

2010 Report to the Pennsylvania Vegetable Research and Marketing Board

Keeping PA Vegetable Growers Profitable: Statewide Cultivar Trials

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To provide growers with information for successful, region specific cultivar selection, in 2010, we evaluated several acorn, butternut, spaghetti squash, kabocha and other types of winter squash cultivars grown in a conventional plasticulture system across the state. Evaluations were located in central Pennsylvania at the Russell E. Larson Research and Education Center in Rock Springs, in eastern Pennsylvania at the Southeast Research and Extension Center in Landisville and in western Pennsylvania at Beinlich Farms. Additionally, butternut and acorn cultivars grown in an organic plasticulture system were trialed at the Russell E. Larson Research and Education Center, Rock Springs.

Please note that 8 cultivars of pumpkin were suggested to be evaluated. Those cultivars were included and are reported in the pumpkin disease resistance and general variety trial by Tim Elkner and Tom Butzler.

The cultivars trialed in the conventional system along with the company from which seed were acquired from are listed below. The standards 'Vegetable Spaghetti' in the spaghetti category, 'Waltham Butternut' in the butternut category and 'Tay Belle' in the acorn category were grown for comparisons.

Cultivar	Seed Company	Type of winter squash
Bush Delicata	Stokes Seeds	Other - Delicata
Red October	Stokes Seeds	Other – orange/red Hubbard
Golden Delicious	Rupp Seeds Inc	Other – orange/red Hubbard
Butternut Supreme	Rupp Seeds Inc	Butternut
Bugle	Rupp Seeds Inc	Butternut
Betternut 401	Rupp Seeds Inc	Butternut
Sun Spot	Rupp Seeds Inc	Other – orange/red Buttercup
Harlequin	Rupp Seeds Inc	Acorn
Table Star	Rupp Seeds Inc	Acorn
Space Station	Rupp Seeds Inc	Kabocha
Thunder	Rupp Seeds Inc	Kabocha
Sweet Lightning	Rupp Seeds Inc	Other - Delicata
Autumn Delight	Seedway, LLC	Acorn
Tay Belle	Seedway, LLC	Acorn
Celebration	Seedway, LLC	Acorn
Sweet Mama	Seedway, LLC	Kabocha
Atlas	Seedway, LLC	Butternut
Tivoli	Seedway, LLC	Spaghetti

Honey Bear	Johnny's Selected Seeds	Acorn
Jet	Johnny's Selected Seeds	Acorn
Tip Top (PMR)	Johnny's Selected Seeds	Acorn
Red Kuri	Johnny's Selected Seeds	Kabocha
Sunshine	Johnny's Selected Seeds	Kabocha
Cha-cha	Johnny's Selected Seeds	Kabocha
Bonbon	Johnny's Selected Seeds	Kabocha
JWS 6823 (PMR)	Johnny's Selected Seeds	Butternut
Metro (PMR)	Johnny's Selected Seeds	Butternut
Waltham Butternut	Johnny's Selected Seeds	Butternut
Spaghetti Squash	Johnny's Selected Seeds	Spaghetti
Piñata	neseed.com	Other - Delicata
Speckled Pup (PMT)	neseed.com	Other – mini Kabocha

The cultivars trialed in the organic system along with the company from which seed were acquired from are listed below. The standards 'Waltham Butternut' in the butternut category and 'Tay Belle' in the acorn category were grown for comparisons.

Cultivar	Seed Company	Type	Organic or Non-treated Seed
Waltham Butternut	Seedway, LLC	Butternut	Organic
Celebration	Seedway, LLC	Acorn	Non-treated
Autumn Delight	Seedway, LLC	Acorn	Non-treated
Tay Belle	Seedway, LLC	Acorn	Non-treated
Betternut 401	Rupp Seeds Inc	Butternut	Non-treated
Metro	Johnny's Selected Seeds	Butternut	Non-treated
JWS 6823	Johnny's Selected Seeds	Butternut	Non-treated
Honey Bear	Johnny's Selected Seeds	Acorn	Non-treated
Tip Top	Johnny's Selected Seeds	Acorn	Non-treated
Jet	Johnny's Selected Seeds	Acorn	Non-treated
Table Queen	High Mowing Seeds	Acorn	Organic
REBA	High Mowing Seeds	Acorn	Organic

At all locations winter squash cultivars were grown in a plasticulture system using raised beds, drip irrigation and black plastic. Three foot in row spacing and 8 foot center-to-center rows were used. At the central Pennsylvania 4-week-old transplants were planted on June 17, 2010 in the conventional system and 5-week-old transplants were planted on May 28 and 29, 2010 in the organic system. Direct seeding was used in the western and south eastern sites.

Fruit were harvested when all plants of an individual cultivar reached maturity. Fruit was categorized as marketable or unmarketable, counted and weighed. Yield data was analyzed using analysis of variance. When P values were less than or equal to 0.05, means were separated using Duncan's LSD test.

Results

Organic Trial

All butternut and acorn squash were harvested on Sept. 9, 2010.

Butternut Squash

Marketable and Unmarketable Yields (Table 1)

'JWS 6823' and 'Butternut 401' produced a larger number of fruit than 'Waltham Butternut' and 'Metro'. All cultivars produced similar yields in terms of weight of fruit.

Very few butternut squash were unmarketable. Differences in unmarketable yields between cultivars were not detected.

Acorn Squash

Acorn squash were harvested on Sept. 9, 2010.

Marketable and Unmarketable Yields (Table 2)

'Celebration' produced a larger number of fruit than 'Tay Belle'. 'REBA', 'Table Queen', 'Honey Bear' and 'Jet' did not produce fruit numbers different than 'Tay Belle'. Fruit numbers from 'Tip Top' and 'Autumn Delight' were smaller than 'Tay Belle'.

In terms of weight, 'Tay Belle' yields were higher than all other cultivars. 'Tay Belle' was followed by 'Celebration' and 'Jet' which produced higher yields than 'Tip Top'. 'Autumn Delight', 'Table Queen' and 'REBA' yields were not different from 'Celebration', 'Jet' or 'Tip Top'. 'Honey Bear' produced the lowest yields in terms of weight.

Very few acorn squash were unmarketable. Differences in unmarketable yields between cultivars were not detected.

Conventional Trial

Squash were directly seeded about 3 weeks late in the western Pennsylvania site. The site experienced a crop failure as by July 21, 2010 each plot averaged only 2 plants.

Interaction between location and cultivar were detected and therefore statistics for each site were analyzed separately.

Spaghetti Squash – Rock Springs, PA

Spaghetti squash were harvested on Aug. 19, 2010.

Marketable and Unmarketable Yields (Table 3)

The performance of 'Vegetable Spaghetti' and 'Tivoli' were not different from each other in terms of marketable or unmarketable yields.

Spaghetti Squash – Landisville, PA

Marketable and Unmarketable Yields (Table 4)

The performance of 'Vegetable Spaghetti' and 'Tivoli' were not different from each other in terms of marketable or unmarketable yields.

Butternut Squash – Rock Springs, PA

Butternut squash were harvested on Sept. 1 and 7, 2010.

Marketable and Unmarketable Yields (Table 5)

The largest numbers of fruit were from 'Bugle' followed by 'Butternut 401'. All other cultivars produced numbers of fruit not different from 'Waltham Butternut'. 'Atlas' produced the largest fruit by weight. Fruit weight from all other cultivars was not different from 'Waltham Butternut'.

Very few butternut squash were unmarketable. Differences in unmarketable yields between cultivars were not detected.

Butternut Squash – Landisville, PA

Marketable and Unmarketable Yields (Table 6)

The number of fruit produced by 'JWS 6823', 'Butternut 401', 'Metro' and 'Bugle' was not different than by 'Waltham Butternut'. 'Butternut Supreme' and 'Atlas' produced fewer fruit than 'Waltham Butternut'. Fruit from 'Atlas' was heavier than from 'Waltham Butternut'. The fruit weight from all other cultivars was not different than from 'Waltham Butternut'.

'Atlas' produced more culls in terms of number and weight than all other cultivars which were not different from each other.

Acorn Squash – Rock Springs, PA

Acorn squash were harvested on Aug. 30 and Sept. 3 and 7, 2010.

Marketable and Unmarketable Yields (Table 7)

'Harlequin' and 'Celebration' produced higher numbers of fruit than 'Tay Belle'. All other cultivars produced fruit numbers not different than 'Tay Belle'. In terms of fruit weight, 'Autumn Delight', 'Harlequin', 'Table Star' and 'Jet' were not different from 'Tay Belle'. The fruit weight of all other cultivars was lower than 'Tay Belle'.

'Table Star' produced more culls in terms of number and weight than all other cultivars which were not different from each other.

Acorn Squash – Landisville, PA

Marketable and Unmarketable Yields (Table 8)

'Harlequin', 'Table Star', 'Celebration' and 'Honey Bear' produced more marketable fruit than 'Tay Belle'. The remaining cultivars produced fruit numbers not different than 'Tay Belle'. 'Jet' fruit weighed more than did fruit from 'Tay Belle'. 'Autumn Delight' fruit weight was not different than from 'Tay Belle'. Fruit weight from the remaining cultivars was less than from 'Tay Belle'.

'Tay Belle', 'Harlequin', 'Honey Bear' and 'Tip Top' produced the largest number of culls. Culls from the remaining cultivars were fewer than from 'Tay Belle'. By weight, 'Tay Belle' produced the highest amount of culls of all cultivars.

Kabocha and Other Types of Winter Squash – Rock Springs, PA

Kabocha and other types of winter squash were harvested on Sept. 1, 2, 3 and 7, 2010.

Marketable and Unmarketable Yields (Table 9)

'Sweet Lightning' produced more fruit than all other cultivars followed by 'Sunspot' and then 'Red Kuri'. 'Sunshine', 'Sweet Mama', 'Space Station', 'Bonbon' and 'Thunder' produced fruit numbers which were not different from each other or 'Red Kuri' or 'Cha-cha'. 'Cha-cha' produced the fewest number of fruit. By weight, 'Sweet Lightning' and 'Red Kuri' fruit yield was heavier than from 'Space

Station', 'Thunder', 'Bonbon' and 'Cha-cha'. The remaining cultivars produced an intermediate amount of fruit by weight.

'Bonbon' produced the highest number of culls followed by 'Cha-cha'. 'Red Kuri' and 'Sweet Lightning' produced no culls. The remaining cultivars produced an intermediate amount of culls. In terms of fruit weight, 'Bonbon' produced the most culls followed by 'Cha-cha', 'Thunder', 'Space Station' and 'Sweet Mama' which were not different from each other. 'Sunshine', 'Sun Spot', 'Red Kuri' and 'Sweet Lightning' produced the fewest culls by weight.

Kabocha Squash – Landisville, PA

Marketable and Unmarketable Yields (Table 10)

'Bonbon' produced the greatest number of marketable fruit followed by all other cultivars which were not different from each other. 'Sweet Mama' produced the highest yield by weight followed by 'Sunshine' and 'Space Station' and then 'Bonbon', 'Thunder' and 'Cha-cha'.

'Cha-cha' produced a greater amount of culls than 'Thunder', 'Sweet Mama' and 'Sunshine'. The remaining cultivars produced an intermediate number of culls. Differences in unmarketable yields in terms of fruit weight were not detected.

Other Types of Winter Squash – Landisville, PA

Marketable and Unmarketable Yields (Table 11)

'Sweet Lightning' produced a greater number of marketable fruit than 'Bush Delicata' and 'Sun Spot', which were not different from each other, and 'Red Kuri', which produced the fewest marketable fruit. 'Piñata' produced an intermediate number of fruit which was not different from 'Sweet Lightning', 'Bush Delicata' or 'Sun Spot'. Fruit yield by weight was highest from 'Red Kuri' followed by 'Sun Spot'. 'Piñata', 'Bush Delicata' and 'Sweet Lightning' produced the lowest yields by weight, which were not different from each other.

Differences in unmarketable yields in terms of fruit number or weight were not detected.

Conclusions

In the 2011 growing season we hope to conduct these trials again to verify repeatability of these results. Until then it is difficult to draw conclusions. However, cultivar performance depended on location and growing system and recommendations will differ based on location and system used.

In an organic system, tentatively it appears that the performance of 'JWS 6823' and 'Betternut 401' butternut squash is not different than 'Waltham Butternut'. 'Celebration', 'Jet', 'Table Queen' and 'REBA' may be recommended acorn cultivars.

In conventional systems in central Pennsylvania, all butternut squash cultivars evaluated seem to perform comparably to 'Waltham Butternut'. 'Autumn Delight', 'Harlequin', 'Table Star' and 'Jet' appear to be high yielding acorn squash cultivars.

In conventional systems in southeastern Pennsylvania, 'JWS 6823', 'Betternut 401', 'Metro' and 'Bugle' appear to have high promise for butternut squash. For acorn squash 'Jet' and 'Autumn Delight' performed comparably to 'Tay Belle'.

In the spaghetti squash category, 'Tivoli' performed as well as 'Vegetable Spaghetti' at both locations.

It is difficult to make tentative recommendations in the kabocha/other squash category because ornamental value is a larger consideration in selecting these types. However, 'Cha-cha' produced a large amount of culls in both locations.

Table 1. Number and weight of marketable and unmarketable organically grown butternut squash, Rock Springs, PA; 2010

(Note: blue color indicates standard cultivar)

Butternut squash cultivar	Mean number of marketable fruit/plant P=0.0019	Mean weight of marketable fruit/plant (lbs) P=0.1535	Mean number of unmarketable fruit/plant P=0.4799	Mean weight of unmarketable fruit/plant (lbs) P=0.4799
JWS 6823	4.23a	8.33	0.00	0.00
Betternut 401	4.05a	7.98	0.00	0.00
Waltham Butternut	3.08b	7.63	0.00	0.00
Metro	2.55b	4.15	0.05	0.05

Table 2. Number and weight of marketable and unmarketable organically grown acorn squash, Rock Springs, PA; 2010

(Note: blue color indicates standard cultivar)

Acorn squash cultivar	Mean number of marketable fruit/plant P=0.0002	Mean weight of marketable fruit/plant (lbs) P<0.0001	Mean number of unmarketable fruit/plant P=0.3496	Mean weight of unmarketable fruit/plant (lbs) P=0.3674
Celebration	5.53a	6.55b	0.00	0.00
Tay Belle	4.38b	7.08a	0.00	0.00
REBA	4.27b	5.67bc	0.27	0.30
Table Queen	4.20bc	5.93bc	0.00	0.00
Honey Bear	4.05bcd	4.40d	0.00	0.00
Jet	3.83bcd	6.48b	0.10	0.13
Tip Top	3.48cd	5.38c	0.00	0.00
Autumn Delight	3.40d	6.03bc	0.00	0.00

Table 3. Number and weight of marketable and unmarketable conventionally grown spaghetti squash, Rock Springs, PA; 2010

(Note: blue color indicates standard cultivar)

Butternut squash cultivar	Mean number of marketable fruit/plant P=0.2921	Mean weight of marketable fruit/plant (lbs) P=0.4398	Mean number of unmarketable fruit/plant P=0.3910	Mean weight of unmarketable fruit/plant (lbs) P=0.1801
Vegetable Spaghetti	5.65	2.78	0.08	0.08
Tivoli	3.83	2.18	0.05	0.03

Table 4. Number and weight of marketable and unmarketable conventionally grown spaghetti squash, Landisville, PA 2010

(Note: blue color indicates standard cultivar)

Butternut squash cultivar	Mean number of marketable fruit/plant P=0.0890	Mean weight of marketable fruit/plant (lbs) P=0.1583	Mean number of unmarketable fruit/plant P=0.6461	Mean weight of unmarketable fruit/plant (lbs) P=0.8657
Vegetable Spaghetti	6.20	3.45	1.35	4.28
Tivoli	5.30	3.70	1.00	3.60

Table 5. Number and weight of marketable and unmarketable conventionally grown butternut squash, Rock Springs, PA; 2010

(Note: blue color indicates standard cultivar)

Butternut squash cultivar	Mean number of marketable fruit/plant P<0.0001	Mean weight of marketable fruit/plant (lbs) P=0.0079	Mean number of unmarketable fruit/plant P=0.0602	Mean weight of unmarketable fruit/plant (lbs) P=0.1703
Bugle	6.35a	2.01bc	0.10	0.10
Betternut 401	4.90b	2.43ab	0.00	0.00
Waltham Butternut	3.78c	2.03bc	0.00	0.00
JWS 6823	3.73c	1.78c	0.00	0.00
Metro	3.58c	1.64c	0.00	0.00
Butternut Supreme	3.35c	2.11bc	0.00	0.00
Atlas	2.70c	2.78a	0.00	0.00

Table 6. Number and weight of marketable and unmarketable conventionally grown butternut squash, Landisville, PA; 2010

(Note: blue color indicates standard cultivar)

Butternut squash cultivar	Mean number of marketable fruit/plant P=0.0007	Mean weight of marketable fruit/plant (lbs) P<0.0001	Mean number of unmarketable fruit/plant P=0.0110	Mean weight of unmarketable fruit/plant (lbs) P<0.0001
JWS 6823	6.65a	2.15b	1.23b	2.70b
Betternut 401	6.45a	2.55b	1.70b	3.68b
Metro	6.20a	2.58b	1.35b	2.63b
Waltham Butternut	5.85a	2.90b	1.63b	4.35b
Bugle	4.83ab	2.05b	1.68b	2.98b
Butternut Supreme	3.98bc	2.63b	1.08b	3.20b
Atlas	2.45c	8.00a	2.93a	19.60a

Table 7. Number and weight of marketable and unmarketable conventionally grown acorn squash, Rock Springs, PA; 2010

(Note: blue color indicates standard cultivar)

Acorn squash cultivar	Mean number of marketable fruit/plant P<0.0001	Mean weight of marketable fruit/plant (lbs) P<0.0001	Mean number of unmarketable fruit/plant P=0.0056	Mean weight of unmarketable fruit/plant (lbs) P=0.0060
Harlequin	8.08a	1.71abc	0.00b	0.00b
Celebration	7.43ab	1.54cd	0.05b	0.03b
Table Star	6.60bc	1.59bcd	0.68a	0.95a
Autumn Delight	5.90cd	1.93a	0.05b	0.03b
Tay Belle	5.88cd	1.9ab	0.27b	0.43b
Honey Bear	5.03d	1.05e	0.13b	0.03b
Tip Top	5.00d	1.32de	0.05b	0.03b
Jet	4.85d	1.59bcd	0.05b	0.05b

Table 8. Number and weight of marketable and unmarketable conventionally grown acorn squash, Landisville, PA; 2010

(Note: blue color indicates standard cultivar)

Acorn squash cultivar	Mean number of marketable fruit/plant P<0.0001	Mean weight of marketable fruit/plant (lbs) P<0.0001	Mean number of unmarketable fruit/plant P=0.0002	Mean weight of unmarketable fruit/plant (lbs) P<0.0001
Harlequin	12.58a	1.38d	2.10ab	1.05b
Table Star	12.15a	1.60c	0.60de	0.40cd
Celebration	11.78a	1.23de	1.28bcd	0.68bcd
Honey Bear	10.43ab	1.18e	1.78abc	0.83bc
Autumn Delight	8.35bc	1.93ab	0.28e	0.20d
Tip Top	7.95bc	1.60c	1.65abc	1.18b
Tay Belle	6.60c	1.85b	2.53a	2.05a
Jet	6.30c	2.05a	1.18cd	0.95bc

Table 9. Number and weight of marketable and unmarketable conventionally grown kabocha and other squash, Rock Springs, PA; 2010

Kabocha and other squash cultivar	Mean number of marketable fruit/plant P<0.0001	Mean weight of marketable fruit/plant (lbs) P=0.0003	Mean number of unmarketable fruit/plant P<0.0001	Mean weight of unmarketable fruit/plant (lbs) P<0.0001
Sweet Lightening	7.20a	1.11a	0.00d	0.00c
Sun Spot	3.25b	0.91abc	0.30cd	0.28c
Red Kuri	2.05c	1.09a	0.00d	0.00c
Sunshine	1.50cd	0.90abc	0.25cd	0.43c
Sweet Mama	1.40cd	0.97ab	0.53bc	1.70b
Space Station	1.23cd	0.61bcd	0.70bc	1.73b
Bonbon	1.10cd	0.51d	1.75a	5.33a
Thunder	0.95cd	0.57cd	0.75bc	2.13b
Cha-cha	0.53d	0.29d	0.88b	2.33b

Table 10. Number and weight of marketable and unmarketable conventionally grown kabocha squash, Landisville, PA; 2010

Kabocha squash cultivar	Mean number of marketable fruit/plant P=0.0066	Mean weight of marketable fruit/plant (lbs) P<0.0001	Mean number of unmarketable fruit/plant P=0.0110	Mean weight of unmarketable fruit/plant (lbs) P=0.1646
Bonbon	6.48a	4.05c	1.65abc	6.25
Thunder	4.30b	4.00c	1.35bc	4.73
Sunshine	4.28b	4.93b	0.88c	4.13
Space Station	3.78b	4.85b	1.95ab	6.45
Cha-cha	3.40b	3.95c	2.18a	7.25
Sweet Mama	3.35b	5.38a	1.03c	4.98

Table 11. Number and weight of marketable and unmarketable conventionally grown other types of winter squash, Landisville, PA; 2010

Other type of winter squash cultivar	Mean number of marketable fruit/plant P=0.0001	Mean weight of marketable fruit/plant (lbs) P<0.0001	Mean number of unmarketable fruit/plant P=0.4794	Mean weight of unmarketable fruit/plant (lbs) P=0.0569
Sweet Lightening	13.43a	0.90c	2.63	1.93
Piñata	11.33ab	1.23c	2.38	2.80
Bush Delicata	9.35b	1.13c	2.73	3.23
Sun Spot	9.23b	1.95b	1.50	2.40
Red Kuri	5.4c	4.63a	1.78	6.20