Specialty Melon Cultivar Evaluation under Organic and Conventional Production in Florida

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Summary. Interest in producing specialty melons (*Cucumis melo*) is increasing in Florida, but information on yield performance, fruit quality, and disease resistance of specialty melon cultivars grown in Florida conditions is limited. In this study conducted at Citra, FL, during the 2011 Spring season, 10 specialty melon cultivars were evaluated, in both certified organic and conventionally managed fields, including: Creme de la Creme and San Juan ananas melon (*C. melo* var. *reticulatus*), Brilliant and Camposol canary melon (*C. melo* var. *inodorus*), Ginkaku and Sun Jewel asian melon (*C. melo* var. *makuwa*), Arava and Diplomat galia melon (*C. melo* var. *reticulatus*), and Honey Pearl and Honey Yellow honeydew melon (*C. melo* var. *inodorus*). 'Athena' cantaloupe (*C. melo* var. *reticulatus*) was included as a control. 'Sun Jewel', 'Diplomat', 'Honey Yellow', and 'Honey Pearl' were early maturing cultivars that were harvested 10 days earlier than 'Athena'. 'Athena' had the highest marketable yield in the conventional field (10.7 kg/plant), but the yield of 'Camposol', 'Ginkaku', 'Honey Yellow', and 'Honey Pearl' did not differ significantly from 'Athena'. Under organic production, 'Camposol' showed a significantly higher marketable yield (8.3 kg/plant) than 'Athena' (6.8 kg/plant). 'Ginkaku' produced the largest fruit number per plant in both organic (10 fruit/plant) and conventional fields (12 fruit/plant) with smaller fruit size compared with other melon cultivars. Overall, the specialty melon cultivars, except for asian melon, did not differ significantly from 'Athena' in terms of marketable fruit number per plant. 'Sun Jewel', 'Diplomat', and 'San Juan' showed relatively high percentages of cull fruit. 'Honey Yellow', 'Honey Pearl', and 'Sun Jewel' exhibited higher soluble solids concentration (SSC) than 'Athena' in both organic and conventional fields, while 'Brilliant', 'San Juan', and 'Ginkaku' also had higher SSC than 'Athena' under organic production. 'Honey Yellow', 'Sun Jewel', 'Brilliant', and 'Camposol' were less affected by powdery mildew (caused by *Podosphaera xanthii*) and downy mildew (caused by *Pseudoperonospora cubensis*) in the conventional field. 'Honey Yellow' and 'Camposol' also had significantly lower aboveground disease severity ratings in the organic field compared with 'Athena', although the root-knot nematode (RKN) (*Meloidogyne* sp.) gall rating was higher in 'Honey Yellow' than 'Athena'.

Melon is a crop with diverse fruit characteristics. According to the International Code of Nomenclature for Cultivated Plants, *C. melo* is divided into 16 groups within two subspecies: *C. melo* ssp. *melo and C. melo* ssp. *agrestis* (Burger et al., 2010). Sweet melons are mainly in the groups of Cantalupensis, Reticulatus, and Inodorus that are in the subspecies of *C. melo* ssp. *melo*, as well as the group of Makuwa that is in the subspecies of *C. melo* ssp. *agrestis* (Burger et al., 2010). The most commonly cultivated melon type in the United States is cantaloupe (Reticulatus group) (Sargent and Maynard, 2009). In 2011, 72,690 acres of cantaloupe were planted in the United States with a production value of $350 million [U.S. Department of Agriculture (USDA), 2013]. Besides cantaloupe, other melon types with distinctive fruit attributes are generally referred to as specialty melon in the United States.

Commonly known specialty melon include charentais, galia, ananas, persian, honeydew, casaba, crenshaw, canary, and asian melon. Among them, galia, ananas, and persian melon are in the same Reticulatus group as cantaloupe (Shellie and Lester, 2004). They produce aromatic, climacteric fruit that slip from vines with an identifiable abscission zone during ripening. Other specialty melon such as honeydew, casaba, crenshaw, and canary melon are in the Inodorus group. Fruit in the Inodorus group generally lack aromatic flavor and do not slip from vines when ripening (Lester and Shellie, 2004). Sweet asian melon is primarily in the Makuwa group. Their fruit are oblate, oval, or pyriform shaped, and have white flesh with light aroma (Akashi et al., 2002).

With unique flavor, shape, and color, specialty melon generally command a higher price than ordinary muskmelon (Bachmann, 2002). In addition, demand for specialty melon is increasing in the United States because of the burgeoning ethnic diversity in the population, for whom specialty melon is staple fruit (Walters et al., 2008). The expanding market also reflects consumer preference for healthy, new, unusual produce and cuisines (Greene, 1992).

Despite the increase in their popularity, according to a report by USDA (2009), only 2 acres of honeydew melon were harvested in Florida in 2007, whereas data on other specialty melon types were not provided. The major production barriers are lack of disease resistant cultivars and poor marketable yield (Maynard, 1989). The challenge is more pronounced in Florida as the humid subtropical environmental conditions often result in high levels of disease pressures on

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4047	acre(s)	ha	2.4711
0.3048	ft	m	3.2808
2.54	inch(es)	cm	0.3937
25.4	inch(es)	mm	0.0394
0.4536	lb	kg	2.2046
1.1209	lb/acre	$kg \cdot ha^{-1}$	0.8922
4.4482	lbf	N	0.2248

melon production (Elmstrom and Maynard, 1992). Moreover, RKN thrive in Florida sandy soils causing root galling and interfering with water and nutrient uptake of melon plants (Zitter et al., 1996). Therefore, specialty melon cultivars with disease resistance or tolerance would be valued by producers and create novel markets.

Breeding for disease resistance is one of the major goals in developing new melon cultivars. Combining high levels of disease resistance with excellent horticultural characteristics, however, is often a challenging task in vegetable breeding (Guan et al., 2012). Damages caused by several soilborne and foliar diseases are still the major problems in melon production. Some specialty melon cultivars released in recent years had resistance to powdery mildew, downy mildew, and certain races of *Fusarium oxysporum* (Cornell University, 2011). However, limited information is available regarding their performance in Florida. Hence, research under Florida production conditions is needed to evaluate yield, disease performance, and fruit quality of these specialty melon cultivars to provide updated recommendations to Florida growers.

Consumer demand for organic produce and interest in organic production among producers have continued to increase in recent years (USDA, 2010). Although the need for developing cultivars specifically suitable for organic crop production has been recognized (Adam, 2005), limited information is available regarding cultivar selection for organic melon production. While performance of cultivars may differ significantly between organic and conventional systems (Murphy et al., 2007), it is also suggested that conventional cultivars can be conveniently used for selecting cultivars well adapted to organic conditions (Lorenzana and Bernardo, 2008). The objective of this study was to evaluate the performance of different specialty melon cultivars in terms of yield potential, disease resistance, and fruit characteristics. In addition, these cultivars were assessed under both organic and conventional production to determine cultivar response to the different farming systems.

Materials and methods

TRANSPLANT PRODUCTION. Specialty melon evaluated in this study consisted of 10 cultivars from five different types including Creme de la Creme and San Juan ananas melon, Brilliant and Camposol canary melon, Ginkaku and Sun Jewel asian melon, Arava and Diplomat galia melon, and Honey Pearl and Honey Yellow honeydew melon. ‘Athena’ cantaloupe, one of the most popular muskmelon cultivars in the southeastern United States, was included as a control (Table 1, Fig. 1). Seeds were sown into 72-cell flats (Pro-Tray; Johnny’s Selected Seeds, Winslow, ME) on 20 Feb. 2011. Untreated or organic seeds were used for producing organic transplants. Peat-based medium (Natural & Organic 10; Fafard, Agawam, MA) and 2N–1.3P–0.8K fertilizer (Organic Fish and Seaweed; Neptune’s Harvest, Gloucester, MA) were used for organic transplant production. Conventional potting soil with a mixture of vermiculite, bark, peatmoss, and perlite (Metro-Mix 200; Sun Gro Horticulture, Bellevue, WA) and 20N–8.7P–16.6K fertilizer (Peters Professional; United Industries, St. Louis, MO) were used for conventional transplant production.

FIELD PLANTING AND HARVEST. Melon plants with three true leaves were transplanted on 28 Mar. 2011 to the certified organic (Quality Certification Services, Gainesville, FL) and conventional field plots at the University of Florida Plant Science Research and Education Unit in Citra, FL (USDA Hardiness Zone 9a). The soil texture at both sites is loamy sands. The organic field was used for conducting organic vegetable production research from 2006 to 2008. Then bahiagrass (*Paspalum notatum*) and bermudagrass (*Cynodon* sp.) were grown in the field until melon experiment. The conventional field was fumigated using methyl bromide chloropicrin (50:50 by weight) at the rate of 400 lb/acre. Both the organic and conventional field experiments were arranged in a randomized complete block design with four blocks and 10 plants per cultivar in each block. Plants were grown in raised beds (30 inches wide and 9 inches high) covered with black plastic mulch. Drip tapes with a 12-inch emitter spacing were used for irrigation. The bed spacing and in-row spacing were 6 and 3 ft, respectively. Fertilization program was based on the soil test conducted before bed preparation and the University of Florida recommendations for muskmelon production in sandy soils (Olson et al., 2011). Fertilizer [10N–4.4P–8.3K (Premium Vegetable Grower Fertilizer; Southern States, Lebanon, KY)] was applied preplant at 75 lb/acre nitrogen (N) to the conventional field. Plants were fertigated 2 weeks after transplanting with 6N–0P–6.6K fertilizer (Dyna Flo; Chemical Dynamics, Plant City, FL) at a weekly rate of 7.5 lb/acre N for 10 weeks. In the organic field, 10N–0.9P–6.6K fertilizer (All Season Fertilizer; Nature Safe, Cold Spring, KY) was applied preplant at 200 lb/acre N.

Anthesis dates (9 out of 10 plants in each plot showed at least one open male flower) of each cultivar were recorded as days after transplanting (DAT). Melon fruit were harvested five times from 14 May to 2 June 2011. The first harvest dates of each cultivar were recorded. Cantaloupe was harvested at 3/4 slip; i.e., abscission zone between fruit and stem is 3/4 separated (Beaulieu et al., 2004). Galia and ananas melons were harvested when rinds turned from green to light yellow, and orange-yellow, respectively. The fruit of ‘Sun Jewel’ asian melon slipped off the vines when ripe, while ‘Ginkaku’ was harvested when rind turned yellow while still attached to vines. The fruit of ‘Honey Yellow’ and ‘Honey Pearl’ were harvested based on aroma and external color changing from green to golden yellow or creamy white. Canary melon is less aromatic than honeydew melon. Hence, the change of fruit external color from green to golden yellow was the primary index for harvesting ‘Brilliant’ and ‘Camposol’ canary melons in our study.

Marketable fruit weight and number were recorded on 10 plants for each cultivar per block. Percentage of cull fruit (immature, misshapen, or defected fruit with cracking, sunburn, or disease and insect damages) was calculated by dividing the number of unmarketable fruit by total fruit number.

INSECT PEST MANAGEMENT. In the conventional field, esfenvalerate (Asana; DuPont, Wilmington, DE), methoxyfenozide (Intrepid; Dow AgroSciences, Indianapolis, IN), cyfluthrin (Baythroid; Bayer CropScience, Research Triangle Park, NC), dimethylcyclopropane carboxylate (Mustang Max; FMC Corp., Philadelphia, PA),

Table 1. Seed sources and descriptions of 10 specialty melon cultivars and 'Athena' cantaloupe grown in organic and conventional fields during Spring 2011 at Citra, FL.

Melon type	Cultivar	Seed source[z]	Fruit characteristics[y]
Ananas	Creme de la Creme	W. Atlee Burpee & Co.	Orange-yellow and lightly netted skin; fruit is creamy white, marbled with pale orange; fragrant, very sweet and slightly spicy
	San Juan	Johnny's Selected Seeds	Orange-yellow rind and heavily netted; ivory colored flesh; pear-like, sweet flavor
Canary	Brilliant	Johnny's Selected Seeds	Dark-yellow and lightly wrinkled skin; white and juicy flesh; sweet and nutty in flavor
	Camposol	Seedway, LLC	Bright-yellow rind and lightly wrinkled skin; white and juicy flesh; honeydew-like taste; large fruit
Asian	Ginkaku	Kitazawa Seed Co.	Small, oval shaped; deep golden color with white stripes; white flesh, is quite thick, crisp, smooth, and remarkably sweet
	Sun Jewel	Johnny's Selected Seeds	Oblong fruit, lemon yellow with shallow white stripes; white flesh, crisp when ripe, moderately sweet
Galia	Arava	Johnny's Selected Seeds	Yellow and netted rind; green and juicy flesh; extra sweet, aromatic
	Diplomat	Johnny's Selected Seeds	Yellow and netted rind; thick, green, and juicy flesh; sweet, aromatic
Honeydew	Honey Pearl	Johnny's Selected Seeds	White-skinned fruit with white flesh; sweet flavor and grainy texture, like asian pears; round, uniform and medium-sized fruit
	Honey Yellow	Johnny's Selected Seeds	Yellow-skinned fruit with orange flesh; juicy and very sweet; smooth skin, round, uniform and medium-sized fruit
Cantaloupe	Athena	Seedway, LLC	Well-netted, sutureless; ripe fruit seldom crack and have a tough rind; good shelf life even when harvested ripe; thick, sweet, orange flesh

[z]W. Atlee Burpee & Co. (Warminster, PA), Johnny's Selected Seeds (Winslow, ME), Seedway, LLC (Lakeland, FL), Kitazawa Seed Co. (Oakland, CA).
[y]Descriptions of fruit characteristics were adapted from the cultivar descriptions provided by seed companies.

and carbaryl (Sevin XLR; Bayer CropScience) were applied in a rotational scheme at the rates based on the product labels. Organic Materials Review Institute–listed pesticides, spinosad (Entrust; Dow AgroSciences) and pyrethrins (PyGanic; McLaughlin Gormley King, Minneapolis, MN), were used in the organic field plot mainly for controlling melon aphids (*Aphis gossypii*).

Disease evaluations. Disease severities were evaluated at the end of harvest. In the conventional field, severity of the combination of powdery mildew and downy mildew was evaluated based on visual estimation of the percentage of defoliated leaves to total canopy coverage of each plot. In the organic field, plant wilting was visible, thus a rating with 0–5 scale was developed to measure aboveground disease severity: 0 = no symptoms on leaves, stems, and crown; 1 = moderate necrosis on leaves, no symptoms on stems and crown; 2 = severe necrosis on leaves, water-soaked symptom, and some lesions on stems and crown, plant wilts in full sun; 3 = severe lesions on stems, large lesions girdle vines, part of the plant is wilting; 4 = plant totally wilts and cannot recover; 5 = plant is dead. After the final harvest, all 10 plants in each organic plot were dug out, and RKN galling was evaluated based on a 0–10 scale: 0 = no galls, 1 = very few small galls, 2 = numerous small galls, 3 = numerous small galls, some of which are grown together, 4 = numerous small galls and some big galls, 5 = 25% of roots are severely galled, 6 = 50% of roots are severely galled, 7 = 75% of roots severely are galled, 8 = no healthy roots but plant is still green, 9 = roots rotting and plant is dying, and 10 = plant and roots are dead (Zeck, 1971).

Evaluations of fruit characteristics. At the third harvest, four typical marketable melon fruit of each cultivar from each block were randomly selected for evaluations of fruit characteristics. Average fruit weight, fruit length (from stem end to blossom end), and fruit width (measured halfway between stem end and blossom end) were recorded. Soluble solids concentration and flesh firmness were also measured within 24 h following fruit harvest. Soluble solids concentration in fruit juice was determined by a refractometer (AR200; Reichert Technologies, Depew, NY). Mesocarp firmness was measured using a penetrometer (Fruit Tester; Wagner Instruments, Greenwich, CT) with an 8-mm plunger.

Statistical analyses. Analysis of variance was performed using the Proc Mixed procedure of SAS (version 9.2C for Windows; SAS Institute, Cary, NC). Fisher's least significant difference test ($\alpha = 0.05$) was conducted for multiple comparisons of different measurements among melon cultivars.

Results and discussion

Anthesis and harvest dates. Anthesis dates ranged from 12 to 18 DAT for all the evaluated melon cultivars (Table 2). 'Honey Yellow' has been reported as an early maturing melon cultivar in Kentucky (Strang et al., 2007). In our study, in addition to 'Honey Yellow', the other honeydew melon, 'Honey Pearl', 'Sun Jewel' asian melon, and 'Diplomat' galia melon were also early maturing cultivars. The first harvest date of these four cultivars was 52 DAT under both organic and conventional production. By contrast, the first harvest of 'Brilliant' and 'Camposol' canary melon, and 'Athena' cantaloupe did not occur until 62 DAT (Table 2). Although the two canary melon cultivars in this study matured late, 'SME 6798', 'ACR 1056CN', and 'HSR 4325' canary melon showed an earlier harvest time than honeydew melon cultivars in Delaware (Johnson and Ernest, 2010). As the rainy season normally starts in May in north and central Florida, using early maturing cultivars may help to alleviate negative impacts caused by warm and wet conditions.

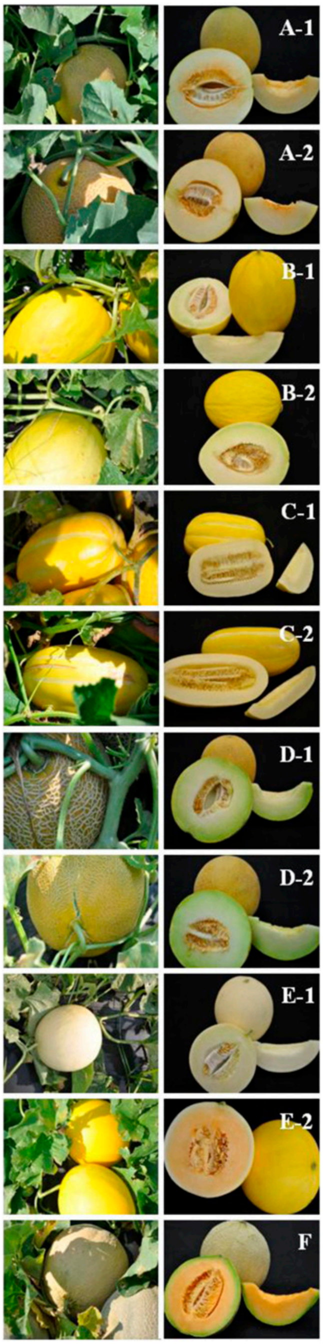

Fig. 1. Melons in the field and harvested fruit of 10 specialty melon cultivars and Athena cantaloupe: (A-1) Creme de la Creme and (A-2) San Juan ananas melon, (B-1) Brilliant and (B-2) Camposol canary melon, (C-1) Ginkaku and (C-2) Sun Jewel asian melon, (D-1) Arava and (D-2) Diplomat galia melon, (E-1) Honey Pearl and (E-2) Honey Yellow honeydew melon, (F) Athena cantaloupe.

Fruit yields. Differential performance of crop cultivars between organic and conventional farming systems has been reported. Murphy et al. (2007) found that the highest yielding wheat (*Triticum aestivum*) cultivar in a conventional system did not exhibit the highest yielding potential in the organic system. In this study, 'Athena' cantaloupe had the highest marketable yield under conventional production (10.7 kg/plant). However, marketable yield of 'Athena' ranked fifth in the organic field (6.8 kg/plant). 'Honey Yellow' honeydew melon had significantly lower marketable yield (6.5 kg/plant) compared with 'Camposol' canary melon (8.3 kg/plant) under organic production, but their yields were similar in the conventional field (8.9 kg/plant) (Table 3).

Although some specialty melon cultivars performed differently in the contrasting production systems, 'Camposol' canary melon consistently exhibited high yields in both organic and conventional fields (8.3 and 8.9 kg/plant, respectively). The high marketable yield of 'Camposol' was primarily attributed to large fruit size and low percentage of culls. High yields and excellent fruit quality of canary melon cultivars were also observed by Strang et al. (2007) in Kentucky.

'Ginkaku' asian melon produced significantly greater numbers of marketable fruit per plant compared with other specialty melon cultivars in both fields (Table 3). Marketable fruit number of the other asian melon, 'Sun Jewel', was also significantly higher than other types of specialty melon cultivars in the organic field, but interestingly, such difference appeared to diminish in the conventional field. Other than the asian melon cultivars, no significant differences in the marketable fruit number were observed between 'Athena' cantaloupe and other specialty melon cultivars in either the organic or conventional field.

'Sun Jewel' asian melon, 'Diplomat' galia melon, and 'San Juan' ananas melon had relatively high percentages of cull fruit under both organic and conventional production, resulting in lower marketable yields

Table 2. Anthesis and first harvest dates of 10 specialty melon cultivars and 'Athena' cantaloupe under organic and conventional production during Spring 2011 at Citra, FL.

	Anthesis[z] (DAT)[y]		First harvest (DAT)	
Cultivar	Organic	Conventional	Organic	Conventional
Creme de la Creme	14	14	62	57
San Juan	14	14	57	57
Brilliant	18	16	62	62
Camposol	18	16	62	62
Ginkaku	18	18	57	62
Sun Jewel	16	16	52	52
Arava	14	14	62	57
Diplomat	14	14	52	52
Honey Pearl	16	14	52	52
Honey Yellow	14	12	52	52
Athena	14	12	62	62

[z]9 out of 10 plants in each plot showed at least one open male flower.
[y]Days after transplanting.

Table 3. Fruit yields of 10 specialty melon cultivars and 'Athena' cantaloupe under organic (Org) and conventional (Con) production during Spring 2011 at Citra, FL.

Cultivar	Marketable fruit wt (kg/plant)[z]		Marketable fruit (no./plant)		Culls (%)[y]	
	Org	Con	Org	Con	Org	Con
Creme de la Creme	7.3 ab[x]	7.4 bcd	4 cd	5 bcd	7.0 bc	12.0 de
San Juan	5.9 bc	5.6 cd	3 cd	4 cd	17.8 b	23.0 bc
Brilliant	6.4 bc	7.5 bcd	4 cd	5 bcd	0 c	4.9 ef
Camposol	8.3 a	8.9 ab	4 cd	5 bcd	0 c	0.9 f
Ginkaku	5.6 c	8.0 abc	10 a	12 a	11.1 bc	17.0 cd
Sun Jewel	5.6 c	5.5 cd	8 b	7 b	38.6 a	41.1 a
Arava	7.2 ab	7.6 bcd	4 cd	6 bc	4.6 c	0.5 f
Diplomat	4.0 d	5.0 d	3 d	3 d	36.9 a	31.6 ab
Honey Pearl	7.2 ab	8.9 ab	5 c	6 bc	1.4 c	3.7 ef
Honey Yellow	6.5 bc	8.9 ab	4 cd	5 bcd	0 c	3.3 ef
Athena	6.8 bc	10.7 a	3 cd	5 bcd	1.5 c	1.0 ef
P value	0.0002	0.0096	<0.0001	<0.0001	<0.0001	<0.0001

[z]1 kg = 2.2046 lb.
[y]Percentage of unmarketable fruit for the season.
[x]Means within a column followed by the same letter are not significantly different according to Fisher's least significant difference test at $P \leq 0.05$.

compared with other specialty melon cultivars. As a result of having a thin rind, premature cracking was the main issue with 'Sun Jewel', particularly following heavy rainfall (Strang et al., 2007). 'Diplomat' galia melon also cracked prematurely at the stem end. Growing melons in greenhouse or high tunnels may overcome this problem (Cantliffe et al., 2002). Ananas melon has a rapid ripening process (Schultheis et al., 2002). Strang et al. (2007) suggested that these types of melons should be harvested daily when skin begins to change color. We harvested the melon fruit every 4–5 d instead of a shorter interval. As a result, some of the 'San Juan' melons were over-ripe, resulting in an increased percentage of culls.

Differential performance of the two cultivars within the same specialty melon type was also observed. By contrast with 'Diplomat', 'Arava' galia melon had an excellent performance in the open-field conditions with marketable yields of 7.2 and 7.6 kg/plant under organic and conventional production, respectively. 'Arava' was also a high-yielding galia melon in Delaware (Johnson and Ernest, 2010).

The majority of melon cultivars tended to have higher yields in the conventional than organic field. By conducting a comprehensive meta-analysis on various crops, Seufert et al. (2012) concluded that organic crop yields were generally lower than conventional yields although the differences could vary considerably with production sites and cultivation systems. As organic matter decomposition and nitrogen mineralization rates are subject to environmental conditions, nitrogen availability was found to be the main yield-limiting factor in organic systems (Pang and Letey, 2000). This was reflected by smaller-sized canopies of organically grown plants compared with conventional ones in our study (data not shown). Nevertheless, yield differences between conventional vs. organic production varied among melon cultivars. The largest difference was observed for 'Athena' cantaloupe with a 57% marketable fruit weight increase in the conventional field compared with the organic field. 'Ginkaku' asian melon and 'Honey Yellow' honeydew melon in the conventional field also showed an increase in marketable fruit weight by over 35% compared with melons in the organic field. However, 'Creme de la Creme' and 'San Juan' ananas melon, 'Camposol' canary melon, 'Sun Jewel' asian melon, and 'Arava' galia melon exhibited similar marketable fruit weight in the organic and conventional fields.

Fruit characteristics. Fruit weight and size varied significantly among specialty melon cultivars (Table 4). Averaged across the two production systems, asian melon produced the smallest fruit, with an average fruit weight of 0.7 and 0.8 kg for 'Ginkaku' and 'Sun Jewel', respectively. One of the distinctive characteristics of asian melon was their elongated fruit shape. In particular, the fruit length of 'Sun Jewel' was almost 2-fold greater than the fruit width. Oval-shaped 'Camposol' canary melon produced the largest fruit, with the average fruit weight of 2.7 and 2.3 kg in organic and conventional fields, respectively. 'Athena' and specialty melons other than the canary and asian melons were close to round-shaped (fruit length to maximum width ratio close to 1), with their fruit length ranging from 11.7 to 19.2 cm.

Of all the quality attributes, SSC, which reflects the level of sugar accumulation during fruit ripening, is used as a primary index in melon grading and marketing. According to the U.S. muskmelon grade standard, minimum values of SSC are 11% and 9% for Fancy and No.1 fruit, respectively (Shellie and Lester, 2004). For honeydew melon, the SSC of marketable fruit needs to reach at least 8% (Lester and Shellie, 2004). Among all the evaluated specialty melon cultivars, Honey Yellow honeydew melon had the highest SSC of 15.3% and 15.6% in the organic and conventional fields, respectively (Table 4), although it was not significantly different from 'Honey Pearl' (14.8%) under conventional production. 'Honey Yellow' was also the sweetest melon reported in a specialty melon trial conducted in Kentucky (Strang et al., 2007). Although in this study, the SSC of canary melons was ≤14%, Johnson and Ernest (2010) reported that SSC of some canary melon cultivars may reach a high SSC of 16%. 'Honey Pearl' honeydew melon and 'Sun Jewel' asian melon also exhibited higher SSC than 'Athena' in both fields, and 'Brilliant' canary melon, 'San Juan' ananas melon, and 'Ginkaku' asian melon

Table 4. Fruit weight, length, shape, soluble solids concentration (SSC), and flesh firmness of 10 specialty melons and 'Athena' cantaloupe under organic (Org) and conventional (Con) production during Spring 2011 at Citra, FL.

	Fruit wt (kg/fruit)[z]		Fruit length (cm)[z]		Fruit shape[y]		SSC (%)		Flesh firmness (N)[z]	
Cultivar	Org	Con	Org	Con	Org	Con	Org	Con	Org	Con
Creme de la Creme	1.8 c[x]	2.0 b	15.9 ef	16.1 cd	1.0 ef	1.1 e	10.3 de	10.3 e	5.1 f	6.5 f
San Juan	2.3 b	1.5 cd	17.3 cd	14.2 e	1.0 ef	1.0 e	11.7 c	11.9 cd	8.4 e	7.9 ef
Brilliant	1.8 cd	1.8 bc	18.3 bc	17.7 b	1.2 c	1.2 d	13.9 b	12.4 c	23.4 c	28.8 b
Camposol	2.7 a	2.3 a	20.4 a	20.1 a	1.2 c	1.3 c	10.4 de	11.0 de	24.4 c	21.3 c
Ginkaku	0.7 g	0.7 f	14.7 gh	15.2 de	1.6 b	1.6 b	11.2 cd	10.5 e	38.3 a	35.3 a
Sun Jewel	0.9 f	0.7 f	18.7 b	17.2 bc	1.9 a	1.9 a	13.1 b	14.2 b	19.9 d	21.7 c
Arava	1.3 e	1.1 e	13.7 h	11.7 e	1.0 f	0.9 f	10.2 e	10.8 de	8.4 e	10.0 e
Diplomat	1.7 cd	1.4 d	15.6 efg	14.2 e	1.1 ef	1.0 e	9.9 e	11.4 cd	6.7 ef	6.2 f
Honey Pearl	1.7 cd	1.6 cd	16.6 de	15.0 de	1.1 de	1.0 e	11.9 c	14.8 ab	19.1 d	15.8 d
Honey Yellow	1.6 d	1.6 cd	15.4 fg	14.8 de	1.0 ef	1.0 e	15.3 a	15.6 a	26.9 b	23.8 c
Athena	2.3 b	1.6 cd	19.2 b	15.3 de	1.2 cd	1.0 e	9.8 e	11.7 cd	7.4 ef	7.7 ef
P value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

[z]1 kg = 2.2046 lb, 1 cm = 0.3937 inch, 1 N = 0.2248 lbf.
[y]Ratio of fruit length to maximum width.
[x]Means within a column followed by the same letter are not significantly different according to Fisher's least significant difference test at $P \leq 0.05$.

also had higher SSC than 'Athena' under organic production. 'Athena' is the most popular cantaloupe melon cultivar grown in the southeastern United States because of its disease resistance and shipping quality. Commercially, 'Athena' is harvested at half to 3/4 slip maturity stage. However, with respect to consumer perceived eating quality, 'Athena' did not show the best performance compared with other melon cultivars that were harvested at the same maturity stage (Simonne et al., 2003).

Fruit firmness is an important component in fruit quality preference by consumers and postharvest shelf life assessment. In Spain, consumers indicated a preference for tender melon fruit (Pardo et al., 2000), while in a sensory study performed in the United States, honeydew melon breeding lines with firmer flesh exhibited a higher consumer rating on textural and overall eating quality compared with cantaloupe (Saftner et al., 2006). Thus, melons with both soft and firm flesh may be differentially favored by specific consumer groups. However, melons with low external firmness may reduce shipping capability and shorten postharvest shelf life. In this study, the flesh firmness of 'Athena' cantaloupe, ananas, and galia melons ranged from 5.1 to 10.0 N, significantly lower than that of full-ripe canary and honeydew melons (flesh firmness ranged from 15.8 to 28.8 N). Cantaloupe, ananas, and galia melons often exhibit climacteric fruit characteristics, while honeydew and canary melons are categorized as nonclimacteric fruit (Burger et al., 2006). As a result of ethylene-dependent softening, the difference in flesh firmness is likely associated with the distinct ripening patterns of climacteric and nonclimacteric melons (Pech et al., 2008). Compared with melons in Reticulatus and Inodorus groups, little information is available about biochemical and physiological characteristics of melons in the Makuwa group (e.g., asian melon). Liu et al. (2004) reported that 'Golden No. 9', a melon cultivar in the Makuwa group, had a climacteric pattern of ethylene production. However, in this study, 'Ginkaku' and 'Sun Jewel' from the same Makuwa group exhibited significantly higher flesh firmness compared with other climacteric melons. It is likely that melons in the Makuwa group might include both climacteric and nonclimacteric fruit, or their softening could be controlled by ethylene-independent mechanisms.

DISEASE OBSERVATIONS. Plants grown in the organic field showed wilt symptoms during the fruit expansion stage. Stem canker and brown, gummy exudates were observed in the cortical tissues, with black specks (pycnidia) appearing on the cankers. Root galls were also observed on the plants. The diseases identified as causing these symptoms were gummy stem blight [caused by *Didymella bryoniae* (Zitter et al., 1996)] and RKN (a mixed population of *Meloidogyne javanica* and *M. incognita*). Overall, 'Camposol' canary melon, 'Arava' and 'Diplomat' galia melon, and 'Honey Pearl' and 'Honey Yellow' honeydew melon showed less aboveground symptoms compared with other melon cultivars (Table 5). Given that 'Honey Yellow' and 'Diplomat' exhibited severe RKN galling, it might be possible that they carry some potential tolerance to RKN infestation. 'Ginkaku' asian melon was also heavily infested by RKN, which may be reflected by severe aboveground disease symptoms. 'Athena' exhibited less galling than the other specialty melon cultivars evaluated, except for 'Camposol', which showed a similar level of galling as 'Athena'.

Powdery mildew and downy mildew occurred simultaneously at the end of the season, and spread to the whole field within a week. Some specialty melon cultivars evaluated in this study exhibited good foliar disease performances. For example, 'Honey Yellow' honeydew melon, 'Brilliant' and 'Camposol' canary melon, and 'Sun Jewel' asian melon, had less than 40% defoliation. Among all the melon cultivars, Ginkaku asian melon had the highest foliar disease severity rating. However, cultivar assessments over multiple seasons that include examination of individual diseases are needed to fully evaluate disease resistance and tolerance of these melon cultivars.

While high temperatures and humidity present unique challenges for high quality specialty melon production in Florida, interest in growing specialty melon as a high-value crop is increasing among local producers.

Table 5. Aboveground diseases severity and root-knot nematode (RKN) gall ratings of 10 specialty melons and 'Athena' cantaloupe under organic and conventional production during Spring 2011 at Citra, FL.

Cultivar	Organic field: Disease severity rating (0–5 scale)[z]	Organic field: RKN gall rating (0–10 scale)[y]	Conventional field: Defoliation (%)[x]
Creme de la Creme	2.9 bc[w]	2.6 d	57.5 bc
San Juan	3.4 ab	4.0 c	70.0 ab
Brilliant	2.8 dc	3.6 c	37.5 cd
Camposol	2.0 e	1.7 de	37.5 cd
Ginkaku	3.7 a	5.0 ab	80.0 a
Sun Jewel	2.9 c	1.9 d	37.5 cd
Arava	2.2 e	4.4 bc	42.5 cd
Diplomat	2.3 de	4.5 abc	70.0 ab
Honey Pearl	2.3 de	3.7 c	75.0 ab
Honey Yellow	2.3 de	5.4 a	27.5 d
Athena	3.2 bc	0.9 e	57.5 bc
P value	<0.0001	<0.0001	<0.0001

[z]Disease symptoms were caused by gummy stem blight and RKN; 0 = no symptoms on leaves, stems, and crown; 1 = moderate necrosis on leaves, but no symptoms on stems and crown; 2 = severe necrosis on leaves, water-soaked symptom and some lesions on stems and crown, plant wilts in full sun; 3 = severe lesions on stems, large lesions girdle vines, part of plants is wilting; 4 = plant totally wilts and cannot recover; 5 = plant is dead.

[y]0 = no galls, 1 = very few small galls, 2 = numerous small galls, 3 = numerous small galls, some of which are grown together, 4 = numerous small and some big galls, 5 = 25% of roots are severely galled, 6 = 50% of roots are severely galled, 7 = 75% of roots are severely galled, 8 = no healthy roots but plant is still green, 9 = roots rotting and plant is dying, 10 = plant and roots are dead.

[x]Percentage of defoliation of whole plot (10 plants), attributed by powdery and downy mildews.

[w]Means within a column followed by the same letter are not significantly different according to Fisher's least significant difference test at $P \leq 0.05$.

In this cultivar evaluation trial in which no fungicides and nematicides have been used, Camposol canary melon, and Honey Yellow and Honey Pearl honeydew melon showed high-yield potential and relatively good foliar disease performance, and produced high quality fruit, although the yield of honeydew melon cultivars appeared to be lower under organic production as compared with conventional production. Given the differential yield performance of some cultivars in organic and conventionally managed fields, selections of promising specialty melon cultivars for different cultivation systems warrant further study. For melons with higher percentages of cull fruit, protected culture may be a beneficial alternative to enhance marketable yield. Taking into consideration the grower needs and consumer demand, further research involving multiple years and locations are also expected to assess yield performance and fruit quality of different melon types and cultivars in different farming systems in Florida.

Literature cited

Adam, K.L. 2005. Seed production and variety development for organic systems. 4 Feb. 2012. <https://attra.ncat.org/attra-pub/summaries/summary.php?pub=70>.

Akashi, Y., N. Fukuda, T. Wako, M. Masuda, and K. Kato. 2002. Genetic variation and phylogenetic relationships in east and south Asian melons, *Cucumis melo* L., based on the analysis of five isozymes. Euphytica 125:385–396.

Bachmann, J. 2002. Specialty vegetables. Appropriate technology transfer for rural areas. ATTRA Publ. No. CT16 1. 1 July 2011. <http://www.attra.org/attra-pub/specialtyveg.html>.

Beaulieu, J.C., D.A. Ingram, J.M. Lea, and K.L. Bett-Garber. 2004. Effect of harvest maturity on the sensory characteristics of fresh-cut cantaloupe. J. Food Sci. 69:250–258.

Burger, Y., H.S. Paris, R. Cohen, N. Katzir, Y. Tadmor, E. Lewinsohn, and A.A. Schaffer. 2010. Genetic diversity of *Cucumis melo*. Hort. Rev. 36:165–198.

Burger, Y., U. Sa'Ar, H.S. Paris, E. Lewinsohn, N. Katzir, Y. Tadmor, and A.A. Schaffer. 2006. Genetic variability of valuable fruit quality traits in *Cucumis melo*. Isr. J. Plant Sci. 54:233–242.

Cantliffe, D.J., N.L. Shaw, and E. Jovicich. 2002. New vegetable crops for greenhouses in the southeastern United States. Acta Hort. 633:483–485.

Cornell University. 2011. Specialty melon: Disease resistance table. 4 Feb. 2012. <http://vegetablemdonline.ppath.cornell.edu/Tables/SpecMelonTable.html>.

Elmstrom, G.W. and D.N. Maynard. 1992. Exotic melons for commercial production in humid regions. Acta Hort. 318:117–123.

Greene, C. 1992. An overview of production and supply trends in the U.S. specialty vegetable market. Acta Hort. 318:41–47.

Guan, W., X. Zhao, R. Hassel, and J. Thies. 2012. Defense mechanisms involved in disease resistance of grafted vegetables. HortScience 47:164–170.

Johnson, G. and E. Ernest. 2010. Specialty melon variety trial results 2010. 4 Feb. 2012. <http://ag.udel.edu/extension/vegprogram/documents/specialtymelon2010.pdf>.

Lester, G. and K. Shellie. 2004. Honey dew melon. In: K.C. Gross, C.Y. Wang, and M. Saltveit (eds.). The commercial storage of fruits, vegetables, and florist and nursery stocks. U.S. Dept. Agr. Hdbk. No. 66. 4 Feb. 2012. <http://www.ba.ars.usda.gov/hb66/075honeydew.pdf>.

Liu, L., F. Kakihara, and M. Kato. 2004. Ethylene changes during development and ripening of fruit with reference to variety of *Cucumis melo* L. Breed. Sci. 54:297–300.

Lorenzana, R.E. and R. Bernardo. 2008. Genetic correlation between corn performance in organic and conventional production systems. Crop Sci. 48:903–910.

Maynard, D.N. 1989. Specialty vegetable production in Florida, USA. Acta Hort. 242:203–215.

Murphy, K.M., K.G. Campbell, S.R. Lyon, and S.S. Jones. 2007. Evidence of varietal adaptation to organic farming systems. Field Crops Res. 102:172–177.

Olson, S.M., E.H. Simonne, W.M. Stall, P.D. Roberts, S.E. Webb, and S.A. Smith. 2011. Cucurbit production in Florida, p. 85–107. In: S.M. Olson and B. Santos (eds.). Vegetable production handbook for Florida. Univ. Florida Coop. Ext. Serv. and Vance Publishing, Lenexa, KS.

Pang, X.P. and J. Letey. 2000. Organic farming: Challenge of timing nitrogen availability to crop nitrogen requirements. Soil Sci. Soc. Amer. J. 64:247–253.

Pardo, J.E., A. Alvarruiz, R. Varón, and R. Gómez. 2000. Quality evaluation of melon cultivars. Correlation among physical-chemical and sensory parameters. J. Food Qual. 23:161–170.

Pech, J.C., M. Bouzayen, and A. Latché. 2008. Climacteric fruit ripening: Ethylene-dependent and independent regulation of ripening pathways in melon fruit. Plant Sci. 175:114–120.

Saftner, R., J.A. Abbott, G. Lester, and B. Vinyard. 2006. Sensory and analytical comparison of orange-fleshed honeydew to cantaloupe and green-fleshed honeydew for fresh-cut chunks. Postharvest Biol. Technol. 42:150–160.

Sargent, S.A. and D.N. Maynard. 2009. Postharvest biology and technology of cucurbits. Hort. Rev. 35:315–354.

Schultheis, J.R., W.R. Jester, and N.J. Augostini. 2002. Screening melons for adaptability in North Carolina, p. 439–444. In: J. Janick and A. Whipkey (eds.). Trends in new crops and new uses. ASHS Press, Alexandria, VA.

Seufert, V., N. Ramankutty, and J.A. Foley. 2012. Comparing the yields of organic and conventional agriculture. Nature 485:229–232.

Shellie, K.C. and G. Lester. 2004. Netted melons. In: K.C. Gross, C.Y. Wang, and M. Saltveit (eds.). The commercial storage of fruits, vegetables, and florist and nursery stocks. U.S. Dept. Agr. Hdbk. No. 66. 4 Feb. 2012. <http://www.ba.ars.usda.gov/hb66/095nettedmelon.pdf>.

Simonne, A., S. Cazaux, E. Simonne, K. Kouri, D. Studstill, R. Hochnuth, S. Stapleton, W. Davis, and M. Taylor. 2003. Assessing the eating quality of muskmelon varieties using sensory evaluation. Proc. Florida State Hort. Soc. 116:360–363.

Strang, J., K. Bale, J. Snyder, D. Carpenter, and C. Smigell. 2007. Specialty melon variety evaluations (Kentucky). Midwest vegetable trial report for 2007. 4 Feb. 2012. <http://www.hort.purdue.edu/fruitveg/rep_pres/2007-8/CD/Start.pdf>.

U.S. Department of Agriculture. 2009. 2007 Census of agriculture: National, state and county tables. U.S. Dept. Agr., Washington, DC.

U.S. Department of Agriculture. 2010. 2008 Organic production survey. U.S. Dept. Agr., Washington, DC.

U.S. Department of Agriculture. 2013. Vegetables 2012 summary. U.S. Dept. Agr., Washington, DC.

Walters, S.A., K.T. Range, B.H. Taylor, and W. Moon. 2008. Consumer attitudes for Asian vegetables in direct markets. HortTechnology 18:500–505.

Zeck, W.M. 1971. A rating scheme for field evaluation of root-knot nematode infestations. Pflanzenschutz Nachrichten 24:141–144.

Zitter, T.A., D.L. Hopkins, and C.E. Thomas. 1996. Compendium of cucurbit diseases. 1st ed. APS Press, St. Paul, MN.