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Kabocha Squash Trials 2014-2016

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ABSTRACT

In 2014-2016, seventeen cultivars of kabocha squash were evaluated for yield and fruit characteristics. The trials were conducted at the Valley Laboratory in Windsor on a well-drained sandy terrace soil (Merrimac sandy loam) and at Lockwood Farm in Hamden on a moderately well drained loamy upland soil (Cheshire fine sandy loam). In 2014, eleven cultivars were evaluated at Windsor. In 2015 and 2016, the ten cultivars were evaluated at both Windsor and Hamden, four of which had been grown in 2014. The cultivars selected were either semi-bush or long-vined types.

In 2014, average yield of all eleven cultivars of butternut squash was 16.5 tons/acre (T/A) at Windsor. There was a crop failure in Hamden. At Windsor, Geisha (32.3 T/A) and Gold Nugget (28.7 T/A) were the highest yielding cultivars. The remaining cultivars produced less than 18 T/A. The high yield of Geisha was due to a combination of producing the second heaviest fruit in the trial (6.6 lb/fruit) with an average number of fruits per plant (2.7 fruit/plant). Gold Nugget produced the greatest number of fruit per plant with almost 10 fruit/plant, but the fruit was the smallest (1.6 lb/fruit).

In 2015, average yield of all ten cultivars of kabocha squash 15.1 T/A at Windsor compared to 9.7 T/A at Hamden. Combining both sites, yield of long-vined Sunshine averaged 18.0 T/A compared to 15.8 T/A for semi-bush Sweet Mama, the next highest yielding cultivar. High yields of Sunshine at both sites were due to heavier fruit. For Sweet Mama, yields were consistent between the two sites with less than 2 T/A difference between Hamden and Windsor.

In 2016, average yield of all ten cultivars of butternut squash 10.7 T/A at Windsor compared to 13.9 T/A at Hamden. Combining both sites, yield of long-vined Eclipse averaged 21.8 T/A compared to 19.7 T/A for semi-bush Sweet Mama, the next highest yielding cultivar. High yields of Eclipse at both sites were due to heavier fruit and slightly more fruit per plant. Sweet Mama produced the heaviest fruit of all the cultivars at both sites, averaging at least 0.5 lb/fruit more than the next heaviest cultivar.

Combining years 2015 and 2016 and both sites, Eclipse and Sweet Mama had the highest yields (17.4 T/A) and were the only cultivars over 14 T/A. Thus, yield was not reduced going from the vined variety Eclipse to the space saving semi-bush Sweet Mama. Sweet Mama produced slightly heavier fruit while Eclipse averaged slightly more fruit per plant. Sunshine is a good choice if a bright orange rind is desired and Winter Sweet produces a good crop of fruit with a gray rind. All cultivars produced excellent quality fruit at both sites during all three years.

INTRODUCTION

Kabocha, also known as buttercup squash (*Curcubita maxima*), is a type of winter squash. It is a member of the gourd family and is related to pumpkin and acorn squash. It is a staple of Japanese cuisine where it is a common ingredient in vegetable tempura and is also made into soup and croquettes. Here, it is commonly used in side dishes and soups, or as a substitute for potato or other squash varieties. Portuguese sailors introduced kabocha from Cambodia to Japan in 1541. The Portuguese name for the squash, Camboja abobora, was shortened by the Japanese to kabocha. Kabocha is hard on the outside with knobby-looking skin. It is shaped like a squat pumpkin and most often has a dull-finished, deep-green skin with whitish stripes and an intense yellow-orange color flesh.

Kabocha should be harvested after they achieve their characteristic blocky shape. The skin color should fade from bright green to a dullish dark green, and the stems will become corky. Kabocha is dry and bland tasting just harvested from the field. To fully ripen kabocha after harvesting, they are stored in a warm place (77°F) for at least two weeks to convert some of the starch to sugar. Then, they should be stored at least a month in a cool place (50°F) to increase the carbohydrate content. After these treatments, kabocha is sweet, similar in texture and taste to a pumpkin and sweet potato combined. Kabocha will keep for three months or longer when stored in a cool, dry place. Nutritionally, kabocha squash is an excellent source of vitamin A (it provides almost 300% of the daily value for a 2,000-calorie diet). It is also a good source of vitamin C and provides small amounts of iron, calcium, some B vitamins, potassium, and magnesium (Munro and Small 1997).

Winter squash in general are popular for fall sales at roadside stands and sales rooms because of their versatility and their storability. Home growers in the past have shunned winter squash because of their demand of garden space. New short-vined and bush types, developed in the last 20 years, have increased home gardener and small farmer interest.

Hill (1999) conducted trials in 1997-1998 of winter squash which included four cultivars of kabocha in Hamden and Windsor. In this bulletin, I report on yield and plant characteristics of 17 cultivars of kabocha grown at Hamden and Windsor in 2014-2016.

METHODS AND MATERIALS

Sites and soils: Kabocha squash trials were conducted for three years (2014-2016) at the Valley Laboratory in Windsor, CT on Merrimac sandy loam (Typic Dystrochrept), an inland sandy terrace soil with somewhat limited moisture holding capacity (Shearin and Hill, 1962); and at Lockwood Farm in Hamden, CT on Cheshire fine sandy loam (Typic Dystrochrept), a loamy upland soil with moderate moisture holding capacity (Reynolds, 1979).

Cultivars: Eleven cultivars were grown in 2014 at both sites. They were Autumn Cup, Eclipse, Space Station, and Sun Spot from Rupp Seeds; Confection, Geisha, Jade, Orange Dawn, and Speckled Pup from Holmes Seeds; Cha Cha from Johnny's Selected Seeds; Gold Nugget from Territorial Seeds. Ten cultivars were grown in 2015-2016 at both sites. They were Autumn Cup, Eclipse, Space Station, Super Delite, Sweet Mama, and Thunder from Rupp Seeds; Black Forest, Cha Cha, Sunshine, and Winter Sweet from Johnny's Selected Seeds. Characteristics of the specific cultivars are described in Table 1.

Culture: Kabocha was direct seeded in the field at both sites all three years. In 2014, kabocha was seeded on May 29 in Hamden and June 10 in Windsor. In 2015, kabocha was seeded on June 19 at both sites. In 2016, kabocha was seeded on June 14 in Windsor and June 15 in Hamden. Three seeds were planted in each of fifteen sites per cultivar. Sites were 3 feet apart in rows separated by 4 feet. Each row was covered with black plastic mulch (3 ft wide) applied by a tractor-pulled plastic layer. Drip irrigation tubing was laid as the plastic was applied. Holes were punctured in the plastic at each planting site when the seeds were planted.

Fertilization: The field soils (pH 6.5) were fertilized at a rate of 1300 lb/A 10-10-10 just before seeding. Different experimental fields at each location were used each year to minimize potential disease build-up.

Weed control: Weeds around each plant were controlled by the black plastic mulch. Weeds in the aisles were mechanically controlled 1-2 times before vines completely carpeted the aisles.

Insect and disease control: Insects and diseases were controlled by Manzate, (mancozeb), Quadris (azostobin), Asana (esferivaterate), and Bravo (chlorothalmil) applied per labeled

direction as needed throughout the growing season.

Irrigation: Water was supplied by drip irrigation at both sites in tubing laid when the plastic was applied. Plots were irrigated at both sites so that plots received at least 1 inch of water per week either through rainfall or irrigation.

Harvest: Kabocha were harvested in October each year at both sites. Fruits were counted, weighed, and evaluated for quality.

RESULTS AND DISCUSSION

2014 Crop: The average yield of all cultivars in Windsor was 16.5 T/A (Table 2). There was a crop failure in Hamden. The average weight of the fruit was 3.5 lbs at Windsor with two cultivars (Geisha and Jade) averaging over 6 lbs more per fruit. Gold Nugget and Sun Spot averaged less than 2 lb per fruit. The average number of fruit per plant was 3.2 with Gold Nugget producing almost 10 fruit per plant. The greatest yielding cultivar was Geisha (32.9 T/A). This was due to a combination of producing the second heaviest fruit in the trial (6.6 lb/fruit) with an average number of fruit per plant (2.7 fruit/plant). Gold Nugget produced the second highest yields (28.7 T/A) with almost 10 fruit/plant but the fruit was the smallest (1.6 lb/fruit). Eclipse (18.0 T/A) and Jade (16.5 T/A) produced the next highest yields with the remaining cultivars yielding less than 15 T/A. The lowest yielding cultivars were Confection (10.3 T/A) and Space Station (10.1 T/A). In both cases, low yields were mostly due to lower than average number of fruit per plant.

2015 Crop: The average yield of all cultivars in Hamden was 9.7 T/A compared to 15.1 T/A in Windsor, a 64% difference (Tables 3 and 4). The average weight of the fruit was 3.3 lbs at Hamden compared to 4.0 lbs at Windsor, a 21% difference. All the cultivars had heavier fruit at Windsor compared to Hamden, except for Eclipse where the weights were equal. The average number of fruit per plant was 1.6 at Hamden compared to 2.2 at Windsor, a 38% difference. Three cultivars (Autumn Cup, Black Forest, and Thunder) averaged more than 1 fruit per plant at Windsor compared to Hamden.

In Hamden, Sunshine averaged the highest yields (15.6 T/A) and Black Forest averaged the lowest yields (3.1 T/A), a 403% difference (Table 3). The yield of Sunshine was 5% greater than Sweet Mama, the cultivar with the second highest yields (14.9 T/A). Eclipse (12.3 T/A) and

Thunder (10.5 T/A) also averaged greater than 10 T/A. These four cultivars produced the heaviest fruit ranging from 4.1 to 3.6 lb/fruit. Sunshine and Sweet Mama averaged the greatest number of fruit per plant (2.1) while Black Forest produced less than one fruit/plant.

In Windsor, Sunshine averaged the highest yields (20.3 T/A) and Super Delite averaged the lowest yields (10.8 T/A), a 88% difference (Table 4). The yield of Sunshine was 6% greater than Thunder, the cultivar with the second highest yields (19.1 T/A). All cultivars averaged greater than 10 T/A with Autumn Cup (19.1 T/A) and Sweet Mama (16.7 T/A) averaging greater than 15 T/A. Cha Cha produced the heaviest fruit (6.4 lb/fruit) almost 2 lbs heavier than fruit from Winter Sweet (4.5 lb/fruit), the second heaviest fruit. Both cultivars averaged the fewest number of fruit per plant. Autumn Cup produced the greatest number of fruit per plant (3.5) and was the only cultivar averaged at least 3 fruit/plant.

2016 Crop: The average yield of all cultivars in Hamden was 13.9 T/A compared to 10.7 T/A in Windsor, a 30% difference (Tables 5 and 6). The average weight of the fruit was 3.6 lbs at Hamden compared to 3.9 lbs at Windsor with only 2 cultivars producing heavier fruit at Hamden compared to Windsor. The average number of fruit per plant was 2.1 at Hamden compared to 1.5 at Windsor, a 40% difference. So even though the cultivars at Windsor produced heavier fruit, they averaged fewer fruit per plant compared to Hamden which lowered the overall yields.

In Hamden, Eclipse averaged the highest yields (21.9 T/A) and Cha Cha (9.1 T/A) and Sunshine (9.0 T/A) averaged the lowest yield, a 143% difference (Table 5). The yield of Eclipse was 11% greater than Autumn Cup, the cultivar with the second highest yields (19.8 T/A). Winter Sweet (18.6 T/A) and Sweet Mama (18.3 T/A) both averaged greater than 18 T/A. Sweet Mama (4.8 lb/fruit), Eclipse (4.3 lb/fruit) and Winter Sweet (4.4 lb/fruit) produced the heaviest fruit. Autumn Cup (3.3) averaged the greatest number of fruit per plant and was the only cultivar producing more at least 3 fruit/plant.

In Windsor, Eclipse (21.6 T/A) and Sweet Mama (21.1 T/A) averaged the highest yields while Super Delite averaged the lowest yields (4.2 T/A), a 402% difference (Table 6). The yield of Sweet Mama was 79% greater than Cha Cha (12.0 T/A), the cultivar with the second highest yields. Five cultivars averaged less than 10 T/A.

Sweet Mama (5.8 lb/fruit) produced the heaviest fruit with Space Station (4.8 lb/fruit), Eclipse (4.4 lb/fruit), and Winter Sweet (4.1 lb/fruit) averaging greater than 4 lb/fruit. Black Forest (2.9 lb/fruit) produced the lightest fruit and along with Space Station (0.5 fruit/plant) and Super Delite (0.8 fruit/plant) averaged less than 1 fruit/plant. Eclipse (2.7) produced the greatest number of fruit per plant. Sweet Mama (2.0 fruit/plant) was the only other cultivar producing at least 2 fruit per plant.

2015-2016 Compiled: For comparison purposes, because the same cultivars were grown at both sites for both years, only the data from 2015 and 2016 was averaged (Table 7). Because of a crop failure in Hamden in 2014, fruit was produced only in Windsor and over half the cultivars were grown only that one year, so 2014 data was excluded from this analysis. Averaging the years 2015 and 2016 and both sites, Eclipse and Sweet Mama (17.4 T/A) averaged the greatest yields. Even though the two cultivars averaged about the same yields over the two years, Sweet Mama averaged greater yields in 2015 while Eclipse had the greater yields in 2016. In both years, yields were within 2.5 T/A of one another. Sweet Mama averaged slighter heavier fruit (0.4 lbs/fruit) while Eclipse produced slightly more fruit per plant (0.4 fruit/plant). Other cultivars averaging greater than 13 T/A were Sunshine (14.0 T/A), Autumn Cup (13.7 T/A), and Thunder (13.4 T/A). All three cultivars averaged smaller fruit compared to Eclipse and Sweet Mama.

Even though Eclipse and Sweet Mama averaged similar yields, Eclipse was a vine and Sweet Mama had a semi-bush habit. Semi-bush plants produce heavier fruit compared to fruits from vining plants while vining plants average more fruits per plant compared to semi-bush plants. In general, Semi-bush plants require about a quarter of the space as vining plants, an important attribute especially where space is limited. In the case of Sweet Mama, this smaller space requirement can be accomplished without a reduction of yield.

Another important consideration when choosing which cultivar to grow is the consistency of the yields, both between sites and between years (Tables 3-6). Of the five top cultivars, Eclipse was by far the most consistent cultivar between sites with yields differing only 4-7% when comparing Hamden and Windsor each year. An even more important characteristic is constancy between years. A grower needs to be able to rely on a relatively consistent yield of a cultivar from

year to year with different weather conditions. Of the five top cultivars, Sweet Mama and Thunder were the most consistent, with only a 20% and 23% difference between the two years. In contrast, Sunshine had almost double the yields in 2015 compared to 2016 for a 99% difference.

Some growers might choose to have a variety of colors to add diversity to their displays. Most kabocha cultivars have dark green skin with orange flesh. Two exceptions in this trial were Sunshine, which had bright orange skin and flash, and Winter Sweet, which had gray skin with orange flesh. While not averaging the highest yields in these trials, these cultivars produced good yields and consistent quality.

Taking all these factors into consideration, Sweet Mama appears to be a good choice, producing high yields consistently from year to year on space-conserving semi-dwarf plants. Sunshine is also a good choice if a bright orange skin is desired and Winter Sweet also produces a nice crop of gray skinned fruit.

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Table 1. Characteristics of cultivars evaluated in the trials

Cultivar	Habit	Fruit Weight	Features
Autumn Cup	Semi-bush	3-4 lbs	Dark green, high quality flesh, oval
Black Forest	Vine	3-4 lbs	Deep green, orange sweet flesh
Cha Cha	Vine	4-5 lbs	Green with gray stripes, sweet flesh
Convection	Vine	3-4 lbs	Smooth gray with bright orange flesh
Eclipse	Vine	4-5 lbs	Black green, yellow flesh
Geisha	Vine	6-7 lbs	Grayish green, orange flesh
Gold Nugget	Semi-bush	1-3 lbs	Orange skin with light orange flesh
Jade	Semi-bush	7-8 lbs	Dark green with light orange flesh
Orange Dawn	Semi-bush	2-3 lbs	Bright orange with light orange flesh
Space Station	Semi-bush	3-4 lbs	Black green with orange flesh
Speckled Pup	Semi-bush	2-3 lbs	Deep green with orange speckles
Sunshine	Vine	3-5 lbs	Bright orange skin and flesh
Sun Spot	Vine	1-2 lbs	Dark red with dark orange flesh
Super Delite	Vine	3-4 lbs	Dark green with bright yellow flesh
Sweet Mama	Semi-bush	4-5 lbs	Dark green with light orange flesh
Thunder	Vine	3-4 lbs	Black green with light orange flesh
Winter Sweet	Vine	4-5 lbs	Light gray with light orange flesh

Table 2. Yield of kabocha at Windsor in 2014

Cultivar	lb/fruit	#/plant	lb/plant	T/A ^z
Autumn Cup	2.9	2.5	7.3	13.2
Cha Cha	2.9	2.3	6.7	12.1
Confection	3.0	1.9	5.7	10.3
Eclipse	4.3	2.3	9.9	18.0
Geisha	6.6	2.7	17.8	32.3
Gold Nugget	1.6	9.9	15.8	28.7
Jade	7.0	1.3	9.1	16.5
Orange Dawn	2.4	2.9	7.0	12.6
Space Station	3.7	1.5	5.6	10.1
Speckled Pup	2.1	3.5	7.4	13.3
Sun Spot	1.8	4.5	8.1	14.7

^z3630 plants/A (4 X 3 foot spacing)

Table 3. Yield of kabocha at Hamden in 2015

Cultivar	lb/fruit	#/plant	lb/plant	T/A ^z
Autumn Cup	2.9	1.4	4.1	7.4
Black Forest	1.9	0.9	1.7	3.1
Cha Cha	2.7	1.6	4.3	7.8
Eclipse	4.0	1.7	6.8	12.3
Space Station	3.6	1.5	5.4	9.8
Sunshine	4.1	2.1	8.6	15.6
Super Delite	3.0	1.8	5.4	9.8
Sweet Mama	3.9	2.1	8.2	14.9
Thunder	3.6	1.6	5.8	10.5
Winter Sweet	3.4	1.0	3.4	6.2

^z3630 plants/A (4 X 3 foot spacing)**Table 4.** Yield of kabocha at Windsor in 2015

Cultivar	lb/fruit	#/plant	lb/plant	T/A ^z
Autumn Cup	3.0	3.5	10.5	19.1
Black Forest	2.9	2.4	7.0	12.6
Cha Cha	6.4	1.2	7.6	13.8
Eclipse	4.0	1.9	7.7	14.0
Space Station	4.2	1.5	6.3	11.4
Sunshine	4.3	2.6	11.2	20.3
Super Delite	3.3	1.8	5.9	10.8
Sweet Mama	4.0	2.3	9.2	16.7
Thunder	3.9	2.7	10.5	19.1
Winter Sweet	4.5	1.6	7.2	13.1

^z3630 plants/A (4 X 3 foot spacing)

Table 5. Yield of kabocha squash at Hamden in 2016

Cultivar	lb/fruit	#/plant	lb/plant	T/A ^z
Autumn Cup	3.3	3.3	10.9	19.8
Black Forest	2.6	2.1	5.5	9.9
Cha Cha	3.6	1.4	5.0	9.1
Eclipse	4.3	2.8	12.0	21.9
Space Station	3.4	1.3	4.4	8.0
Sunshine	3.3	1.5	5.0	9.0
Super Delite	3.1	1.7	5.3	9.6
Sweet Mama	4.8	2.1	10.1	18.3
Thunder	3.6	2.3	8.3	15.0
Winter Sweet	4.1	2.5	10.3	18.6

^z3630 plants/A (4 X 3 foot spacing)

Table 6. Yield of kabocha at Windsor in 2016

Cultivar	lb/fruit	#/plant	lb/plant	T/A ^z
Autumn Cup	2.8	1.8	5.0	9.1
Black Forest	2.9	0.9	2.6	4.7
Cha Cha	3.9	1.7	6.6	12.0
Eclipse	4.4	2.7	11.9	21.6
Space Station	4.8	0.5	2.4	4.4
Sunshine	3.7	1.4	5.2	9.4
Super Delite	2.9	0.8	2.3	4.2
Sweet Mama	5.8	2.0	11.6	21.1
Thunder	3.8	1.3	4.9	9.0
Winter Sweet	4.1	1.5	6.2	11.2

^z3630 plants/A (4 X 3 foot spacing)

Table 7. Summary of yields of kabocha combining years 2015 and 2016 at both sites

Cultivar	lb/fruit	#/plant	lb/plant	T/A ^z
Autumn Cup	3.0	2.5	7.6	13.7
Black Forest	2.6	1.6	4.2	7.7
Cha Cha	4.2	1.5	5.9	10.7
Eclipse	4.2	2.3	9.6	17.4
Space Station	4.0	1.2	4.7	8.5
Sunshine	3.9	1.9	7.7	14.0
Super Delite	3.1	1.5	4.7	8.6
Sweet Mama	4.6	2.1	9.6	17.4
Thunder	3.7	2.0	7.4	13.4
Winter Sweet	4.0	1.7	6.8	12.4

^z3630 plants/A (4 X 3 foot spacing)

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