

# Evaluation of Cornell Breeding Onion Lines for Potential Use in Organic Production: Field Trial, 2004

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## **Objective:**

To screen Cornell University yellow pungent onion breeding lines for their suitability in organic production.

## **Procedures:**

Varieties: Onion seed from six Cornell yellow pungent onion breeding lines were provided by Martha Mutschler, Dept. of Plant Breeding, Cornell. They include Algonquin, Cayuga, Elba, Iroquois, and YIX S7G. NY Early was included as an industry standard.

Transplant Production: Plug transplants were produced organically from seed in a greenhouse by Michael Glos, NOFA-NY. Two hundred eighty eight-cell trays were used. Adequate soil moisture and vigorous plant growth were difficult to achieve in these small cell size trays.

Trial Set-up: Field and bed preparation were performed by the grower cooperator. Transplants (~3 leaf stage) were planted into pre-punched black plastic mulch by hand on 13-May. The trial was set up as a randomized complete block design with 2 replications. Each replicate consisted of 4 x 20 foot rows of onions. Row spacing was approximately 15 inches and plant spacing was 3 inches. One foot of red onions was planted between replicates. Drip irrigation was set up, but not required during the 2004 growing season. The trial plot was maintained by the grower according to his usual practices.

Data Collection: Stand counts were taken for each plot on 2-Jun. Percent lodging was estimated on 10-Aug. Onions were pulled on 23-Aug (Rep 1) and 3-Sep (Rep 2). On 13-Sep, the onions were topped and bagged, removed from the field, and cured by the grower cooperator. On 26-Oct, onions were weighed, sorted into small, medium, large, and jumbo bulb classes. Culls were weighed and their cause noted. A 50 lb bag per variety of jumbo, large, and medium size bulbs were put into common storage. A storage assessment for bulb characteristics and quality was made after 12 weeks in storage on 19-Jan 05.

To account for stand loss due to poor plant establishment as a function of moisture stress, harvest data per replicate, including weight and number of bulbs, was transformed based on the stand per replicate in the trial, which was 215. Therefore, number of bulbs and weight per replicate of all other replicates was multiplied by 215/stand count.

Field Season: The 2004 growing season was abnormally cool and wet. Average ambient air temperatures recorded at the NEWA weather station in Elba were 56.8°F, 61.5°F, 66.2°F, 65.0°F, 60.9°F, and 48.5°F for May, June, July, August, September, and October, respectively. Similarly, total rainfall accumulated, in inches, for May, June, July, August, September, and October were 5.7, 3.2, 5.8, 1.7, 4.0, and 1.7, respectively.

## **Results:**

Harvest Assessment (Table 1 and Figure 1):

Percent lodging on August 10 (Table 1) was used to determine maturity, with Algonquin maturing just before the standard NY Early, and the other varieties maturing later than the standard. All varieties except Iroquois (96.2) had more healthy bulbs than the standard NY Early (149.8). Elba (184.5) had the highest number of healthy bulbs, followed by Algonquin (174.3).

Marketable yield was estimated using the average yield of healthy bulbs. Algonquin had the highest estimated marketable yield (266 cwt/A) in the trial, followed by Cayuga (257 cwt/A) and the standard NY Early (252 cwt/A). Elba (216 cwt/A), and Iroquois (181 cwt/A) yielded lower than the trial average.

The percentage of the total bulb weight that were culls ranged from 6.8 to 38.6% per variety (Table 1). Elba notably had the lowest proportion of culls (6.8%), followed by Algonquin (13.0%). The standard NY Early had 20.8% culls, which was similar to Cayuga (18.9%) and YIX S7G (17.9%). Iroquois notably had 38.6% culls, which explains why it had a very low marketable yield. Almost all culls were due to rots caused by *Botrytis allii* (i.e. neck rot). Onion maggot damage out of the field was less than 4.0% of the culls for all of the varieties. Elba notably had no onion maggot damage.

The bulb size distribution by weight of the standard NY Early was 0.8% small, 3.5% medium, 61.6% large and 34.1% jumbo (Figure 1). All varieties had less than 3% of the marketable weight as small bulbs. Medium bulb size distribution ranged from 2.9% to 13.1% of marketable weight, with Elba having notably the highest proportion of medium bulbs (13.1%). In all varieties, the majority of the marketable weight fell into the large bulb class and ranged from 50.9 to 80.6%. The two varieties that had the lowest percentage of marketable weight in the large bulb class, Iroquois and NY Early had the greatest proportion in the jumbo class of 46.2% and 34.1%, respectively. Algonquin (22.1%), YIX S7G (19.2%) and Cayuga (20.0%) all had about 20% of the marketable weight in the jumbo bulb class, while Elba notably had the least at 3.8%.

#### Storage Evaluation (Table 2):

Bulb characteristics of the varieties evaluated were all acceptable, with no variety scoring below 7.0 out of 9.0. Elba had the best scores for shape uniformity (9.0), peelers (9.0) and firmness (9.5) and a best total score of 42.5, which was the same as the standard, NY Early. NY Early had the best color (9.0) and Algonquin had the best neck quality (9.0). Cayuga had the overall lowest score for bulb characteristics (37) with the lowest scores in shape uniformity (7.0), color (7.0), peelers (7.0) and neck quality (7.0). Elba (7.0) also received a lower score for neck quality, while Algonquin (7.0) and YIX S7G (7.0) also received low scores for peelers and color, respectively.

After three months in storage, only 53.1% of the bulbs in the trial were sound with neck rot being the major cause of culls (73.8%) (Table 2). Elba had the highest percentage of sound bulbs coming out of storage (76.5%), while the standard, NY Early, had the least (37.0%). Iroquois (43.5%) and Algonquin (42.4%) also had less than 50% sound bulbs out of storage. Algonquin was the most susceptible to neck rot, but did not have any other disease problems in storage. Elba was the least susceptible to neck rot. NY Early and Cayuga also had *Fusarium* basal rot and bacterial problems in addition to Neck Rot. Iroquois also had bacterial problems in addition to neck rot. Algonquin and YIX S7G had no bacterial problems. NY Early was the only variety that had onion maggot damage out of storage.

A sub-sample of 10 healthy bulbs was cut in half to evaluate internal quality. Iroquois (80%) and YIX S7G (60%) had a very high proportion of double centered bulbs. NY Early had no double centers while all other varieties had 10-30% double centers.

By taking both external and internal sprouting into consideration as the main indicator of storability, the order of storability from shortest to longest is Elba, YIX S7G, Iroquois, NY Early, Algonquin, and Cayuga.

#### **Variety Summaries:**

##### Algonquin:

Earliest maturity in the trial, just ahead of NY Early. Highest marketable yield, and second highest number of bulbs at harvest, due to second lowest percent cull weight out of the field. Average bulb

size distribution of 4.0 : 73.2 : 22.1 med:large:jumbo. Good score for bulb characteristics - tightest necks in the trial, a few peelers. Algonquin had the second longest storability in the trial. Lost 57.6% of bulbs out of storage, almost exclusively to neck rot (98.1%), no bacterial or Fusarium basal rot out, 30% double centers.

*Summary: good yield and bulb characteristics, lot's of rot*

NY Early: Industry standard. Matured before all varieties except Algonquin. Third highest marketable yield, second lowest bulb count at harvest, average cull weight mostly due to neck rot. Excellent bulb distribution of 3.5 : 61.6 : 34.1 med:large:jumbo. Top score for bulb characteristics - overall best color. NY Early had the third-longest storability in the trial. Lost the most bulbs out of storage (63%) due mostly to neck rot (77.3%), but also to bacterial disease (11.3%), onion maggot (6.2%), and Fusarium basal rot. No double centers.

*Summary: best yield, good bulb characteristics, big bulbs, lot's of rot out of storage.*

#### Iroquois:

Matured at about the same time as NY Early. Lowest marketable yield and bulb count at harvest due to highest cull weight (38.6%) in the trial, which was almost exclusively due to neck rot. Best bulb size distribution in the trial, with 2.9 : 50.9 : 46.2 med:large:jumbo. Second highest score for bulb characteristics - good scores for all characteristics. Iroquois had the fourth longest storability in the trial. Lost 56.5% of bulbs out of storage mostly due to neck rot (77.1%), but also to bacterial disease (11.4%) and sprouts (11.4%). 80% double centers- highest in trial.

*Summary: low yield, high cull out, big bulbs with good characteristics, lot's of rot and double centers*

#### YIX S7G:

Matured later than NY Early and Iroquois. Average marketable yield, bulb count, and cull weight at harvest. Culls due to neck rot. Average bulb size distribution - 2.9 : 77.9 : 19.2 med:large:jumbo. Average score for bulb characteristics - one of lower scores in trial for color. YIX S7G had the second shortest storability in the trial. Lost 38% of bulbs out of storage to neck rot (68.4%) and sprouts (3.6%). High proportion of double centers (60%).

*Summary: average yield and bulb size distribution, double centers, not as much rot.*

#### Cayuga:

Matured later than YIX S7G. Second highest marketable yield, third highest bulb count and average cull loss at harvest. Average bulb size distribution - 5.2 : 74.2 : 20.0 med:large:jumbo. Lowest score for bulb characteristics - lowest score in trial for shape uniformity, color, peelers, and neck quality. Longest storing variety in the trial. Lost 42.9% bulbs out of storage, primarily to neck rot (84.4%), but also to bacterial disease (4.4%) and Fusarium basal rot (2.2%). 10% double centers.

*Summary: good yield, average bulb size distribution, poorer bulb characteristics*

#### Elba:

Last variety to mature in this trial. Second lowest marketable yield, lowest bulb count and lowest cull weight (6.8%) at harvest. Bulb distribution towards large and medium classes- 13.1 : 80.6 : 3.8 med:large:jumbo. Highest score for bulb characteristics - best shape uniformity, fewest peelers, and hardest onions in trial. Elba had the shortest storage life in the trial. Lost the least amount of bulbs out of storage (23.5%), mostly due to sprouts (58.3%) but also to neck rot (37.5%). 30% double centers.

*Summary: small bulbs good quality, does not store well, less rots.*

#### **Acknowledgements:**

This project was funded by the Public Seed Initiative and Northeast Organic Farming Association of New York. Special thanks to Karie Myers for her assistance on this project.

Table 1. Harvest Assessment of Yellow Pungent Onion Varieties Grown Organically - Lodging and Yield

Variety <sup>1</sup>	% Lodging (10-Aug) <sup>2</sup>	Harvest (27-Oct)						
		Avg. # marketable bulbs <sup>2</sup>	Avg. wt. (lb) <sup>2</sup>	Est. Marketable Yield <sup>3</sup> (cwt/A)	% culls of total wt.	% of culls		
						OM <sup>7</sup>	rots <sup>6</sup>	double <sup>8</sup>
Algonquin	35.0	174.3	<b>61.1</b>	<b>266</b>	13.0	1.7	93.1	5.2
NY Early (std.)	30.0	149.8	57.7	252	20.8	3.7	96.3	0.0
Iroquois	27.5	<u>96.2</u> <sup>4</sup>	<u>41.6</u>	<u>181</u>	<u>38.6</u>	2.4	97.6	0.0
YIX S7G	10.0	165.1	56.2	245	17.1	3.2	96.8	0.0
Cayuga	5.0	169.1	59.0	257	18.9	1.8	96.3	1.9
Elba	1.0	<b>184.5</b>	49.6	216	<b>6.8</b>	0.0	100.0	0.0
<b>Trial Average</b> <sup>5</sup>	<b>18.1</b>	<b>156.5</b>	<b>54.2</b>	<b>236</b>	<b>19.2</b>	<b>2.1</b>	<b>96.7</b>	<b>1.2</b>

<sup>1</sup> Varieties listed in order of maturity.

<sup>2</sup> Average of two replicates. A replicate is 4x20 foot rows of onions.

<sup>3</sup> Estimated marketable yield = average yield (lb) x 43 560/ 100 ft<sup>2</sup>\* /100 lb; \*replicate size

<sup>4</sup> Underlined numbers indicated the poorest result in each column. **Bolded** numbers indicate the best result in each column.

<sup>5</sup> Trial Average across all varieties. Compare a single variety to the trial average.

<sup>6</sup> Rots were primarily caused by *Botrytis allii* (i.e. Neck Rot).

<sup>7</sup> OM: Onion maggot.

<sup>8</sup> Double centers.

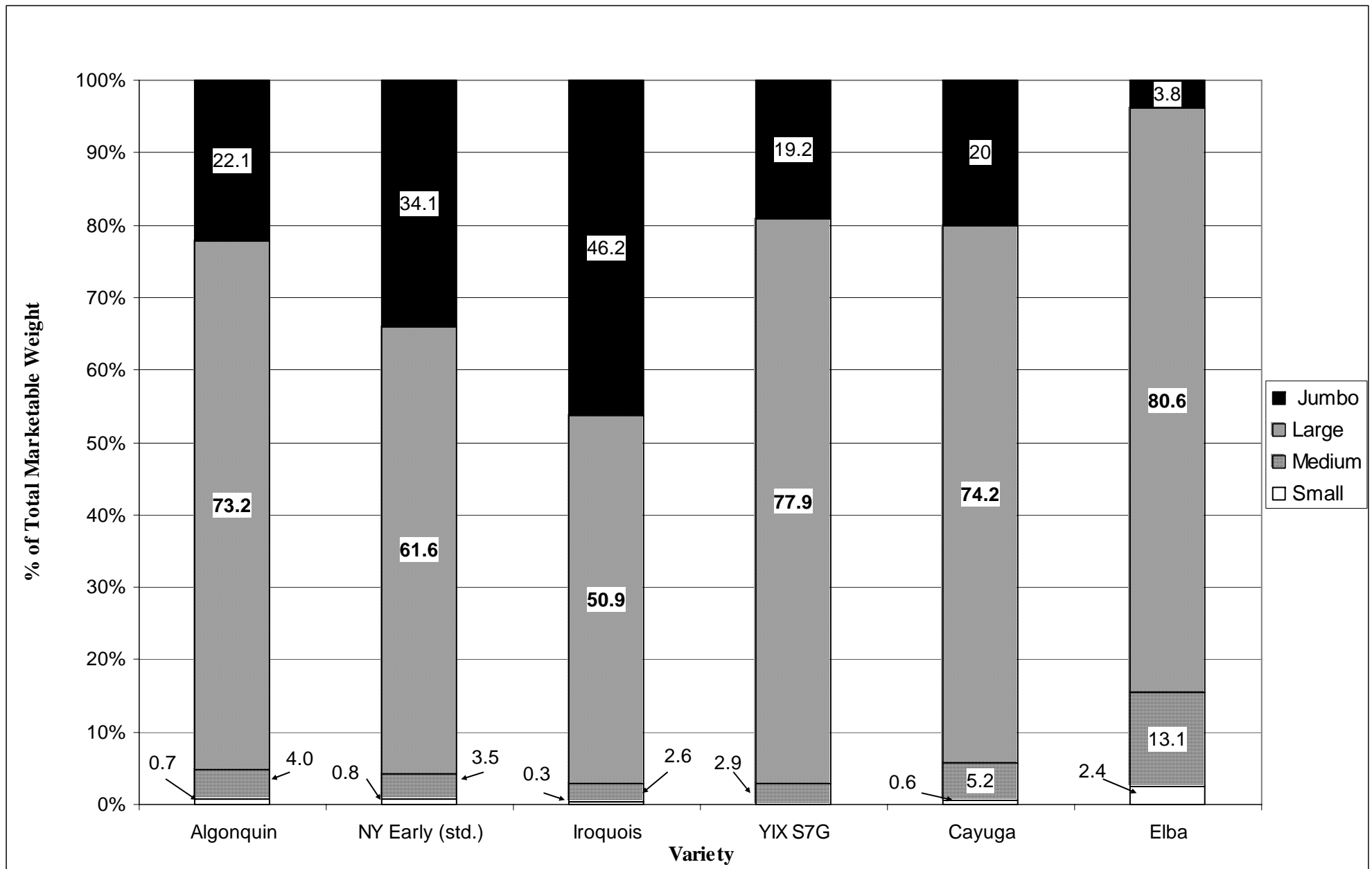


Figure 1. Harvest Assessment of Yellow Pungent Onion Varieties Grown Organically- Bulb Size Distribution.

Table 2. Storage Evaluation of Yellow Pungent Onion Varieties Grown Organically. Onions evaluated on 19-Jan 2005.

Bulb Characteristics						Bulb quality									Total # bulbs assessed
Variety	Shape uniformity <sup>1</sup>	Color <sup>1</sup>	Peelers <sup>1</sup>	Firmness <sup>1</sup>	Necks <sup>1</sup>	Total Score	Internal Quality <sup>7</sup>		% healthy	Culls (% of total bulbs)					
							% doubles	% sprouts		NR <sup>2</sup>	Fus <sup>3</sup>	Bac <sup>4</sup>	OM <sup>5</sup>	sprouts	
Algonquin	7.5	8.0	<u>7.0</u>	8.0	<b>9.0</b>	39.5	30.0	80.0	42.4	<u>98.1</u>	0.0	<b>0.0</b>	0.0	<b>1.9</b>	92
NY Early (std.)	8.0	<b>9.0</b>	8.0	9.0	8.5	<b>42.5</b>	<b>0.0</b>	80.0	<u>37.0</u>	77.3	<u>2.1</u>	<u>11.3</u>	<u>6.2</u>	3.1	154
Iroquois	8.0	8.0	8.0	8.0	7.5	39.5	<u>80.0</u>	<u>100.0</u>	43.5	77.1	0.0	11.4	0.0	11.4	105
YIX S7G	8.0	<u>7.0</u>	8.0	8.0	8.0	39.0	60.0	<u>100.0</u>	62.0	68.4	0.0	<b>0.0</b>	0.0	31.6	102
Cayuga	<u>7.0</u> <sup>6</sup>	<u>7.0</u>	<u>7.0</u>	9.0	<u>7.0</u>	<u>37.0</u>	10.0	<b>20.0</b>	57.1	84.4	2.2	4.4	0.0	8.9	100
Elba	<b>9.0</b> <sup>6</sup>	8.0	<b>9.0</b>	<b>9.5</b>	<u>7.0</u>	<b>42.5</b>	30.0	80.0	<b>76.5</b>	<b>37.5</b>	0.0	4.2	0.0	<u>58.3</u>	154
<b><i>Trial Average</i></b> <sup>8</sup>	<b>7.9</b>	<b>7.8</b>	<b>7.8</b>	<b>8.6</b>	<b>7.8</b>	<b>40.0</b>	<b>35.0</b>	<b>76.7</b>	<b>53.1</b>	<b>73.8</b>	<b>0.7</b>	<b>5.2</b>	<b>1.0</b>	<b>19.2</b>	<b>117.8</b>

<sup>1</sup> Based on a scale of 1 (poor) to 10 (excellent).

<sup>2</sup> **NR:** Neck Rot

<sup>3</sup> **Fus:** Fusarium Basal Rot

<sup>4</sup> **Bac:** Bacterial Rot, primarily sour skin

<sup>5</sup> **OM:** Onion Maggot

<sup>6</sup> Underlined numbers indicated the poorest result in each column. **Bolded** numbers indicate the best result in each column.

<sup>7</sup> Internal quality of a sub-sample of 10 bulbs cut in half.

<sup>8</sup> Trial Average across all varieties. Compare a single variety to the trial average.