>
<th>Year</th>
<th>% DW</th>
<th>Fruit FW t/ha</th>
<th>Meso FW t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>8.0</td>
<td>70.1</td>
<td>59.6</td>
</tr>
<tr>
<td>2013</td>
<td>9.3</td>
<td>68.7</td>
<td>58.4</td>
</tr>
</tbody>
</table>
Are Interspecific Hybrids the “Holy Grail” for Productivity in *Cucurbita* species?

- The semi-bush, upright plant phenotype appears to have greater photosynthetic capacity than vine plants.

- The root system is probably more resistant to soil-borne pathogens than either *C. pepo* or *C. maxima*.

- Do not have to allocate photosynthetic energy to seed development.

- Plants show PMR, are not attacked by vine borer, and are not attractive to squash bugs.
Acknowledgements

Hua Cue - Research Technician
Jake Uretsky - Graduate student
Jennifer Noseworthy - Graduate student
Kaitlyn Orde - Research assistant
Whitaker Cole
John McLean - Farm Superintendent
David Goudreault - Greenhouse Manager

Research funded by the NH AES and Rupp Seeds.
Dry Matter (1\textsuperscript{st} vs. 2\textsuperscript{nd} Fruit)

![Graph showing dry matter comparison between control and pruned conditions for 1\textsuperscript{st} and 2\textsuperscript{nd} fruit.](image)

- Control: 1st Fruit = a, 2nd Fruit = a
- Pruned: 1st Fruit = a, 2nd Fruit = a