

# Pumpkin as an Alternative Crop in a Northeast Florida Seepage-irrigated Production System

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ADDITIONAL INDEX WORDS. *Cucurbita pepo*, Tri-County Agricultural Area, jack-o-lantern, ornamental, heirloom

**Pumpkin (*Cucurbita pepo* L., *C. maxima* Duch., *C. moschata* Duch. ex Poir.) production was evaluated as an alternative crop for northeastern Florida farmers. Twenty-six cultivars were evaluated at the Florida Partnership for Water, Agricultural and Community Sustainability (PWACS) at Hastings farm in Hastings, FL, in 2006. Pumpkin cultivars were categorized into five classes or types (miniature, small-decorative, medium and large-sized jack-o-lantern, and specialty). Treatments were arranged in a randomized complete-block design with three replications. Total N, P, and K were applied at 258, 30, and 119 kg·ha<sup>-1</sup>, respectively. Pumpkins were grown on raised beds with silver reflective plastic mulch using seepage irrigation. Plant spacing for vining and bush-type cultivars was 0.8 m within-row and 2.7 and 2.0 m between-rows, respectively. Seeds were planted 18 July and fruit harvested 9 Oct (83 days after planting). ‘Lil’ Pump-ke-mon’ produced the highest yields in the “miniature” category (18.4 MT·ha<sup>-1</sup>) followed by ‘Hooligan’ and ‘Baby Boo’ at 13.4 and 12.3 MT·ha<sup>-1</sup>, respectively. In the “small decorative” category, ‘Orange Smoothie’ produced significantly higher marketable yields (25.8 MT·ha<sup>-1</sup>) than all other cultivars in the category. Total and marketable fruit yields were not significantly different within “medium” and “large-sized jack-o-lantern” categories. Average fruit weights for these two categories were 2.5 and 3.1 kg, respectively. ‘Cinderella’, the highest yielding “specialty” cultivar, produced significantly higher marketable fruit yields (46.1 MT·ha<sup>-1</sup>) than ‘Long Island Cheese’ (19.0 MT·ha<sup>-1</sup>) and ‘Lumina’ (13.2 MT·ha<sup>-1</sup>). Pumpkin variety evaluation should continue in northeastern Florida to identify cultivars with improved production characteristics to expand crop options.**

Pumpkins are a familiar sight in grocery stores in the fall especially around Halloween. For Florida consumers, most pumpkins in stores have been shipped from western and/or northern states (Elmstrom, et al., 1988). Currently, very little ornamental commercial pumpkin production occurs in Florida, e.g., jack-o-lantern types for carving or cultivars used as a decorative addition in the home or landscape in the fall. Warm growing conditions and normally substantial rainfall from July through Oct make pumpkin production a challenge. High temperatures inhibit fruit set in conjunction with rainy conditions which enhance disease pressure (Stanghellini et al., 2003).

Ornamental pumpkin production, however, still may be a good fit for northeastern Florida for several reasons. First, pumpkin importation from northern and western markets increases final product cost. Additionally, the time spent in transport can decrease shelf-life. The Tri-County Agricultural Area (TCAA; Flagler, Putnam, and St. Johns counties) near Hastings, FL is conveniently located close to the relatively large regional markets of Jacksonville, Orlando, and Tampa–St. Petersburg. Secondly, pumpkins are a good complement to the traditional crops grown in the TCAA in many ways. Pumpkins can be planted in early July after the winter/spring crop season. Differing pest pressures and nutritional needs of pumpkin suggest they can be grown on the same field following many cool season crops grown in the area. Lastly, pumpkins are a good choice for “U-Pick” pumpkin patch operations, which would boost agritourism in northeastern Florida. According to the United States, United States Census Bureau,

2007, Florida ranks fourth in population behind California, Texas, and New York. Additionally, Flagler County is recognized as one of the fastest growing counties in the state. Therefore, promoting agricultural activities and events in northeastern Florida are very important. The objective of this evaluation was to determine the production and quality characteristics of pumpkin cultivars under northeastern Florida growing conditions.

## Materials and Methods

A pumpkin variety evaluation trial was conducted at the Florida Partnership for Water, Agricultural and Community Sustainability (PWACS) at Hastings Farm in Hastings, FL in 2006 on an Ellzey fine sand (sandy, siliceous, hyperthermic Arenic Ochraqualf; sand 90% to 95%, <2.5% clay, <5% silt) (Soil Survey, St. Johns County, 1983).

The study was arranged as a randomized complete-block design with three replications. Plots (8.5 m) were a single row with 10 hills with two plants per hill with a 1.7-m buffer located between plots. Plant spacing for vining-type cultivars was 0.8 m within-row and 2.7 m between rows, resulting in 3912 hills per hectare. Plant spacing for bush-type cultivars was 0.8 m within-row and 2.0 m between-rows, resulting in 5866 hills per hectare. Beds were 0.2 m high with a top width of 0.9 m with silver reflective mulch (Intergro, Clearwater, FL).

A combination of ammonium nitrate [AN; N at 112 kg·ha<sup>-1</sup> (34–0–0)] and polymer sulfur-coated urea [N at 112 kg·ha<sup>-1</sup> (38–0–0)] and total P (32 kg·ha<sup>-1</sup> as 14–6–12) and K (119 kg·ha<sup>-1</sup> as 0–0–50) requirement was mechanically applied and incorporated prior to the polyethylene mulch application. An additional 34 kg·ha<sup>-1</sup> N as calcium nitrate (15.5–0–0) was broadcast on 24 Aug. 2006, 37 d after planting before vines closed the rows. Weekly pesticide

Acknowledgments. With sincere appreciation, the authors thank the farm crew and staff for their dedication and assistance throughout the production season.

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Table 1. Pumpkin quality characteristics information used to evaluate pumpkin cultivars.

	Stem width	Sutures	Color	Overall appearance (OA)
1	Very thin	Very smooth	Yellow	Very poor
2	+-	+-	+-	+-
3	Thin	Smooth	Light orange	Poor
4	+-	+-	+-	+-
5	Medium	Slightly ribbed	Medium orange	Fair
6	+-	+-	+-	+-
7	Thick	Moderately ribbed	Dark orange	Good
8	+-	+-	+-	+-
9	Very thick	Deeply ribbed	Reddish orange	Excellent

application schedule followed IFAS Extension recommendations for disease and insect control (Olson, et al., 2006).

Twenty-six pumpkin cultivars representing five classes were selected for evaluation. The cultivars by class were: miniature, 'Baby Boo', 'Gold Dust', 'Hooligan', 'Jack-Be-Little', 'Lil' Pump-ke-mon', 'Mini Treat', and 'Sweetie Pie'; small decorative, 'Cannon Ball', 'Iron Man', 'Lil' Ironsides', 'Orange Smoothie', 'Pic-A-Pie', 'Prankster', 'Touch of Autumn', and 'Trickster'; medium-sized jack-o-lantern, 'Autumn Gold', 'Neon', and 'Racer'; large-sized jack-o-lantern, 'Big Autumn', 'Gold Challenger', 'New Rocket', 'Rocket', and 'Sorcerer'; specialty, 'Cinderella', 'Long Island Cheese', and 'Lumina'.

Four pumpkin seeds were hand planted per hill on 18 July and thinned to two plants by removing extra plants when plants were approximately 5 cm tall. Rows were watered with a tractor-driven watering cart until plants emerged. After emergence, irrigation water was supplied through seepage irrigation when needed. All pumpkins were harvested 9 Oct. 2006, 83 d after planting.

At harvest, individual marketable fruit number per plot, fruit weight, fruit height, fruit diameter, and stem length were recorded. Stem width, suture prominence, fruit color, and overall fruit appearance for each fruit were rated based on the information in Table 1. Data were analyzed by analysis of variance and means were separated using Tukey's adjustment as implemented in SAS (SAS Institute, 2004).

## Results and Discussion

'Lil' Pump-ke-mon' (*C. pepo*), in the miniature pumpkin category, produced significantly higher marketable fruit yields (18.4 MT·ha<sup>-1</sup>) than 'Jack-Be-Little', 'Mini Treat', and 'Sweetie Pie' at 6.7, 5.2, and 4.3 MT·ha<sup>-1</sup>, respectively. Marketable fruit yield of 'Lil' Pump-ke-mon' was not statistically different from 'Hooligan', 'Baby Boo', and 'Gold Dust' at 13.4, 12.3, and 11.9 MT·ha<sup>-1</sup>, respectively (Table 2). White and Hutchinson (2003) also reported significantly higher 'Lil Pump-ke-mon' yields than for 'Munchin', 'Jack-Be-Little' and 'Baby Boo' in a variety trial at the Mid-Florida Research and Education Center (MFREC), Apopka. Marketable fruit yields were similar to those reported by Elmstrom et al. (1988) and 39% higher than those reported by White (2002). The numbers of fruit per hectare for 'Lil Pump-ke-mon' at PWACS were approximately 27% lower than fruit numbers per hectare reported in eastern North Carolina by Stanghellini et al. (2003). The overall appearance of all cultivars ranged from 6.5 to 8.0, which was considered good to very good (Tables 1 and 2). 'Baby Boo' had a significantly higher fruit number per hectare (95,490) compared with all other cultivars with the exception of 'Gold Dust' (65,516). The higher fruit numbers per hectare of 'Baby Boo' may be explained by the drier weather conditions experienced in 2006.

'Orange Smoothie' (*C. pepo*), in the small-sized category, had significantly higher marketable fruit yields (25.8 MT·ha<sup>-1</sup>) compared with all other cultivars, followed by 'Lil Ironsides' and 'Prankster' each at 20.2 MT·ha<sup>-1</sup> (Table 3). Marketable fruit yields of 'Orange Smoothie' and 'Lil Ironsides' averaged 59% higher than yields reported by White and Hutchinson (2003). Marketable fruit yields of 'Lil Ironsides' were 52% higher than those reported by Hochmuth et al. (2003). Although the average fruit size of 'Orange Smoothie' did not get as large (1.4 kg) compared with fruit size in northern markets (2.3 to 2.7 kg) (D. Gergela, personal communication, 30 Apr. 2007), its smooth shell makes it a desirable cultivar for decorative painting. 'Lil Ironsides' had significantly higher number of fruit per hectare compared with all other cultivars. 'Lil Ironsides' fruit is smaller than 'Orange Smoothie', but the very hard shell and rind make it a desirable cultivar for shipping to outside markets. The stem length of 'Trickster' fruit was significantly higher compared with other

Table 2. Production and quality characteristics for *miniature* pumpkins produced at the Florida Partnership for Water, Agricultural and Community Sustainability (PWACS) Hastings, FL in 2006.

Variety	Seed source <sup>y</sup>	Total yield ----- MT·ha <sup>-1</sup> -----	Marketable			Stem <sup>z</sup>		Fruit quality characteristics <sup>z</sup>					
			Yield -----	No.	Avg wt -- kg---	Length	Width	Ht	Diam	Ht:diam	Sutures	Color	OA <sup>x</sup>
Baby Boo	D	12.5 a-c <sup>w</sup>	12.3 a-c	95,490 a	0.1	2.3 ab	1.0	4.3 d	7.6 d	0.6	6.5	--- <sup>v</sup>	7.7
Gold Dust	C	12.7 a-c	11.9 a-c	65,516 ab	0.2	3.6 a	1.0	5.1 c	8.6 c	0.6	6.5	4.0	7.0
Hooligan	A	14.1 ab	13.4 ab	55,525 bc	0.2	3.3 ab	1.0	5.6 b	9.4 b	0.6	6.5	5.0 <sup>u</sup>	8.0
Jack-Be-Little	B	6.9 b-d	6.7 b-d	53,124 bc	0.1	2.5 ab	1.0	4.6 d	7.9 d	0.6	7.5	4.0	6.5
Lil' Pump-ke-mon	A	18.6 a	18.4 a	63,980 b	0.3	3.0 ab	2.0	5.3 bc	9.9 ab	0.6	6.5	--- <sup>t</sup>	8.0
Mini Treat	D	5.6 cd	5.2 dc	15,178 d	0.3	4.3 a	4.0	7.9 a	10.2 a	0.8	2.5	4.0	6.8
Sweetie Pie	D	5.1 d	4.3 d	28,530 cd	0.1	1.5 b	1.0	4.6 d	7.7 cd	0.6	7.5	2.5	6.5

<sup>z</sup>See Table 1.

<sup>y</sup>Source: A, Harris Seeds; B, Johnny's Selected Seeds; C, Rupp Seeds; D, Stokes Seeds.

<sup>x</sup>Overall appearance.

<sup>w</sup>Treatment means followed by the same letter within columns are not significantly different at the  $P \leq 0.05$  level using Tukey's studentized range test.

<sup>v</sup>White-off white.

<sup>u</sup>Mottled orange with white specks.

<sup>t</sup>White with green and orange stripes.

Table 3. Production and quality characteristics for small-sized pumpkins produced at the Florida Partnership for Water, Agricultural and Community Sustainability (PWACS) Hastings, FL in 2006.

Variety	Seed source <sup>y</sup>	Total yield	Marketable			Stem <sup>z</sup>		Fruit quality characteristics <sup>z</sup>					
			Yield	No.	Avg wt	Length	Width	Ht	Diam	Ht:diam	Sutures	Color	OA <sup>x</sup>
		----- MT·ha <sup>-1</sup> -----	- per ha-	-- kg--	----- cm -----	----- cm -----	----- cm -----						
Cannon Ball	A	14.8 c <sup>w</sup>	9.2 d	6,340 d	1.5 a	7.6 bc	8.5	12.9 ab	15.2 ab	0.9	2.5	5.5	7.4
Iron Man	A	8.1 d	7.2 d	7,205 d	1.0 b	6.1 bc	8.6	11.6 b-d	13.7 bc	0.9	2.5	4.5	6.8
Lil' Ironsides	A	22.6 ab	20.2 b	32,663 a	0.6 c	5.6 c	4.9	9.9 e	11.6 d	0.8	2.5	4.5	7.5
Orange Smoothie	B	27.1 a	25.8 a	18,443 b	1.4 a	5.8 c	5.3	14.7 a	15.7 a	0.9	2.0	4.0	6.8
Pik-A-Pie	C	21.7 ab	19.2 bc	14,217 c	1.4 a	9.6 b	7.2	12.7 b	15.7 a	0.8	3.0	4.5	6.6
Frankster	C	23.1ab	20.2 b	19,982 b	1.0 b	5.8 c	7.7	10.9 c-e	14.9 ab	0.7	3.5	4.5	6.7
Touch of Autumn	C	17.5 bc	15.0 c	21,325 b	0.7 bc	7.1 bc	2.9	10.1 de	11.9 cd	0.8	3.0	4.0	6.9
Trickster	C	17.5 bc	15.9 bc	18,443 b	0.9 bc	13.4 a	4.3	11.6 b-d	13.2 cd	0.9	3.0	3.5	6.5

<sup>z</sup>Table 1.

<sup>y</sup>Source: A, Harris Seeds; B, Johnny's Selected Seeds; C, Rupp Seeds; D, Stokes Seeds.

<sup>x</sup>Overall appearance.

<sup>w</sup>Treatment means followed by the same letter within columns are not significantly different at the  $P \leq 0.05$  level using Tukey's studentized range test.

small-sized cultivars, which would make it a desirable cultivar for decoration. High marketable fruit yield, higher average individual fruit weight, and good overall appearance characteristics make 'Orange Smoothie' as well as 'Lil Ironsides' fruit well suited for northeastern Florida growing conditions.

Marketable fruit yield and number of fruit per hectare of 'Racer', 'Neon', and 'Autumn Gold' (*C. pepo*), in the medium-sized category were not statistically different (41.9, 22.9, and 19.7 MT·ha<sup>-1</sup>), respectively (Table 4). Similar yields of 'Autumn Gold' were reported by Elmstrom et al. (1988) at 17.7 MT·ha<sup>-1</sup> in Manatee County, FL. Average individual fruit weight of 'Racer' was significantly higher than 'Autumn Gold'. 'Racer' fruit is medium to dark orange in color with slight ribbing with a thick stem, which is desirable for jack-o-lantern cultivars. 'Neon' fruit is bright orange in color and is an earlier maturing cultivar that is typically ready to harvest at approximately 70 d after planting. Both 'Racer' and 'Neon' fruit are considered to be very well suited for northeastern Florida growing conditions.

'Big Autumn', 'Gold Challenger', 'New Rocket', 'Rocket', and 'Sorcerer' (*C. pepo*), in the large-sized jack-o-lantern category, were not statistically different for marketable fruit yield, number of fruit per hectare, or average individual fruit weight.

Marketable fruit yields ranged from 23.9 MT·ha<sup>-1</sup> for 'Rocket' to 11.4 MT·ha<sup>-1</sup> for 'Gold Challenger' (Table 4). Marketable fruit yields of 'Rocket' were similar to those reported in cultivar trials in upstate New York at 21.5 and 29.3 MT·ha<sup>-1</sup>, in 1996 and 1997, respectively (Ranjarahan and Ingall, 1996, 1997). 'New Rocket', 'Rocket', and 'Sorcerer' fruit are mature at 90 d after planting. 'Sorcerer' fruit is a darker orange with a thick stem. 'Rocket' and 'New Rocket' fruit are both well proportioned and have long stems, which are attractive qualities for larger-sized pumpkins.

In the specialty category, three cultivars were evaluated, 'Cinderella', 'Lumina' (*C. maxima*), and 'Long Island Cheese' (*C. moschata*). 'Cinderella', a French heirloom variety, is reddish orange in color and has a flattened deeply ridged appearance. The fruit is very attractive for decoration and very productive in northeastern Florida growing conditions. Marketable fruit yields were significantly higher compared with 'Lumina'. Marketable fruit yields of 'Lumina' (13.2 MT·ha<sup>-1</sup>) were similar to those reported by Hochmuth et al. (2003) at 12.3 MT·ha<sup>-1</sup>. Although the average fruit weight of 'Cinderella' was 6.4 kg, there was variability in the shapes and sizes of 'Cinderella'. Many of the fruit were 9.1 to 11.3 kg, while some were over 18 kg (Table 5).

Table 4. Production and quality characteristics for medium- and large-sized jack-o-lantern pumpkins produced at the Florida Partnership for Water, Agricultural and Community Sustainability (PWACS) Hastings, FL in 2006.

Variety	Seed source <sup>y</sup>	Total yield	Marketable			Stem <sup>z</sup>		Fruit quality characteristics <sup>z</sup>					
			Yield	No.	Avg wt	Length	Width	Ht	Diam	Ht:diam	Sutures	Color	OA <sup>x</sup>
		----- MT·ha <sup>-1</sup> -----	- per ha-	-- kg--	----- cm -----	----- cm -----	----- cm -----						
<i>Medium-sized</i>													
Autumn Gold	C	21.6	19.7	9,702	2.0 b <sup>x</sup>	4.8 b	5.8	17.5	19.0	0.9	3.0	2.5	6.3
Neon	A	24.4	22.9	9,030	2.6 ab	5.8 b	6.4	18.2	19.5	0.9	3.0	3.5	6.5
Racer	B	46.3	41.9	13,449	3.0 a	10.7 a	7.7	16.7	20.8	0.8	4.0	5.5	7.0
<i>Large-sized</i>													
Big Autumn	C	19.8	14.1	4,994	2.8	5.1 d	5.5	19.0 b	21.3	0.9	2.5	3.0	6.2
Gold Challenger	C	18.1	11.4	3,265	3.3	9.1 bc	7.4	18.5 b	20.3	0.9	4.4	5.0	5.6
New Rocket	B	24.4	20.6	6,629	3.0	11.1 ab	6.4	20.0 ab	22.3	0.9	3.0	3.0	6.8
Rocket	B	27.1	23.9	7,780	3.0	12.2 a	6.1	21.6 a	20.8	1.0	4.0	3.0	7.0
Sorcerer	A	25.8	18.6	5,955	3.1	7.4 cd	7.1	20.3 ab	22.6	0.9	4.0	5.0	7.1

<sup>z</sup>Table 1.

<sup>y</sup>Source: A, Harris Seeds; B, Johnny's Selected Seeds; C, Rupp Seeds; D, Stokes Seeds.

<sup>x</sup>Overall appearance.

<sup>w</sup>Treatment means followed by the same letter within columns are not significantly different at the  $P \leq 0.05$  level using Tukey's studentized range test.

Table 5. Production and quality characteristics for *specialty* pumpkins produced at the Florida Partnership for Water, Agricultural and Community Sustainability (PWACS) Hastings, FL in 2006.

Variety	Seed source <sup>y</sup>	Total yield ----- MT·ha <sup>-1</sup> -----	Marketable			Stem <sup>z</sup>		Fruit quality characteristics <sup>z</sup>					
			Yield - per ha-	No.	Avg wt -- kg---	Length ----- cm	Width -----	Ht ----- cm-----	Diam	Ht:diam	Sutures	Color	OA <sup>x</sup>
Cinderella	B	49.7 a <sup>w</sup>	46.1 a	7,012	6.4 a	6.8 a	4.4	16.3 a	32.3 a	0.5	7.5	8.0	6.9
Long Island Cheese	B	23.2 ab	19.0 b	5,955	3.1 ab	5.8 ab	3.7	12.4 b	25.1 b	0.5	6.5	--- <sup>v</sup>	7.5
Lumina	C	15.0 b	13.2 b	5,091	2.6 b	3.6 b	3.7	16.8 a	20.3 b	0.8	3.0	--- <sup>u</sup>	6.7

<sup>z</sup>Table 1.

<sup>y</sup>Source: A, Harris Seeds; B, Johnny's Selected Seeds; C, Rupp Seeds; D, Stokes Seeds.

<sup>x</sup>Overall appearance.

<sup>w</sup>Treatment means followed by the same letter within columns are not significantly different at the  $P \leq 0.05$  level using Tukey's studentized range test.

<sup>v</sup>Tan-light tan.

<sup>u</sup>White-off white.



**a.**



**b.**



**c.**



**d.**

Fig. 1. Pumpkin cultivars: (a) 'Lil' Pump-ke-mon' (miniature category); (b) from left to right, 'Rocket' (large-sized category), 'Racer' (medium-sized category) 'Pik-A-Pie', and 'Touch of Autumn' (small-sized category); (c) 'Orange Smoothie' (small-sized category); (d) 'Cinderella' (specialty category).

White and Hutchinson (2003) reported marketable fruit yields of 'Cinderella' and 'Long Island Cheese' at 29 and 33 MT·ha<sup>-1</sup>, respectively. There was no significant difference among cultivars in the specialty category for number of fruit per hectare. 'Long Island Cheese' fruit is tan to light tan in color with a deep-orange colored flesh and resembles a wheel of cheese. This variety typi-

cally takes 10 to 20 d longer to mature compared with 'Cinderella' and 'Lumina' fruit.

Based upon marketable fruit yield, fruit size and overall appearance, cultivars that had the highest marketable fruit yields in northeast Florida growing conditions were identified as 'Lil-Pump-ke-mon' (miniature category) (Fig. 1a); 'Orange Smoothie' (small

category)(Fig. 1c); ‘Racer’ (medium jack-o-lantern category)(Fig. 1b); ‘Rocket’ (large jack-o-lantern) (Fig. 1b); and ‘Cinderella’ (specialty category) (Fig. 1d). Other cultivars that appear to be well suited for northeastern Florida growing conditions include ‘Baby Boo’, ‘Jack-Be-Little’, ‘Gold Dust’, ‘Hooligan’, ‘Lil’ Ironsides’, ‘Neon’, ‘New Rocket’, and ‘Long Island Cheese’. These cultivars set fruit and grew relatively well in northeastern Florida growing conditions. Pumpkin variety evaluations should continue to further identify and improve production and quality characteristics for each class.

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