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Fruit Yield, Quality Variables, and Powdery Mildew Susceptibility of Galia Melon Cultivars Grown in a Passively Ventilated Greenhouse

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Galia muskmelon (*Cucumis melo* L. var. *Reticulatus* Ser.) is an F_1 hybrid known for exceptional fruit flavor. Since introduction to the market in 1973, the original 'Galia' has become a trade name for look-alike cultivars. Some 'Galia'-type cultivars are firmer, ship well, and may be less susceptible to powdery mildew [*Podosphaera xanthii* (*Px*) (syn. *Sphaerotheca fulignea*)] than a true 'Galia', but often lack the sweetness and flavor of the original hybrid. The objective of this study was to identify 'Galia'-type cultivars with similar sweetness of the true 'Galia' while at the same time producing excellent yields with improved resistance to powdery mildew, a common disease for producers in a protected environment. During Fall 2005 and Spring 2006, various 'Galia' and 'Galia'-type cultivars were grown in a passively ventilated greenhouse in Citra, FL and evaluated for fruit yield, quality (fruit size, soluble solids content and firmness), and powdery mildew susceptibility. Powdery mildew disease severity ratings (DSR) were recorded weekly from the first appearance of disease until final harvest. Area under disease progress curve (AUDPC) values were also calculated from weekly DSR ratings. Results from the two seasons indicated that cultivars Nestor, Galileo, and Vicar were suitable and are recommended for greenhouse production because of their powdery mildew disease tolerance, high yields and fruit quality.

Galia muskmelon is an F_1 hybrid known for its exceptional quality. This yellow-netted, green-fleshed, highly aromatic, and sweet muskmelon was developed by Israeli breeder, Zvi Karchi and released in 1973 (Karchi, 2000). Since then, it has become a popular fruit throughout the Mediterranean and Europe with prices averaging $2 to $4 per fruit in the United States (Karchi, 2000; Rodriguez et al., 2002). 'Galia's popularity is attributed to its intense aroma and sweet flavor, which makes them an ideal high-value crop for protected culture (Cantliffe et al., 2003). Nevertheless, 'Galia' is not without some disadvantages. The main problem with 'Galia' is that it has a limited shelf-life. To achieve peak flavor and sweetness, 'Galia' muskmelon should be picked at the full-ripe stage (Karchi, 1979), therefore shelf-life can be limited (Shaw et al., 2001). 'Galia' is also highly susceptible to powdery mildew (Mitchell et al., 2005; Mitchell et al., 2006).

Due to these limitations, a "new generation" (MOAG, 2006) of 'Galia' melons have been bred. Called 'Galia'-type cultivars, these muskmelons are generally firmer and therefore shipping is improved. Today, there are over 60 'Galia'-type cultivars available in the market, according to a recent survey (Mitchell, data not shown). Not only do they have an improved shelf-life, many 'Galia'-types have improved disease resistance to powdery mildew, which is a persistent problem of 'Galia' melons grown in a greenhouse (Mitchell et al., 2005; Mitchell et al., 2006; Rodriguez et al., 2006) and is the most common and aggressive cucurbit fungus (McGrath, 2005). Powdery mildew thrives in moderate/high temperatures (25 to 35 °C) and high humidity (90 %) without rainfall or overhead irrigation. Consequently, the dense plant growth and high temperatures of a greenhouse 'Galia' muskmelon crop provide the optimal conditions for severe powdery mildew outbreaks to occur (Elad et al., 1996; Jett, 2005b; Pottorff, 2005). Powdery mildew can be a persistent and devastating disease since a severe epidemic will decrease photosynthesis, increase respiration and transpiration, impair vegetative and fruit growth, and ultimately reduce yields and fruit quality (Agrios, 2005).

Fruit quality can be described as a set of external and internal traits such as size, color, firmness and flavor (Causse et al., 2003). The 'Galia'-type cultivars are high in quality because they are firmer, ship well, and are less susceptible to powdery mildew than a true 'Galia'. Nevertheless, they too have their own limitation; they often lack the sweet flavor of the original 'Galia' hybrid. Even though there are many components to flavor such as taste, aroma and texture (Goff and Klee, 2006), it is fruit sweetness that is the most important fruit quality component (Yamaguchi et al., 1977) and 'Galia' muskmelon is well-known for its high soluble solids content (13 to 15 °Brix) (Karchi, 2000). The objective of this study was to identify 'Galia'-type cultivars with a similar sweetness to the true 'Galia', while producing optimum yields and exhibiting improved powdery mildew resistance in a greenhouse environment.

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Table 1. Screened 'Galia' and 'Galia'-type muskmelon (*Cucumis melo*) cultivars, Fall 2005 and Spring 2006.

Cultivar	Year grown	Disease tolerance listing[z]	Seed source[y]
Gallicum	2005–06	$PM_{1,2}$	Seigers Seed Co.
Girlie	2005–06	PM_2	D. Palmer Seed Co.
Gala	2005–06	PM_2	D. Palmer Seed Co.
GVS 125	2005–06	N.R.	Golden Valley Seed
GVS 205	2005–06	N.R.	Golden Valley Seed
GVS 206	2005–06	N.R.	Golden Valley Seed
Melon 96-Nestor	2005–06	PM	Hazera Genetics
Melon 6003-Elario	2005–06	PM	Hazera Genetics
Melon 6004	2005–06	N.R.	Hazera Genetics
Vicar	2005–06	PM_1	Rogers/Syngenta
Galileo	2005–06	PM_1	Rogers/Syngenta
Galia F1 (Haz)	2005–06	N.T.	Hazera Genetics
Galia F1 (Tech)	2005	PM	Technisem
Kamila[x]	2005	N.R.	Oustanding Seed Co.
Galia F1 (ZG)	2006	PM_1	Zeraim Gedera
MG 10183	2006	N.R.	Zeraim Gedera
MG 10089	2006	N.R.	Zeraim Gedera

[z]Disease tolerance to powdery mildew *(P. xanthii)* as listed by suppliers: $PM_{1,2}$ = tolerance to race 1 or 2; N.R.= not reported; N.T.= no tolerance.

[y]Seed was donated by various seed companies.

[x]'Kamila' was advertised as a 'Galia'-type, but it was found to be a Japanese-type.

Materials and Methods

Trials were conducted in Fall 2005 and Spring 2006. Seeds of 14 cultivars were sown on 22 July 2005 and seeds of 15 cultivars were sown on 7 Feb. 2006 (Table 1). 'Galia' (ZG), 'MG10183', and 'MG 10089' were not used in 2005 since seeds were not received in time for sowing and 'Galia' (T) and 'Kamila' were not used in 2006 due to unavailability of seeds. For each experiment, seedlings were grown in polystyrene trays (Model 128A, Speedling, Bushnell, FL) in a commercial fine-grade growing medium (Premier ProMix FPX, Quakertown, PA) at the University of Florida, Gainesville campus in a growth chamber (Controlled Env. Ltd., Winnipeg, Manitoba, Canada). Temperatures were maintained at 28 °C (day) and 22 °C (night) with 12-h daily artificial lighting**.** After the cotyledons were fully expanded, seedlings were fertilized once per week with a fertilizer solution of 20N–8.7P–16.6K to provide 100 ppm N, 44 ppm P and 83 ppm K (20–20–20, Peters Professional All Purpose Plant Food, Spectrum Group, St. Louis, MO).

Seedlings were transplanted on 18 Aug. 2005 and 16 Mar. 2006 when they had three true leaves. Both trials were conducted in a passively ventilated, high-roof, sawtooth greenhouse (TOP greenhouses, Ltd., Barkan, Israel) located at the UF Plant Science Research Education Unit, Citra, FL. Commercial greenhouse production techniques and nutrient requirements for producing muskmelons hydroponically were used according to Shaw et al. (2001). Plants were pollinated by bumble bees. Two Class A research hives (*Bombus impatiens*, Natupol, Koppert Biological Systems, Inc., Romulus, MI) were used in the fall and spring.

A randomized complete-block experimental design was used, with five plants per plot and cultivars were replicated three times. Plant spacing was 0.3 m between plants and 1.2 m between rows with a plant density of 3.3 plants/m^2. Plants were grown in 11 L nursery pots (Lerio Co., Kissimmee, FL) with composted pine bark medium (Elixson Wood Products Inc., Starke, FL) and fertigated through a 1.9 cm polyhose and pressure-compensating drip emitters (Netafim USA, Fresno, CA). Nutrients were delivered with each irrigation event using an Elgal Fertimix system (Eldar-Shany Agricultural Control, Israel). Scheduling was based on plant need to achieve 20% of the irrigation solution as leachate.

Insect pests were monitored weekly by scouting one plant from each plot per replicate. Several beneficial insects were released preventatively and as needed to augment pest management. Parasitic wasps (*Aphidius colemani*) (APHIPAR, Koppert Biological Systems, Inc., Romulus, MI) of the green peach aphid (*Myzus persicae* [Sulzer]), were released in the fall on 8 Sept. (rate: 4.9 wasps/m^2) and in the spring on 1 Apr. 2006 (rate: 2.4 wasps/m^2). *Neoseiulus californicus* (Biotactics Inc., Perris, CA) predatory mites were used to control two-spotted spider mites (*Tetranychus urticae*) and broad mites (*Polyphagotarsonemus latus* [Banks]). Predatory mites were released in the fall on 8 Sept. (rate: 29.6 mites/m^2), 28 Sept. (rate: 59.1 mites/m^2), and 5 Oct. 2005 (rate: 98.5 mites/m^2). Release rates increased during the season due to an outbreak of two-spotted spider mites on a cucumber crop that was in close proximity to the muskmelon crop. In the spring, predatory mites were released on 13 Mar. (preplant rate: 2.1 mites /seedling), 18 Apr., 5 May, and 5 June 2006 at a rate: 28.3 mites/m^2 for each release date. Again, there was an outbreak of two-spotted spider mites on cucumbers within the same greenhouse. Also, the two-spotted spider mites were controlled by *Phytoseiulus persimilis* (SPIDEX, Koppert Biological Systems, Inc., Romulus, MI). *Phytoseiulus persimilis* were released on 2 May 2006 (rate: 9.4 mites/m^2). *Erotmocerus eremicus* (ERCAL, Koppert Biological Systems, Inc., Romulus, MI) were released to control whitefly (*Bemisia tabaci* biotype B). *E. eremicus* were released in the fall on 8 Sept. (rate: 14.8 wasps/m^2) and 5 Oct. 2005 (rate: 88.7 wasps/m^2). The release rate increased due to an outbreak of whiteflies. In the spring *E. mundus* (BEMIPAR, Koppert Biological Systems, Inc., Romulus, MI) were released in lieu of *E. eremicus* on 2 May 2006 (rate: 4.0 wasps/m^2). There were no whiteflies in the spring crop. *Orius insidiosus* (THRIPOR-I, Koppert Biological Systems, Inc., Romulus, MI), a predatory bug for control of flower thrips (*Frankliniella tritici* (Fitch)), were released in the fall on 8 Sept. and 5 Oct. 2005 at a rate: 9.9 predator bugs/m^2. In the spring *O. insidiosus* were released 1 Apr. (rate: 1.4 predator bugs/m^2), 11 Apr. (rate: 2.4 predator bugs/m^2) and 2 May 2006 (rate: 4.7 predator bugs/m^2). The total cost of all beneficial insects for the fall and spring seasons was \$5 and \$2 per square meter, respectively.

Powdery mildew disease ratings were recorded at first sign of disease symptoms. Ratings were taken according to the method of Mitchell et al. (2006) on each of the five plants per plot. Each plant was divided into lower, middle, and upper sections. Ratings were taken as a percentage of leaf area infected per one sample leaf per section. This process was repeated once per week until the end of the crop production cycle. The mean of the three sample leaves (from each section) represented the disease severity rating (DSR). In Fall 2005, seven ratings were recorded and in Spring 2006 eight ratings were recorded. To keep the plants productive, plants were sprayed once a week directly after the ratings with potassium bicarbonate (Milstop, BioWorks Inc., Fairport, NY), a foliar fungicide that suppresses powdery mildew. No other chemical pesticides were used. Final area under disease progress curves (AUDPC) were generated by the method of Shaner and Finney (1977) from the weekly DSR. AUDPC indicated the total amount of disease that occurred throughout crop production cycle whereas DSR reflected the amount of disease present at a given time interval only.

Fruits were harvested at full-slip stage. Harvest in 2005 began on 17 Oct. until 21 Nov. and in 2006 from 5 May until 26 June. Harvest data collected included number of fruit per plant, number of culled fruit, fruit weight, flesh thickness, soluble solids content (SSC), and firmness. Culled fruit were described as being less than 25% netted and/or damaged. These variables were measured on each harvest day.

Harvest data were measured according to the methods of Mitchell et al., 2006. Directly after harvest, fruits were weighed, a 2.5 cm slice was taken from the equatorial region of each fruit and flesh thickness, firmness, and soluble solids content were measured. A caliper (Digimatic Mycal, Mitutoyo, Japan) was used to measure flesh thickness from peel to cavity. Pulp firmness was determined at two equidistant points on the equatorial region of each fruit slice using an Instron Universal Testing Instrument (Model 4411-C8009, Canton, MA). The Instron was fitted with a 50 kg load cell and an 11 mm convex probe with a crosshead speed of 50 mm/min. Firmness data were expressed as the maximum force (bioyield point, in Newton) attained during deformation. Soluble solids content (SSC) (°Brix) was measured with a temperature-compensating, handheld refractometer (Model 10430, Reichert Scientific Instrument, Buffalo, NY) from juice expressed from three pulp samples taken from the equatorial slice.

Disease and fruit quality harvest data means (n= five plants per plot) were subjected to an analysis of variance (ANOVA) by the Statistical Analysis System (SAS Institute, Version 9, Cary, NC). Spring and fall season data were analyzed separately and then data was combined and analyzed where appropriate. Cultivar means in each season were subjected to Fisher's least significant difference (LSD, $P< 0.05$).

Results and Discussion

Disease development. In Fall 2005, powdery mildew was first observed 47 d after transplanting. After 7 weeks of ratings, 'Gala' had the highest final AUDPC, which indicated that this cultivar is highly susceptible to powdery mildew and the final DSR for 'Gala' was at 100% (Table 2). Final DSR was over 50% for 'GVS-205', 'GVS-206', 'Kamila', and 'Galia (T)'; and from 25% to 50% for 'Melon 6004,' 'Vicar,' 'Girlie', 'GVS-125', 'Gallicum', and 'Galia (H)'. Cultivars Galileo and Elario had a final DSR of less than 20% and 'Nestor' was the lowest with 3%. The two true 'Galia' cultivars, 'Galia (H)' and 'Galia (T)' were significantly different from each other. 'Galia (H)' had a final DSR rating of 49%, while 'Galia (T)' was at 83%. 'Galia' (T) was among the cultivars most affected by powdery mildew with a final DSR significantly higher than 11 other cultivars, including 'Galia' (H). The final AUDPC was also higher for 'Galia' (T), illustrating that more disease was present over time. The difference between 'Galia' (T) and 'Galia' (H) may have been associated with variations in the seed company's parental lines and breeding techniques. Such variations could result in a cultivar that is not the true 'Galia' hybrid (E. Kabelka, Cucurbit Breeder, UF, personal communication, 2007). This may explain why, 'Galia' (T) was advertised as having 'powdery mildew' tolerance, while 'Galia' (H) was listed as 'not tolerant' to powdery mildew (Table 1).

In the spring, powdery mildew was observed at 41 d after transplanting and eight weekly of ratings were recorded. The early incidence of the disease could be attributed to a presence of inoculum provided by a summer squash (*Cucurbita pepo*) trial, which had powdery mildew and was grown concurrently in the greenhouse. Powdery mildew AUDPC and DSR values were higher overall in the spring experiment than the fall experiment (Tables 2 and 3). 'Gala' had a final DSR at 100% and the highest final AUDPC. Nine of the 15 cultivars had a final DSR over 50%. 'Elario' and 'Melon 6004' had a final DSR from 25% to 50 %. 'MG 10098', 'MG 10183' and 'Nestor' had a final DSR less than 25%. 'Nestor' was, again, among the cultivars with a low final DSR (2%). The two true 'Galia' cultivars, 'Galia' (H) and new to the spring experiment, 'Galia' (ZG), had similar final DSR and AUDPC values and were among the most affected by powdery mildew. 'Galia' (H) grown in the spring had a higher final AUDPC and DSR than when grown in the fall. The greater AUDPC value illustrated how more powdery mildew occurred throughout the crop production period than the fall crop.

Table 2. Final area under disease progress curve (AUDPC) and disease severity ratings (DSR) for 'Galia' and 'Galia'-type muskmelon (*Cucumis melo*) cultivars, Fall 2005 and Spring 2006.

	AUDPC[z]		Disease-severity rating[y] (%)	
Cultivar	Fall 2005	Spring 2006	Fall 2005	Spring 2006
Gala	2262	3670	100	100
Kamila	1172	NA[x]	80	NA
Galia (T)	1143	NA	83	NA
GVS 206	970	1216	55	78
GVS 125	794	1399	48	69
GVS 205	786	2101	54	80
Gallicum	594	1514	50	99
Galia (H)	534	1255	49	92
Girlie	444	1027	42	81
Vicar	431	1350	38	74
Melon 6004	236	287	28	43
Melon 6003-Elario	127	208	14	26
Galileo	87	835	15	64
Melon 96-Nestor	42	7	3	2
Galia F_1 (ZG)	NA	1251	NA	86
MG 10183	NA	203	NA	13
MG 10098	NA	224	NA	21
[w]$LSD_{(0.05)}$	553	386	10	42

[z]AUDPC = area under disease progress curve.
[y]Disease severity ratings (0 to 100%) were the mean of three leaves per plant and recorded as percent leaf area infected.
[x]NA = Not applicable: cultivar was not grown in that season.
[w]Means separated using Fisher's least significant difference ($P< 0.05$).

Table 3. Average final area under disease progress curve (AUDPC) values and disease severity ratings (DSR) (final ratings) for similar 'Galia' and 'Galia'-type muskmelon (*Cucumis melo*) cultivars grown in both Fall 2005 and Spring 2006.

Experiments	AUDPC[z]	Disease-severity rating[y] (%)
Fall 2005	600	41
Spring 2006	1259	59
Significance	*	*

[z]AUDPC = area under disease progress curve.
[y]Disease severity ratings (0 to 100%) were the mean of three leaves per plant and recorded as percent leaf area infected.
*Significant at $P<0.05$.

The marked increase of powdery mildew in the spring may not only be due to infection from squash, but may also be the consequence of higher temperatures. Powdery mildew, as mentioned earlier, thrives in moderate/high temperatures. Furthermore, powdery mildew resistance has been shown to be reduced by high temperatures in muskmelon cultivars (Hoysoya et al., 2000). Indeed, the spring temperatures were at levels more conducive to powdery mildew development and with daily average temperatures at 27 and 29 °C in Mar. and Apr. respectively, which then increased in May and June to 35 °C and higher. In the fall, temperatures were only initially high at transplanting and flowering where the daily average temperature was greater than 33 °C for August and September. By October and November, the average temperatures decreased to 27 and 24 °C, respectively.

Yield. In the fall experiment, there were differences in yield among cultivars (Table 4). Fruit number per square meter was low overall due to poor bumble bee activity, possibly due to high temperatures (above 30 °C) during the pollination period. Marketable fruit number/m² ranged from 2.5 fruits ('Gala') to 5.5 fruits ('Galileo'). Previous greenhouse muskmelon trials averaged 3.3 to 16.2 fruits/m² (Shaw et al., 2001; Rodriguez et al., 2005 and 2006). 'Galileo', 'Kamila', 'Gallicum', 'Vicar', and 'Melon 6003- Elario' had an average of five or more marketable fruits/m²; yet, the final DSR varied from 14% to 80%. Mean individual fruit weight ranged from 1.1 kg ('Nestor' and 'GVS 125') to 1.9 kg ('Girlie'). These weights were similar to other 'Galia' muskmelon trials with low fruit set. A smaller fruit (0.7 to 0.9 kg) is preferred by European markets, while in the U.S. consumers favor larger fruits (1.4 kg) (Shaw et al., 2001). 'Gala', 'GVS 125', and 'GVS 205' had the greatest number of culls per plant. These cultivars also had corresponding high final AUDPC and DSR values for powdery mildew. The remaining cultivars had low cull numbers despite having variable final AUDPC and DSR values.

The cultivars grown in the spring also had significant yield differences (Table 4). Although bumble bee activity improved and fruit number increased in the spring, it was again, not as high as other 'Galia' melon trials (Shaw et al., 2001; Rodriguez et al., 2005 and 2006). The mean number of marketable fruit/m² ranged from 2.6 fruits ('Gala') to 9.5 fruits ('Vicar'). These cultivars each had high final powdery mildew DSR values (100% and 74%), but the AUDPC was lower for 'Vicar', suggesting a slower rate of disease progression, which may have contributed to its higher yield. Nine cultivars had yields greater than 7.4 fruits/m² and final DSR values varied from 13% to 99% among them, suggesting that some of these cultivars may be tolerant to powdery mildew. Powdery mildew tolerance has also been seen with another greenhouse specialty crop, Beit-Alpha cucumbers, which had no yield differences regardless of 0 or 100% powdery mildew coverage (Shaw and Cantliffe, 2003). Mean fruit weight ranged from the smallest fruits of 'Vicar' (0.9 kg) to the largest, 'Girlie' (1.7 kg). These weights were slightly lower than the fall averages (Table 5), and may be a result of the higher yields. Higher yields resulted in smaller fruit weight for previous 'Galia' muskmelon trials (Rodriguez et al., 2002). Average cull numbers per plant were low overall in the spring and four cultivars did not have any culled fruit despite increased disease pressure.

Fruit quality. In the fall season, differences in fruit quality variables revealed variability in fruit size and flesh thickness between cultivars (Table 6). 'Nestor' was a smaller fruit in diameter than 'Elario,' yet both had similar AUDPC values and a low final DSR for powdery mildew. Soluble solids content (SSC) also appeared to have no relationship to DSR or yield

Table 4. Mean fruit yields and culls of 'Galia' and 'Galia'-type muskmelons (*Cucumis melo*), Fall 2005 and Spring 2006.

Cultivar	Marketable fruit (no./m²) Fall	Marketable fruit (no./m²) Spring	Marketable fruit wt (kg) Fall	Marketable fruit wt (kg) Spring	Culls per plant (no.) Fall	Culls per plant (no.) Spring
Gala	2.5	2.6	1.5	1.3	1.10	0.52
Kamila	5.2	NA[z]	1.5	NA	0.30	NA
Galia (T)	3.5	NA	1.6	NA	0.43	NA
GVS 206	2.6	6.5	1.4	1.2	0.37	0.09
GVS 125	4.0	6.5	1.1	1.1	0.83	0.24
GVS 205	3.9	6.7	1.4	1.1	0.70	0.32
Gallicum	5.2	9.3	1.2	1.0	0.27	0.04
Galia (H)	3.8	8.2	1.3	1.2	0.23	0.10
Girlie	3.9	6.2	1.9	1.7	0.30	0.06
Vicar	4.8	9.5	1.2	0.9	0.07	0.04
Melon 6004	3.7	8.1	1.7	1.4	0.40	0.00
Melon 6003-Elario	4.6	7.4	1.7	1.4	0.50	0.03
Galileo	5.5	7.5	1.5	1.2	0.13	0.00
Melon 96-Nestor	3.6	6.7	1.1	1.1	0.23	0.04
Galia F_1 (ZG)	NA	7.7	NA	1.2	NA	0.00
MG 10098	NA	9.3	NA	1.0	NA	0.05
MG 10183	NA	8.8	NA	1.0	NA	0.00
[y]$LSD_{(0.05)}$	2.0	2.1	0.3	0.3	0.5	0.2

[z]NA = Not applicable; cultivar was not grown in that season.
[y]Means separated using Fisher's least significant difference ($P<0.05$).

Table 5. Season comparison of average marketable yields of similar 'Galia' and 'Galia'-type muskmelons (*Cucumis melo*) grown in both Fall 2005 and Spring 2006.

Season	Fruit (no./m²)	Avg fruit wt per cultivar (kg)	Avg culls per plant (no.)
Fall 2005	4.0	1.4	0.43
Spring 2006	7.1	1.2	0.12
Significance	*	*	*

*Significant at $P<0.05$.

Table 6. Mean marketable fruit quality characteristics of 'Galia' and 'Galia'-type muskmelons (*Cucumis melo*), Fall 2005.

Cultivar	Fruit length (cm)	Fruit width (cm)	Flesh thickness (mm)	Soluble solids (°Brix)	Fruit firmness (N)
Gala	151.8	143.8	35	11.8	17
Kamila	157.7	149.5	35	15.0	31
Galia (T)	160.7	140.9	32	9.6	8
GVS 206	144.6	143.6	33	9.4	24
GVS 125	135.7	131.2	31	10.3	22
GVS 205	150.8	141.8	34	9.6	17
Gallicum	145.6	135.0	33	10.1	13
Galia (H)	139.5	136.6	33	11.7	18
Girlie	150.5	145.7	34	11.5	16
Vicar	135.3	137.1	33	11.7	30
Melon 6004	151.6	155.2	38	8.9	20
Melon 6003-Elario	159.7	158.4	41	8.8	20
Galileo	157.7	154.9	36	12.4	32
Melon 96-Nestor	133.9	131.0	32	10.3	23
$LSD_{(0.05)}$[z]	12.2	12.1	5	1.3	8

[z]Means separated using Fisher's least significant difference ($P<0.05$).

since ‘Gala,’ had a final DSR of 100% and SSC of 11.8 °Brix, and ‘Kamila’ had a final DSR of 80% and SSC of 15 °Brix. The lowest SSC were 8.8 °Brix for ‘Elario’ (14 % DSR) and 8.9 °Brix for ‘Melon 6004’ (28 % DSR), both with a low final DSR. These cultivars also did not meet the high fruit sweetness of true ‘Galia’; however, neither did ‘Galia’ (T) with 9.6 °Brix. But unlike ‘Elario’ and ‘Melon 6004’, ‘Galia’ (T) had a higher final DSR at 83 %. In addition to its low SSC, fruit firmness was also low for ‘Galia’ (T), which averaged 8 Newtons (N). The overall low fruit quality of ‘Galia’ (T) reinforces the earlier statement that questioned the authenticity of this hybrid, as true ‘Galia’ should be sweeter and firmer. Mean fruit firmness of all fall cultivars was 21 N. ‘Nestor’ had an average firmness of 23 N despite having a low final DSR. The firmest cultivars were ‘Galileo’ (32 N), ‘Kamila’ (31 N), and ‘Vicar’ (30 N), whereas the least firm cultivars were ‘Galia (T)’ (8 N), ‘Gala’ and ‘GVS 205’ (both at 17 N). Although all of these least firm cultivars had a final DSR greater than 50 %, ‘Kamila,’ which was among the firmest also had a high final DSR (80 %). Although ‘Kamila’ was advertised as a ‘Galia’-type, it did not slip from the vine, netting and flesh were not similar to ‘Galia,’ and although it had high SSC, it did not have the ‘Galia’ flavor. Qualities of this muskmelon cultivar were similar to the description of Japanese netted muskmelons as described by Schultheis et al., 2002.

The ‘Galia’ cultivars, ‘Galia (Hazera)’ and ‘Galia (Technisem)’ varied not only in their powdery mildew susceptibility but also in regard to fruit quality. Soluble solids content (°Brix) was higher for ‘Galia (H)’ (11.7 °Brix) than ‘Galia (T)’ (9.6 °Brix). Additionally, ‘Galia (H)’ was a firmer fruit (18 N) than ‘Galia (T)’ (8 N), however, yields were similar (Table 3). The AUDPC and DSR for powdery mildew were also lower for ‘Galia (H)’ than ‘Galia (T)’, which may have contributed to the improved fruit quality of ‘Galia (H)’. Overall, of all the fall cultivars, ‘Nestor’, ‘Galileo’, and ‘Vicar’ had high yields, fruit quality and sweetness that were considered good, and were less susceptible to powdery mildew.

There were differences in all quality variables among cultivars grown in the spring season (Table 7). Fruit size varied as ‘Vicar’ and ‘Galileo’ were among the smallest fruit in diameter while ‘Girlie’ and ‘Elario’ were the largest. However, ‘Vicar’, ‘Galileo’, and ‘Girlie’ all had a final DSR greater than 60% while ‘Elario’ was at 27%. All cultivars had soluble solids content (SSC) greater than 9 °Brix. Acceptable SSC levels are at least 9 °Brix for U.S.D.A. grade ‘No. 1’ and 11 °Brix for ‘Fancy’ (Lester and Shellie, 2004). However, 9 °Brix is considered low for ‘Galia’ melons, which should average 13 °Brix (Karchi, 2000). The cultivars with highest SSC were ‘MG 10098’ (12.5 °Brix), ‘MG 10183’ (11.4 °Brix) and ‘Galia’ (ZG) (11.3 °Brix). ‘Galia’ (ZG) was able to accumulate a high amount of soluble solids even though it had a final DSR at 86%, while ‘MG 10183’ and ‘MG 10098’ had a lower final DSR of 13% and 21%, respectively.

Overall, fruit size was larger in the fall experiment and firmness was higher in the spring. Although there were no differences in SSC between the seasons for similar cultivars grown in both seasons, there was an interaction between cultivar and season for SSC (Table 8). Seasonal variability occurred for all cultivars except ‘Gallicum’, ‘GVS 205’, and ‘Vicar’, which were able to maintain similar sugar levels in both seasons despite having higher final AUDPC and DSR values for powdery mildew in the spring. All cultivars had acceptable sugar levels in both seasons and were at least U.S. grade No. 1 in both seasons. Additionally, six cultivars in both fall and spring were considered U.S. grade Fancy. In these trials the true ‘Galia’ cultivars averaged from 10 to 12 °Brix, which although considered low for ‘Galia’, these values were comparable to other greenhouse ‘Galia’ muskmelon trials where preventative measures were taken to supress powdery mildew development (Shaw et al., 2001; Rodriguez et al., 2005 and 2006). The fact that many of the ‘Galia’-type cultivars averaged the same or higher Brix than true ‘Galia’ in both experiments exemplified their ‘Galia’-like fruit sweetness as part of their high quality. Fruit firmness was higher in the spring, regardless of an increase in powdery mildew development. Mean fruit firmness in spring was 24 N for all cultivars. ‘Galileo’, ‘Vicar’, ‘MG 10098’ and ‘GVS 125’ were the firmest cultivars, which ranged from 30 to 40 N.

The two true ‘Galia’ cultivars grown in the spring, ‘Galia’ (H) and ‘Galia’ (ZG) did not differ significantly. Both cultivars had high fruit number/m^2 and high SSC (>10.5 °Brix) even though final AUDPC and DSR for powdery mildew were high. However, neither one of these cultivars was among the firmest. Although the spring cultivars developed powdery mildew earlier than in the fall, ‘Nestor’ continued to exhibit a low level of powdery mildew susceptibility. Also, ‘Galileo’ and ‘Vicar’ remained good performers even with a high final DSR and maintained high yields and fruit quality. ‘MG 10183’ and ‘MG 10098’ also proved to be excellent types with low disease susceptibility, high yields and high fruit quality. However, with only one season of data, additional research would be necessary to make a sound recommendation.

Table 7. Mean marketable fruit quality characteristics of ‘Galia’ and ‘Galia’-type muskmelons (*Cucumis melo*), Spring 2006.

Cultivar	Fruit length (cm)	Fruit width (cm)	Flesh thickness (mm)	Soluble solids (°Brix)	Fruit firmness (N)
Gala	149.8	135.3	31	9.4	18
Gallicum	136.8	116.8	27	10.4	14
Galia (H)	146.5	129.9	27	10.6	19
Galia (ZG)	147.6	128.1	28	11.3	19
Girlie	163.6	148.6	32	10.2	17
GVS 205	138.4	126.2	25	9.4	17
GVS 206	139.9	130.7	28	9.8	27
Vicar	124.6	120.5	27	9.7	35
GVS 125	136.0	122.3	27	9.4	32
Melon 6003- Elario	153.4	143.7	34	10.4	22
Galileo	136.2	125.0	25	10.8	40
Melon 6004	150.3	141.9	33	9.7	20
Melon 96- Nestor	138.1	129.9	29	11.2	27
MG 10098	132.7	125.8	27	12.5	33
MG 10183	135.3	129.0	30	11.4	26
$LSD_{(0.05)}$[z]	11.1	8.7	3	1.2	8

[z]Means separated using Fisher’s least significant difference ($P<0.05$).

Table 8. Season comparison of average marketable fruit quality characteristics of similar ‘Galia’ and ‘Galia’-type muskmelons (*Cucumis melo*) grown in both Fall 2005 and Spring 2006.

Season	Fruit length (cm)	Fruit width (cm)	Flesh thickness (mm)	Soluble solids (°Brix)	Fruit firmness (N)
Fall 2005	146.4	142.9	34	10.5	21
Spring 2006	142.8	130.9	29	10.2	24
Significance	*	*	*	NS	*
Cultivar × season	NS	NS	NS	*	NS

NS, *Nonsignificant or significant at $P<0.05$, respectively.

In these experiments, many of the 'Galia'-type cultivars exhibited equal or higher SSC than the original 'Galia' as well as increased firmness, high yields and most important to greenhouse production, tolerance to powdery mildew. Since 'Nestor' maintained low levels of powdery mildew in both seasons, had favorable yields and maintained good quality, it is recommended for greenhouse production. Furthermore, although 'Galileo' and 'Vicar' were inconsistent in their powdery mildew susceptibility, they sustained high yields and high fruit quality. Their fruit were also among the sweetest and firmest cultivars in both seasons. For those reasons, they may also be suitable cultivars.

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