

Organic Seed Partnership

Butternut Squash 2006 Replicated Trial Report

OSP Butternut Trial Collaborators:

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2006 Butternut Replicated Variety Trials

As part of the Organic Seed Partnership (OSP) we evaluated butternut varieties and advanced breeding lines in replicated trials at Cornell University, University of California at Davis, and WVSU. The objective of the trials was to compare Cornell PMR variety Bugle with standard butternut varieties Waltham and JWS 6823 PMR, and to evaluate the performance of several advanced Cornell breeding lines of large PMR butternuts as well as a novel mini-butternut. The sites included Cornell's Organic Research Farm in Freeville, NY, the UC Davis Student Farm and Pepper King Farm in Gallipolis Ferry, WV. All sites were either certified organic, or at the least managed organically.

2006 Butternut Replicated Trial Summary:

We got a good assessment of how these butternut squash varieties performed in NY, but excessive heat and drought posed problems at the WVSU and UC Davis locations. At Freeville Bugle did as well as JWS PMR 6823 and better than Waltham. In a year where powdery mildew is severe then we would expect the performance to be quite a bit better than the non-resistant Waltham. The 3 large size butternuts were indistinguishable from each other based on the parameters measures. There were few significant differences in performance among the varieties at WVSU, but overall yields were slightly lower and fruit was quite a bit smaller than at Freeville. In contrast, yields (number fruit and kg/plant) were remarkably high at UC Davis (e.g. 10-13 fruit/plant at UC Davis vs 3-4 fruit/plant at Freeville), but here again, the fruit was quite a bit smaller than the fruit harvested at Freeville and similar in size to the fruit harvested at WVSU. Growing time was slightly shorter at UC Davis and WVSU, which could partially explain this, but the extreme heat at both locations could have also been a factor affecting fruit size. Despite the small size of the fruit at UC Davis the total and marketable yields were quite high, 2-3 times as high as obtained in Freeville, due to the sheer number of fruit produced. It should be noted though that the number of plants that survived at UC Davis was low, 2-5 plants/variety, so there was less competition for water, nutrients and sunlight as compared to the other locations. Due to the low number of survivors it is not possible to make statistical comparisons at the UC Davis site. The mini-butternut performed best at Freeville with respect to the combination of number of fruit, size of fruit and BRIX rating. This variety has been released under the name of "Honey Nut" and is currently being sold by High Mowing Seeds <http://www.highmowingseeds.com/>.

Cornell University- Freeville Organic Vegetable Research Farm

Materials and Methods:

Plants were started in the greenhouse on May 1st and transplanted to the field on June 2nd. Each plot consisted of 12 plants in a raised bed with 1 plant per hill. In row plant spacing was 2 ft and between row spacing was 9 ft. Black plastic was used between rows. Soil type was Howard loam. Dairy compost was applied on May 8th at a rate of 5.4 tons/acre which is equivalent to 133 lbs of N per acre. All beds had drip irrigation, but because of a very wet season this was never used. Four applications of Pyganic were used to control cucumber beetle. Fruit was harvested on Sept 3rd from plants 2-11 leaving plants 1 and 12 as a buffer. Total number of fruit, marketable fruit, total yield, and marketable yield were recorded for each plot. A representative fruit from each plot was measured each week for size (length and width) and soluble solids using the BRIX test, which measure the sugars in the flesh.

Results:

Bugle and JWS PMR out yielded Waltham with respect to total fruit, but there were no significant differences in marketable fruit, total yield or marketable yield among the standard size or among the large size butternuts in this trial (Tables 1a and 1b). As expected, the mini-bitternut had higher numbers of smaller fruit than the standards or large sized butternuts (Table 1c).

Table 1a. Butternut yield, Cornell Organic Farm, Freeville NY

Standard size Butternuts*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
Waltham	2.6 b	1.5 a	3.4 a	2.0 a
JWS PMR 6823	3.6 a	1.6 a	3.5 a	1.6 a
Bugle	4.1 a	1.2 a	3.4 a	1.6 a
LSD**	0.9	0.9	1.3	0.7

Table 1b.

Large size Butternuts*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
NY05-118	2.3 a	0.5 a	4.2 a	0.9 a
NY05-116	2.1 a	0.4 a	4.0 a	0.8 a
NY05-127	2.2 a	0.4 a	3.4 a	0.7 a
LSD	0.5	0.4	1.3	0.8

Table 1c.

Mini-Butternut	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
NY05-131	3.7	2.1	1.6	1.1

*Varieties sorted by Marketable Yield

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other.

With respect to fruit characteristics, Bugle was significantly smaller (30% smaller) than Waltham (Table 2a). Of the large PMR butternuts, NY05-118 was significantly larger than NY05-116 and NY05-127 (Table 2b). There were no significant differences in soluble solids among the standard size and among the large size butternuts, however the standard size butternuts tended to have higher BRIX ratings than the large size butternuts. The mini-bitternut NY05-131 had a very high BRIX rating compared to the standard and large sized butternuts (Table 2c).

Table 2a. Butternut fruit characteristics, Cornell Organic Farm, Freeville NY

Standard size Butternuts*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
Waltham	1357.3 a	22.3 a	12.0 a	268.7 a	9.2 a
JWS PMR 6823	1061.7 a	21.2 a	10.3 b	219.4 ab	9.7 a
Bugle	1671.3 a	19.3 a	9.5 b	184.0 b	8.2 a
LSD**	1207.7	3.4	1.6	63.4	1.8

Table 2b.

Large size Butternuts*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
NY05-118	1817.0 a	29.0 a	12.3 a	357.7 a	7.5 a
NY05-127	1648.7 a	21.7 b	13.0 a	280.0 b	7.7 a
NY05-116	1843.3 a	20.3 b	13.0 a	264.7 b	6.7 a
LSD**	530.6	2.7	2.4	48.9	1.7

Table 2c.

Mini-Butternut	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
NY05-131	1085.3	13.5	8.3	112.7	11.2

*Varieties sorted by Average Length x Average Width

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other.

West Virginia State University Organic Farm

Materials and Methods:

This trial was planted at the Pepper King Farm in Gallipolis Ferry, WV. The trial went well overall although there was heat and drought during July and August. Fruit were harvested on Sept 22nd. Total number of fruit, marketable fruit, total yield, and marketable yield were recorded for each plot. A representative fruit from each plot was measured each week for size (length and width) and soluble solids using the BRIX test, which measure the sugars in the flesh.

Results:

There were no significant differences in number of fruit or yield among the standard size butternuts or among the large size butternuts (Tables 3a and 3b). As expected, the mini-bitternut had higher numbers of smaller fruit than the standard size or large size butternuts (Table 3c). In general, yields were slightly lower than those obtained at the Freeville, NY location.

Table 3a. Butternut yield, WVSU

Standard size Butternuts*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg)	Marketable Yield (kg)
Bugle	3.1 a	2.7 a	1.1 a	1.1a
Waltham	1.4 a	1.2 a	0.9 a	0.9 a
JWS PMR 6823	2.3 a	1.6 a	0.9 a	0.9 a
LSD**	3.7	4.1	1.7	1.7

Table 3b.

Large size Butternuts*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg)
NY05-118	2.0 a	1.8 a	1.0 a	1.0 a
NY05-116	1.8 a	1.6 a	1.0 a	1.0 a
NY05-127	1.6 a	1.4 a	0.9 a	0.9 a
LSD**	3.2	3.3	1.7	1.7

Table 3c.

Mini-Butternut	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg)
NY05-131	2.7	2.6	0.6	0.6

*Varieties sorted by Marketable Yield

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other.

There were also no significant differences in fruit characteristics among the standard size or among the large size butternuts except that NY05-118 was significantly larger overall than NY05-116 (Tables 4a and 4b). There were no significant differences in soluble solids among the standard size and among the large size butternuts; however the standard size butternuts tended to have higher BRIS ratings than the large size butternuts. The mini-butternut NY05-131 had a very high BRIS rating compared to the standard size and large size butternuts (Table 4c). Overall the fruit weighed considerably less than the fruit harvested at the NY location weighing in at about 45-74% less than the standard sized, 57-67% less than the large sized and 80% less than the mini sized fruit harvested in the trial at the Freeville Organic Farm. This is likely attributable to the excessive heat and drought during the growing season. Soluble solids were not affected by the adverse conditions as the BRIS scores were equal to or higher than those obtained at the Freeville location.

Table 4a. Butternut fruit characteristics, WVSU

Standard size Butternuts*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIS)
Waltham	752.0 a	18.6 a	8.9 a	165.5 a	9.0 a
Bugle	438.5 a	16.2 a	7.3 a	118.2 a	11.0 a
JWS 6823	571.0 a	15.6 a	7.2 a	112.3 a	11.3 a
LSD**	435.3	5.2	2.1	69.1	7.0

Table 4b.

Large size Butternuts*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIS)
NY05-118	594.5 a	18.6 a	8.3 a	154.0 a	7.5 a
NY05-127	707.5 a	19.1 a	7.6 a	144.8 ab	10.0 a
NY05-116	622.5 a	15.8 a	7.5 a	117.3 b	8.0 a
LSD**	270.2	3.4	1.2	29.3	6.6

Table 4c.

Mini-Butternut	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
NY05-131	218.0	11.1	6.1	67.1	11.0

*Varieties sorted by Average Length x Average Width

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other.

University of California at Davis- UC Davis Student Farm

Materials and Methods:

Seed was planted directly in the field on June 30th. Within row spacing was 1 ft. and between row spacing was 5 ft. Feathermeal (12-0-0) was applied before sowing on June 28th at a rate of 10 lbs/200 ft. Underground irrigation was used twice a week. Soil type was Yolo Sandy loam and floating row cover was used for insect control. Fruit was harvested on Oct 10th. Total number of fruit, marketable fruit, total yield, and marketable yield were recorded for each plot. A representative fruit from each plot was measured each week for size (length and width). One fruit from each variety was tested for soluble solids using the BRIX test, which measures the sugars in the flesh.

Results:

Germination was poor because of problems with the irrigation and extreme hot weather (over 100° F) right after sowing. Only 2-5 plants/rep survived out of the 12 planted. Because of the low number of plants that survived no statistics were performed on the data. The plants that did survive produced many fruit with approximately 10-13 total fruit and approximately 6 marketable fruit per plant for the standard size varieties and 8-10 total fruit and 7-10 marketable fruit per plant for the large size varieties (Table 5a and 5b). However, overall the fruit were relatively very small, weighing in at about 27-72% less than the standard size, 42-68% less than the large sized and 76% less than the mini sized fruit harvested in the trial at Freeville, NY (Table 6a and 6b). Soluble solids were comparable to those obtained at the Freeville location. JWS PMR 6823 and NY05-127 were rated the best overall for the standard and large size butternuts. Bugle had an unusually low BRIX rating of 5.5. As expected, the mini-bitternut had higher numbers of smaller fruit with a higher BRIX rating than the standards or large sized butternuts (Tables 5c and 6c).

Table 5a. Butternut yield, UC Davis Student Farm, California

Standard size Butternuts*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
Waltham	10.2	9.6	6.6	6.5
JWS PMR 6823	9.7	8.7	6.9	6.7
Bugle	13.2	13.2	5.8	5.8

Table 5b.

Large size Butternuts*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
NY05-127	7.8	7.7	8.0	8.0
NY05-116	7.8	7.1	4.4	4.2
NY05-118	10.0	9.8	6.4	6.2

Table 5c.

Mini-Butternut	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
NY05-131	12.6	10.1	2.6	2.3

*Varieties sorted by Marketable Yield.

Table 6a. Butternut fruit characteristics, UC Davis Student Farm

Standard size Butternuts*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
Waltham	674.3	18.2	9.3	168.3	9.5
JWS 6823	776.7	16.9	9.7	165.6	12.0
Bugle	464.5	16.5	8.9	146.8	5.5

Table 6b.

Large size Butternuts*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
NY05-127	1056.7	18.6	11.0	202.7	8.7
NY05-118	560.5	17.1	9.5	164.4	6.2
NY05-116	535.0	14.6	10.2	150.0	8.6

Table 6c.

Mini-Butternut	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Average Length x Average Width	Soluble Solids (BRIX)
NY05-131	237.0	12.7	7.4	94.4	10.0

*Varieties sorted by Average Length x Average Width