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HYDROPONICALLY PRODUCED MINI-CUCUCMBER WITH IMPROVED POWDERY MILDEW RESISTANCE

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Abstract. The Beit Alpha (BA) cucumber is a new commodity for the Florida greenhouse industry. In past trials, BA cultivar production and quality were compared to traditional 'Dutch' or European cucumber cultivars. The cv. Sarig, a BA-type, produced three times more yield than the Dutch-type cv. Kalunga. The BA cucumber was originally bred for production on an Israeli kibbutz. More recently, several seed companies in Holland began distributing a similar BA cucumber, termed the 'mini-cucumber' (MC) with proposed powdery mildew resistance (a trait lacking in some early BA cultivars). In Spring 2002, four Dutch MC cultivars, two US released MC cultivars and six BA-type Israeli cultivars were compared for yield, fruit quality and disease resistance. Plants were grown hydroponically in perlite in a passive-ventilated high-roof greenhouse in Gainesville, FL. Fruit were harvested 27 times from 13 March until 24 May, 2002. Fruit were graded and weighed, and powdery mildew resistance was evaluated at the end of the season. 'Figaro', 'Manar', 'Sarawat', and 'Meitav' produced the greatest amount of fruit, an average of 238 fruit·m^{-2}. The control cv. Sarig produced 213 fruit·m^{-2}. Average fruit weight ranged from 103 g for 'Figaro' to 139 g for 'Diva'. For early control of powdery mildew, 'Quadris' fungicide was applied 2 and 4 weeks after transplanting, with 'Nova' applied during week 3. No other fungicide applications were made in order to allow powdery mildew to naturally attack susceptible cultivars. Powdery mildew leaf coverage for 'Sarig' and 'Meitav' were 90% and 100%, respectively. 'Sarawat' had approximately 40% leaf coverage with powdery mildew while all other cultivars had less than 25% coverage. Mini-cucumber cvs. Figaro and Manar were found comparable to 'Sarig' in fruit yield and quality. The improved powdery mildew resistance of the MC cultivars may offer disease control advantages compared to traditional cultivars when this fungi is present.

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The Beit Alpha (BA) cucumber (*Cucumis sativus* L.) was introduced to the Florida greenhouse industry in the summer of 2000 (Shaw et al., 2000). Since then, greenhouse growers across the US, from Florida and the Carolinas to Hawaii, have produced the vegetable with rewarding benefits. One drawback of the cultivars initially introduced such as 'Sarig' (Shaw et al., 2000) was the high susceptibility to the powdery mildew fungi (*Sphaerotheca fuliginea*). Powdery mildew should be controlled in cucumber especially when other susceptible crops are being grown in the same greenhouse. In Israel and other Middle-eastern countries where the BA cucumber is widely grown, powdery mildew can be controlled with vaporized sulfur. Sulfur works well to control the disease, however, it has a negative impact on beneficial insects used in an Integrated Pest Management system. When vaporized, sulfur can leave a residue on the interior surface of greenhouse structures, which decreases the life of plastic coverings.

The European or 'Dutch' cucumber is probably the most recognized vegetable to be produced hydroponically in a greenhouse. Production dates back to the early 1800s (Bailey, 1903). European type cucumbers have nearly twice the fruit length, but produce only 1/3 of the total fruit load per plant of BA-types when grown in a passive-ventilated greenhouse in Florida (Shaw et al., 2000). One reason for the lower fruit load is the single fruit set per node by Dutch cultivars compared to a multiple fruit set habit of BA-types. However, European-type cucumbers distributed by Dutch seed companies have excellent powdery mildew disease tolerance.

Powdery mildew of cucurbits is one of the most destructive foliar diseases in both temperate and subtropical climates (Sitterly, 1978). The destructive effect on cucumbers is more common in greenhouses and plastic tunnels (Kristkova and Lebeda, 1999) because of favorable climate including high temperatures (between 25 and 30ºC) and low relative humidity on the leaf surface (Roberts and Boothroyd, 1972). BA cucumbers were traditionally grown in open field production in Israel (Zvi Karchi, personnel communication) where powdery mildew disease pressures were low, therefore, breeding for disease resistance was not a priority in that region of the world until more recently when greenhouse production became more dominant.

Dutch seed companies are now distributing the 'mini-cucumber' (MC) worldwide for greenhouse production. MC cultivars are described to have fruit characteristics similar to the BA cucumber, are proposed to have powdery mildew tolerance, can be produced year-round in mild-winter climates, and have excellent vigor and strong female flowering with excellent fruit set. While the BA-types are known for a multiple fruit set habit, it is unknown if the MC-types would be as prolific.

The present research was conducted to evaluate fruit yield and quality and tolerance to the disease powdery mildew of seven MC-type Dutch or US cultivars and six BA-type Israeli cultivars when grown in a passive-ventilated greenhouse.

Materials and Methods

Cucumbers were grown at the Protected Agriculture Project (PAP, website: http;//www.hos.ufl.edu/protectedag) located at the Horticultural Research Unit in Gainesville, Florida. The PAP greenhouse is a high-roof passive-ventilated structure (Top Greenhouse Ltd., Israel) with 3.6-m sidewalls and a 1-m roof vent. The roof was covered with double-layer polyethylene (Ginegar Plastics, Israel) and both the sidewalls and roof vent were covered with 0.6 mm insect screen (Klaymen Meteor Ltd., Petah-Tikva, Israel).

The experiment was a randomized complete-block design with 3 replications. Each plot consisted of 2 bags with 3 plants in each bag. Plant spacing was 30 cm between plants and 1.2 m between single rows. Temperatures during the season ranged from 9 to 40ºC, with 38 nights below 16ºC at which point, diesel-fired heaters were used to maintain minimum air-temperatures (Sundair, Sunderman Mfg. Co., Baltic, SD).

The following BA-type cucumber cultivars were donated for the trial from Hazera Genetics (D.N. Shikmim, Israel): Ex1605, M-733, Meitav, 9976, 976, and Sarig. Sarig was chosen as the control cultivar based on superior yields and fruit quality in past trials (Shaw et al., 2000). The following seven cultivars were listed as MC-types from each seed source. The cv. Deltastar was received from Rijk Zwaan (De Lier, The Netherlands). DeRuiter Seeds C/V (Bergschenhoek, The Netherlands) donated the cvs. Figaro, Manar, Sarawat, and Tornac. Johnny's Selected Seed (Albion, ME) provided the cvs. Aria and Diva.

Cucumber seeds were sown in 2.54 cm x 2.54 cm Speedling stryofoam trays (Speedling Inc., Sun City, FL) on 14 Jan. 2002 containing a mixture of 60% peat and 40% vermiculite then

placed in a Conviron E15 (Controlled Environments Inc., Ashville, NC) growth chamber where temperatures were 28ºC day and 22ºC night (12-hr photoperiod). After emergence, seedlings were fertilized twice weekly using a solution made from Peter's Professional All Purpose Plant Food (Spectrum Group, St. Louis, MO). Nutrient concentrations (N-P_2O_5-K_2O) were each maintained at 100 ppm.

Seedlings were transplanted on 11 Feb. 2002 into 1 m x 0.32 m white-polyethylene sleeves (Agrodynamics, Coppell, TX) filled with coarse-grade perlite (Airlite Processing Corp. of Florida, Vero Beach, FL). Cucumber plants were trellised on individual twine using a plastic clip (Paskal Technologies, Ltd., Galilee, Israel) every 30 cm. Lateral branches were removed up to the 8th node. The remaining lateral branches were allowed to develop and pruned at the second node.

Plants were managed during the season based on production methods developed by Shaw et al. (2000). Irrigation scheduling was based on plant need to achieve 10-20% daily leachate using a programmable timer (Sterling 12, Superior Controls Co. Inc., Valencia, CA). Plants were fertilized at each irrigation with a complete nutrient solution. At transplant, cucumbers received 120 ppm N from liquid Calcium nitrate (Chemical Dynamics, Plant City, FL) and Potassium nitrate. Four weeks after transplanting N levels were raised to 150 ppm where it remained for the rest of the season. For the complete season, P, from phosphoric acid (Chemical Dynamics) was held at 50 ppm. K (potassium nitrate, potassium chloride) was maintained at 150 ppm throughout the season. Ca (calcium nitrate), Mg (magnesium sulfate), and S (sulfate containing fertilizers) were maintained constant through the season at 175 ppm, 50 ppm, and 60 ppm. All micronutrient levels remained constant through the season at 3 ppm Fe (Sequestrene 330), 0.2 ppm Cu (copper sulfate), 0.8 ppm Mn (manganese sulfate), 0.3 ppm Zn (zinc sulfate), 0.7 ppm B (Solubor), and 0.06 ppm Mo (sodium molybdate). The pH of the final solution was maintained between 5.5 and 6.5.

Powdery mildew (*Spaerotheca fulignea*) was controlled early during plant growth using an alternating fungicide spray program of Quadris (azoxystrobin, Zeneca Agricultural Products, Wilmington, DE) and Nova (myclobutanil, Rohn & Haas Co., Philadelphia, PA). The spray program began four weeks after transplanting with each fungicide applied twice with 10 to 14 days between applications.

Beneficial insects were released throughout the season as biological control for insect pests. Pests included the green peach aphid (*Myzus persicae*) and two-spotted spider mites (*Tetranychus urticae*). As a general predator, lady beetle larvae (*Hippodamia convergens*, Entomos LLC, Gainesville, FL) were released beginning the week of transplanting at a rate of one larva per plant. Aphids were effectively controlled using parasitic wasps (*Aphidius colemani*, IPM Laboratories, Locke, NY). Beginning three weeks after transplanting, *Aphidius colemani* were released for three consecutive weeks at a rate of 500 per week. *Neoseiulus californicus* predatory mites were released at four and six weeks after planting to control the two-spotted spider mite (3000 predators per release). Approximately 200 *Orius insidiosus*, also a general predator, were released on a weekly basis from transplanting until the end of April.

Cucumbers were harvested 27 times approximately every other day beginning 13 March until 24 May, 2002. Fruits were harvested, graded, and weighed as fancy, No. 1, oversize and cull (Shaw et al., 2000). Total marketable fruit was the combined total of fancy, No. 1, and oversize. Fruit quality characteristics were measured on 20 March and 20 April, 2002. Three fruit from each plot were measured for length and diameter. Fruit uniformity and fruit skin wrinkle ratings were based on all fruit harvested per plot on 20 March and 20 April, 2002. Fruit

uniformity scale: 1 = no uniformity, 5 = complete uniformity. Fruit skin wrinkle scale: 1 = smooth skin, 5 = most wrinkle skin.

At the end of the season, each plot was rated for powdery mildew severity. The plants were not inoculated with spores of powdery mildew. However, the disease was noticeable within the crop six weeks after planting. Plants were rated on a 1 to 10 scale, where 1 = less than 10% of leaves with powdery mildew, 2 = 20%, 3 = 30%, 4 = 40%, 5 = 50%, 6 = 60%, 7 = 70%, 8 = 80%, 9 = 90%, and 10 = 100% of leaves with mildew.

Results and Discussion

The first 12 harvests occurred from 13 March until 7 April, 2002 and were considered early yield (Table 1). Average fruit weight, early marketable fruit number, early marketable fruit weight, fancy fruit number, fancy fruit weight and culls per plant were significantly different among cultivars. Average fruit weight ranged from 73 g for 'Figaro' to 95 g for '9976'. Early marketable fruit number and weight per plant was lowest for 'Figaro' at 11 fruit weighing 1.0 kg. 'Manar' and 'Sarawat' produced the greatest early marketable fruit number per plant at 29 fruit per plant, but were not significantly different than 'Meitav' at 27 fruit per plant. Early marketable fruit weight per plant was greatest for 'Manar' (2.6 kg), but not significantly different than 'Sarawat' (2.5 kg) or 'M-733' (2.4 kg). Early harvested fancy fruit per plant was greatest for 'Manar', 'Sarawat', 'Tornac', 'M-733', '976', and 'Sarig'. Fancy fruit weight per plant ranged from 0.3 kg for 'Diva' to 1.4 kg for 'Manar'. For the early harvest, culls were minimal and depended on cultivar (Pr = 0.0035), culled fruit per plant ranged from 1 to 3, weighing from 0.04 kg to 0.22 kg per plant.

There were significant differences among the 13 cultivars for all of the total yield variables (Table 2). Unlike the early yield, when 'Figaro' had lower fruit weight than all other cultivars, average fruit weight of 'Figaro' over the season was the same as 'Ex1605', 'Meitav', 'Sarig', and '976'. 'Diva' and 'DeltaStar' had the largest average fruit weight at 139 g and 135 g per fruit, respectively. 'DeltaStar' was not significantly different than 'Aria' at 125 g per fruit. Total marketable fruit number per plant ranged from a low of 43 for 'Diva' to a high of 77 for 'Figaro'. 'Figaro' was not significantly different than 'Manar', 'Sarawat', and 'Meitav' at 73, 68, and 71 fruit per plant, respectively. The cv. Manar produced the greatest total marketable fruit weight per plant at 8.8 kg. However, it was not significantly different than 'Aria' (7.9 kg), 'DeltaStar' (8.5 kg), 'Figaro' (7.9 kg), 'Sarawat' (8.5 kg), 'M-733' (8.3 kg), and 'Meitav' (7.8 kg). Fancy fruit number and weight per plant ranged from 15 fruit at 1.4 kg for 'Diva' to 33 fruit at 3.2 kg for 'Manar'. The cv. Diva produced the least amount of cull fruit, 8 per plant, while 8 other cultivars produced more than 17 cull fruit per plant. Cull fruit weight ranged from 0.6 kg per plant for 'Diva' to 1.4 kg per plant for 'Aria' and 'Tornac'.

The amount of culls produced may be reduced by the grower if intensive pruning is employed. During this research the lateral branches were allowed to set fruit up to the second node, thus creating a dense canopy where fruit can be damaged by tendrils or missed during a pruning event. It was observed that the cv. Diva was excessively vegetative throughout the season, for example, the distance between internodes on the main stem was more than 1 meter while most cultivars were about 30 cm. 'Diva' required more intense pruning and removal of lateral branches than all other cultivars.

When yields were compared on an area basis, 'Figaro', 'Manar', 'Sarawat', and 'Meitav' produced the greatest number of fruit at 253, 239, 225, and 233 fruit$\cdot$m^{-2}, respectively (Table 3). However, only 'Figaro' produced significantly more fruit than the remaining nine cultivars. During this trial, the control cv. Sarig produced 213 fruit$\cdot$m^{-2} over 27 harvests. This yield is

similar to past research during a spring season where 'Sarig' produced approximately 220 fruit·m^{-2} over 23 harvests (planted 31 March 1999, harvest 1 May through 1 July, 1999; Shaw et al., 2000). Fruit weight ranged from 26 to 29 kg·m^{-2} for 'Figaro', 'Manar', 'Sarawat', and 'Meitav'.

Mini-cucumber production is expanding across the US. In 1999, only one producer was known to be growing Beit Alpha-type cucumbers in Florida (BeliFarms, Inc., Welborn, FL). More recently, growers in Baja, CA and Mexico have been producing Beit Alpha or mini-cucumbers for markets in Los Angeles. These growers are receiving about $1.20 per kg wholesale (personnel communication). Under the greenhouse conditions and plant populations (10,000 plants·ha^{-1}) described in this research, growers in Florida could potentially gross $348,000 per hectare per crop at the Los Angeles wholesale market price.

There was a significant interaction between cultivar and time of season for the quality variables fruit length and diameter (Table 4). On 20 March, fruit length ranged from 10 cm for 'Aria' and 'Diva' to 15 cm for '9976'. On 20 April, fruit length ranged from 14 cm for 'Figaro' and '967' to 18 cm for 'M-733'. Fruit length increased for all cultivars from 20 March until 20 April. However, the cultivars producing the shortest or longest fruit in March were not the same as in April. Fruit length may be a factor to consider when choosing a mini-cucumber cultivar because some markets may prefer the shorter BA fruit-types. On 20 March, fruit diameter was greatest for '9976' at 32 mm and smallest for 'Aria' and 'Diva' at 17 and 24 mm, respectively. Average fruit diameter on 20 March for the remaining 10 cultivars was 27 mm. Similar to fruit length, fruit diameter increased for nearly all cultivars during the season. On 20 April, only the cv. Ex1605 was significantly smaller than all other cultivars, 29 mm compared to 35 mm.

There were no differences between cultivars for fruit skin wrinkle (Table 4). The average skin wrinkle rating for cultivars was 3.7 which corresponds to partially wrinkled skin. Fruit uniformity ranged from no uniformity for 'Diva' to mostly uniform for 'Aria', 'DeltaStar', 'Figaro', 'M-733', 'Meitav', '9976' and '967'. Mini-cucumbers can be more easily packed for shipping and marketing if all fruit have uniform size and shape.

Plants were rated for susceptibility to powdery mildew at the end of the season (Table 4). The standard BA-type cvs. Meitav and Sarig were rated at 100% and 90% powdery mildew coverage, respectively (Table 4). 'Sarawat' was rated with 40% coverage and 'M-733' had nearly 30% coverage. All other cultivars were rated with either 10% or 20% powdery mildew coverage. 'Diva' produced the lowest yield; however, it had the highest resistance to powdery mildew. Conversely, 'Meitav' produced one of the highest yields but had the lowest resistance to powdery mildew. Powdery mildew may be more of a visual problem in Beit Alpha or mini-cucumbers than a detriment to yield (see photo). However, if other susceptible crops are being grown in the same greenhouse, for example bell pepper, the disease has potential to spread and would want to be controlled for all crops. Early sprays with systemic fungicides may prove helpful for reducing disease pressure through the majority of the season. However, continuous fungicide application throughout the season may be unnecessary. By the end of the season after 27 harvests, all cultivars no longer set fruit. Harvesting was terminated due to lack of fruit and not because of problems associated with powdery mildew.

While greenhouse crops generally cannot be considered organically grown because of the fertilizers, many growers would like to market 'pesticide-free' product. However, the use of fungicides in an Integrated Pest Management program may kill the beneficial insects if not timed appropriately between the releases of insects. Therefore, selecting cultivars with disease resistance so that fungicide applications are limited would provide a better environment for

biological control insects. It may also provide growers with the ability to eliminate the fungicide need altogether and add value to the commodity when marketed as 'pesticide-free'.

One goal of this study was to compare germplasm from the US, the Netherlands, and Israel. It is concluded that there are several new cultivars with better yield potential than our standard high-yielding cv. Sarig. They originate from both Israeli and Dutch seed companies. In conclusion, the MC cvs. Figaro, Manar, and Sarawat would perform well under passive-ventilated greenhouse conditions in Florida with improved powdery mildew resistance. However, the BA-type cv. Meitav produced excellent yields with more uniform fruit length and diameter, regardless of the disease pressure caused by the powdery mildew fungi.

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Table 1. Means for early yield (12 harvests) of 13 mini-cucumber cultivars grown hydroponically in a passive-ventilated greenhouse. 13 March to 7 April, 2002. Gainesville, Fla.

Cultivar [z]	Avg. ft. wt. (g)	Early mkt. no.	Early mkt. wt. (kg)	Fancy no.	Fancy wt. (kg)	Cull no.	Cull wt. (kg)
Mini-cucumber type		----------yield per plant----------					
Aria	87 bcd	25 bc	2.2 cd	8 e	0.6 e	3 abc	0.13 abc
Diva	84 cd	11 e	1.0 g	5 f	0.3 f	1 e	0.04 c
DeltaStar	93 ab	25 bc	2.3 cd	11 cde	0.9 cd	3 a	0.22 a
Figaro	73 e	25 bc	1.8 f	11 de	0.7 de	2 a-e	0.10 bc
Manar	90 abc	29 a	2.6 a	17 a	1.4 a	1 de	0.05 c
Sarawat	87 bcd	29 a	2.5 ab	15 abc	1.2 ab	2 c-e	0.09 bc
Tornac	92 ab	23 c	2.1 c-f	12 cd	1.0 bcd	2 a-d	0.13 abc
Beit Alpha type							
Ex1605	81 d	25 bc	2.0 def	13 bcd	0.9 bcd	3 ab	0.16 ab
M-733	92 ab	26 bc	2.4 abc	16 ab	1.3 a	2 a-d	0.13 abc
Meitav	82 d	27 ab	2.2 cde	13 a-d	1.0 bcd	1 cde	0.04 c
Sarig	83 d	25 bc	2.1 c-f	14 a-d	1.0 bc	2 a-d	0.11 bc
9976	95 a	20 d	1.9 ef	11 de	0.9 bcd	2 a-e	0.12 bc
976	83 d	24 bc	2.0 def	14 a-d	1.0 bc	3 a	0.17 ab
R-square	0.84	0.93	0.92	0.84	0.86	0.67	0.60

[z] Means within each column were separated using Duncan's multiple range test, $P \leq 0.05$.

Table 2. Means for total yield (27 harvests) of 13 mini-cucumber cultivars grown hydroponically in a passive-ventilated greenhouse. Spring 2002. Gainesville, Fla.

Cultivar	Avg. ft. wt. (g)	Total mkt. no.	Total mkt. wt. (kg)	Fancy no.	Fancy wt. (kg)	Cull no.	Cull wt. (kg)
Mini-cucumber type		----------yield per plant----------					
Aria	128 bc	62 cde	7.9 a-e	16 de	1.5 e	19 ab	1.4 a
Diva	139 a	43 f	6.0 g	15 e	1.4 e	8 e	0.6 d
DeltaStar	135 ab	63 cde	8.5 abc	24 bc	2.3 bcd	10 de	0.9 cd
Figaro	103 e	77 a	7.9 a-e	30 ab	2.5 bcd	21 a	1.2 abc
Manar	122 cd	73 ab	8.8 a	33 a	3.2 a	11 de	0.8 cd
Sarawat	124 cd	68 abc	8.5 ab	28 abc	2.7 abc	14 bcd	1.1 abc
Tornac	121 d	62 cde	7.5 b-e	24 bc	2.2 cd	21 a	1.4 a
Beit Alpha type							
Ex1605	109 e	56 e	6.1 fg	22 cd	1.9 de	21 a	1.3 ab
M-733	124 cd	67 bcd	8.3 a-d	30 ab	2.9 ab	17 abc	1.1 abc
Meitav	110 e	71 abc	7.8 a-e	27 abc	2.4 bcd	19 ab	1.1 abc
Sarig	110 e	64 b-e	7.1 d-g	29 ab	2.5 bcd	18 abc	1.1 abc
9976	125 cd	58 de	7.2 c-f	24 bc	2.4 bcd	13 cd	0.9 bcd
976	108 e	63 cde	6.8 efg	28 abc	2.5 bcd	22 a	1.3 a
R-square	0.92	0.84	0.76	0.78	0.76	0.80	0.64

[z] Means within each column were separated using Duncan's multiple range test, $P \leq 0.05$.

Table 3. Means for fruit number·m^{-2} and kg·m^{-2} of 13 mini-cucumber cultivars grown hydroponically in a passive-ventilated greenhouse. Spring 2002. Gainesville, Fla.

Cultivar	Fruit number per square meter	Kg per square meter
Mini-cucumber type		
Aria	204 cde	26.1 a-e
Diva	142 f	19.8 g
DeltaStar	208 cde	28.0 abc
Figaro	253 a	26.1 a-e
Manar	239 ab	29.1 a
Sarawat	225 abc	28.1 ab
Tornac	204 cde	24.7 b-e
Beit Alpha type		
Ex1605	185 e	20.2 fg
M-733	221 bcd	27.4 a-d
Meitav	233 abc	25.6 a-e
Sarig	213 b-e	23.4 d-g
9976	191 de	23.9 c-f
976	208 cde	22.6 efg
R-square	0.84	0.76

[z] Means within each column were separated using Duncan's multiple range test, $P \leq 0.05$.

Table 4. Means for fruit quality measurements on 20 March and 20 April, 2002 (harvest 4 and 17) and powdery mildew ratings on 9 May, 2002 (harvest 24) for 13 mini-cucumber cultivars. Spring 2002. Gainesville, Fla.

Cultivar[z]	Fruit length (cm)		Fruit diameter (mm)		Fruit skin wrinkle[y] (scale 1-5)	Fruit uniformity (scale 1-5)	Powdery mildew rating (scale 1-10)
MC-type	20-Mar	20-April	20-Mar	20-April			
Aria	10.3 d	15.9 cd	17 c	35 a	2.8	4.2 ab	2.0 cd
Diva	10.5 d	14.6 fg	24 b	34 a	4.0	1.5 d	1.0 d
DeltaStar	12.8 abc	15.9 cd	27 ab	36 a	3.8	3.5 abc	2.0 cd
Figaro	11.3 cd	13.8 g	26 ab	35 a	3.5	4.0 ab	2.0 cd
Manar	13.5 ab	16.5 bc	29 ab	35 a	3.8	3.2 bc	2.0 cd
Sarawat	13.2 abc	17.1 b	25 ab	36 a	3.5	2.8 c	4.3 b
Tornac	13.5 ab	15.7 cde	27 ab	33 a	3.5	3.2 bc	2.0 cd
BA-type							
Ex1605	12.8 abc	14.8 efg	29 ab	29 b	4.2	3.2 bc	2.3 cd
M-733	13.4 ab	18.2 a	26 ab	36 a	3.8	4.2 ab	2.7 c
Meitav	13.1 abc	15.9 def	28 ab	33 a	3.5	4.3 a	10.0 a
Sarig	12.8 abc	15.0 def	28 ab	34 a	3.8	3.2 bc	9.3 a
9976	14.6 a	16.5 bc	32 a	33 a	4.2	3.7 abc	1.3 cd
967	12.5 bc	13.9 g	25 ab	34 a	3.5	3.7 abc	2.3 cd
R-square	0.36	0.66	0.21	0.27	0.80	0.82	0.95

[z] *MC-type* = Mini-cucumber cultivars and *BA-type* = Beit Alpha cucumber cultivars. Quality measurements performed 20 March and 20 April, 2002, harvest 4 and 17. Date x cultivar interaction was significant for fruit length and fruit diameter. Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

[y] Fruit skin wrinkle scale: 1 = smooth, 5 = most wrinkle. Fruit uniformity scale: 1 = no uniformity, 5 = complete uniformity. Powdery mildew rating scale: 1 = no leaves with powdery mildew, 10 = all leaves with powdery mildew. Powdery mildew was rated on 9 May, 2002, harvest 24.

Photo courtesy of Nicole Shaw, UF – Protected Agriculture Project. The cultivar on the left is Sarig (Hazera Genetics, Israel) with 100% coverage with powdery mildew, the cultivar on the right is Tornac (DeRuiter Seeds C/V, The Netherlands) which averaged 20% coverage with powdery mildew.