Hydroponic Greenhouse Production of Specialty Cucurbit Crops

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Abstract

A recent survey concluded that nearly 40 ha of greenhouse vegetables are produced throughout the state of Florida, USA. The University of Florida's Horticultural Sciences Department Protected Agriculture Project (UFPAP) has been conducting research trials on specialty cucurbit crops since the late 1980s. In 1999, a passively-ventilated high-roof greenhouse was built to accommodate experiments on a commercial-scale. New crops have been introduced to the U.S. market via this project, such as the 'Beit Alpha' cucumber, baby squash and the 'Galia' muskmelon, in which the highest quality fruit can only be produced in a protected structure. Research at UFPAP has included cultivar trials, production systems such as plant density and media, nitrogen nutrition, disease resistance, disease prevention, integrated pest management and economics. More recently, research at UFPAP has addressed at the market potential for hydroponic baby squash production – a gourmet commodity that is currently imported by the U.S. market. Publications are available on selection of proper cultivars and postharvest handling procedures for squash blossoms.

INTRODUCTION

The University of Florida's Horticultural Sciences Department Protected Agriculture Project (UFPAP) has focused research on the introduction of new cucurbit crops to the U.S. greenhouse industry. Through trials on cultivar selection, plant nutrition, disease prevention, and integrated pest management, complete hydroponic production systems are now available for 'Beit Alpha' (BA) cucumber, 'Galia' muskmelon, and baby squash production in Florida. Both the BA cucumber and the 'Galia' muskmelon are commonly grown in greenhouses or protected structures throughout the Mediterranean area. Squash is grown in regions of Spain and Italy under tunnels for high quality yields and protection of male flowers which are also commonly sold in regional markets.

The most common cucumber grown in a greenhouse is the European type, also called Dutch, hothouse, greenhouse, or hydroponic cucumber. The European type of cucumber is approximately 30 cm in length, 4 to 5 cm in diameter, yields 20 to 30 fruit per plant, and the fruit must be individually shrink-wrapped to prevent water loss during postharvest handling. The BA-type of cucumber was originally developed in the 1940s by growers (self-made breeders) in Israel. The cucumber was bred for field production under intensive irrigation and fertilization practices of the desert climate. The original cultivars were highly susceptible to powdery mildew and viruses, however, they were well suited for the pickling industry due to the short fruit length (about 15 cm) and solid core. The BA cucumber became a popular fresh market cucumber and parthenocarpic (seedless) cultivars were developed. Other characteristics of present seedless BA cucumber cultivars include short internodes and a clustering fruit habit. The BA cultivars available today are adapted for trellising under protected cultivation, produce 3 to 4 times more fruit than their European counterparts, and are of higher fruit quality (taste and firmness).

Muskmelons are not commonly grown in greenhouses in the U.S., but are grown in arid field production regions of California, Arizona, and Texas. The 'Galia' muskmelon was developed in the 1970s by Dr. Zvi Karchi for dry-land farming in the desert regions of Northern Israel (Karchi, 2000). Production of this type of melon in arid regions of the

U.S. is difficult due to disease susceptibility and improper fertilization and irrigation techniques which lead to low yields and poor quality fruit. 'Galia' muskmelon production in humid regions such as Florida can be successfully done in greenhouses where irrigation and fertilization of the plants can be strictly controlled. Furthermore, disease pressure can be reduced by keeping excess moisture (such as rainfall) from the plants and trellising the plants vertically to increase air movement. Trellising the plants can increase yields over field production by 4 to 7 fruits per plant.

Baby squash and squash blossoms are a common culinary favorite of Italy and other European countries, however, the use of squash blossoms may have originated via the Native American (Paris and Janick, 2005). Baby squash sold in U.S. supermarkets are imported from Central American countries such as Guatemala, or grown and distributed through local farmers and farmers' markets (Shaw and Cantliffe, 2005). Squash is generally produced under open-field cultivation practices, however, in parts of the world, squash are grown in low and high tunnels, as well as glass and plastic greenhouses (European and Mediterranean Plant Protection Organization, 2004). Therefore, due to adverse weather conditions in Florida and the delicate characteristics of baby squash, production in protected structures is necessary. Baby squash cultivars are generally selected from summer squash types, however, most seeds available are not labeled for greenhouse production, nor is there sufficient information on the production practices of these cultivars under greenhouse conditions. The UFPAP has evaluated 18 summer squash cultivars for yield and fruit characteristics when produced in a passively-ventilated greenhouse.

The purpose of this study was to provide an overview of the cucurbit research at the UFPAP. For more information on the production of 'Beit Alpha' cucumbers please see "A new crop for North American greenhouse growers: Beit Alpha cucumber – progress of production technology through university research trials" by N.L. Shaw, D.J. Cantliffe and P.J. Stoffella in this issue. Also, for an economic study related to greenhouse cucurbit production, please see "Alternative use of pine bark media for hydroponic production of 'Galia' muskmelon results in profitable returns" by N.L. Shaw, D.J. Cantliffe, J.C. Rodriguez, and Z. Karchi in this issue. The present paper will thus focus on 'Galia' muskmelon and baby squash research which are not covered in the above mentioned publications.

MATERIALS AND METHODS

Research conducted from 1999 through 2003 was located at the UFPAP in Gainesville, FL. The 0.20 ha greenhouse (Top Greenhouses Ltd., Barkan, Israel) had a passively-ventilated design with 3.6 m high sidewalls and a 1.2-m roof vent at 6 m for a total floor to roof peak of 7.2 m. The structure was covered with double layer polyethylene plastic (Ginegar Plastic Products, Ltd., Kibbutz Ginegar, Israel). Both the sidewall and roof vent openings were covered with 0.6-mm insect screen (Klaymen Meteor Ltd., Petah-Tikva, Israel) to prevent insect movement into or out of the greenhouse.

In 2004, squash experiments were conducted in a similar high-roofed, passively-ventilated greenhouse structure located at the UF Plant Science Research and Education Center in Citra, FL. The 0.41 ha greenhouse (Top Greenhouses Ltd.) had sidewalls 4.2 m high and a 1.5-m roof vent located at 4.2 m for a total roof to floor peak of 5.7 m. The structure was covered with single layer polyethylene (Ginegar Plastic Products, Ltd.). Sidewall and roof vent openings were covered in the same insect screen as previously mentioned.

For all experiments, seeds were sown in polystyrene flats (cell size, 2.25 cm^2, 164 cells per flat; Speedling, Inc., Bushnell, FL). The seedling growing media was a mixture of 3 parts sphagnum peat : 2 parts vermiculite (by volume). Transplants were grown in either an evaporative cooled glasshouse or growth chambers (model E15, Conviron, Winnepeg, Manitoba, Canada). Temperatures in the growth chambers were 20-25°C day/night with a 14-h photoperiod. Seedlings were irrigated with fertilizer solution (100 mg/L N, 50 mg/L P, and 80 mg/L K with micronutrients) every other day once cotyledons were fully expanded.

All trials were a randomized complete block experimental design with either three or four replications. Two different container systems were used. Plants were grown in either white-polyethylene layflat bags (1 m long x 0.32 m wide) or 11.4 L black plastic nursery pots. Several types of media were used during the various experiments: coarse grade perlite (Airlite Processing Corp. of Florida, Vero Beach, FL), medium grade perlite (Airlite) and pine bark (Elixson Wood Products Inc., Starke, FL).

'Galia' muskmelon cultivar trials (1999-2000) were initially grown in bags using coarse perlite at a plant density of 1.9 plants/m^2 (Shaw et al., 2001). Several melon experiments were set up concurrently. For one such trial, nitrogen (N) fertigation experiments (2000-2001) were conducted in bags filled with medium grade perlite at a plant density of 3.1 plants/m^2 (Rodriguez et al., 2005), other trials compared containers and media (2001-2002) using combinations of bags and pots, coarse perlite, medium perlite and pinebark at a plant density of 3.1 plants/m^2 (Shaw et al., 2004; Rodriguez et al., 2002), and plant density trials (2001-2002) were conducted using bags and coarse perlite at four densities: 1.7, 2.5, 3.3, and 4.1 plants/m^2 (Rodriguez et al., 2003; Rodriguez, 2003; Rodriguez et al., 2002). The squash trials (2003-2004) were grown in pots filled with pine bark at a plant density of 2.2 plants/m^2 (Shaw et al., 2007a).

Both melon and squash plants were pruned and trellised vertically on individually strings (Shaw et al., 2001; Shaw et al., 2004). Bumble bees (*Bombus impatiens*, Natupol, Koppert Biological Systems, Romulus, MI) were used to pollinate flowers of melon, but were not needed for the squash since fruit were harvested on the day of anthesis (Shaw et al., 2007a).

Integrated pest management methods were used throughout each experiment. Insect pest pressures included two-spotted spider mites (*Tetranychus urticae*), aphids (*Myzus persicae*), and whitefly (*Bemisia tabaci*). Pests were controlled with releases of beneficial insects such as: predatory mites (*Neoseiulus californicus*), lady beetles (*Hippodamia convergens*), big-eyed bug (*Geocoris punctipes*), minute pirate bug (*Orius insidious*), and parastic wasps for aphids and whiteflies (*Aphidius colemani* and *Eretmocerus eremicus*). Both melon and squash crops were affected by powdery mildew (*Spaerotheca fuliginea*) while some melon plants were susceptible to gummy stem blight (*Didymella bryoniae*). In 1999, mancozeb and chlorothalonil fungicides were used on melon (Shaw et al., 2001). In latter crops of both melon and squash, only azoxystrobin and myclobutanil were used since they could be more successfully combined with an IPM system.

All plants were irrigated and fertilized via individual pressure-compensating drip emitters (Netafim USA, Fresno, CA). Excluding the N muskmelon trial, all plants were fertilized with approximately the same nutrient concentrations. The nutrient levels were: 120-160 mg/L N (from calcium nitrate and potassium nitrate), 50 mg/L P (from phosphoric acid), 150 mg/L K (from potassium chloride and potassium nitrate), 135 mg/L Ca (from calcium nitrate), 50 mg/L Mg (from magnesium sulfate), 65 mg/L S (from all sulfate sources listed here), 3 mg/L Fe (from Sequestrene330), 0.2 mg/L Cu (from copper sulfate), 0.8 mg/L Mn (from manganese sulfate), 0.3 mg/L Zn (from zinc sulfate), 0.7 mg/L B (from Solubor), and 0.06 mg/L Mo (from molybdenum sulfate). For the N fertilization trial, N was applied at either 80, 120, 160, 200, 240 or an alternating N (ALT-N) concentration, all other nutrient concentrations were the same as listed above (Rodriguez et al., 2005). The ALT-N program followed four plant growth stages and adjusted the N concentration with plant need (120-160-200-120 mg/L). The pH of the final solution throughout each experiment remained between 5.5 and 6.5.

'Galia' melons were harvested at full-slip stage when the fruit had reached its peak flavor (Karchi, 1979) and the rind had turned yellow-orange and was well-netted (Karchi, 2000). Fruit were harvested two times per week and graded by size into extra small (0.5-0.69 kg), small (0.7-0.99 kg), medium (1.0-1.19 kg), large (1.20-1.49 kg) and extra large (> 1.49 kg) categories. Baby squash were harvested every other day. Zucchini, yellow-summer, and cousa-types were graded as 'baby' fruit if they were 10 cm in length or less. Fruit sizes up to 20 cm in length and uniformly shaped were graded fancy, other marketable fruit were graded No. 1, and all non-marketable fruit were culled. Patty pan/scallop-types and the round zucchini (*Eight Ball*) were considered 'baby' size if they were 4-cm diameter or less. Fruit which were 4 to 8-cm in diameter and uniformly shaped were graded fancy, other marketable fruit were graded No. 1, and all non-marketable fruit were culled. All fruit were harvested per plot and graded. Data were subjected to analysis of variance using SAS (SAS Institute, Cary, NC).

RESULTS AND DISCUSSION

In the first of three seasons of cultivar trials, cultivars were similar for yield or average fruit weight (Table 1). Plants produced an average of 3 fruit per plant weighing 1.4 kg each. Fruit yield per plant ranged from less than 2 fruit for the cultivars 'Galia-H' and 'Golan' to nearly 4 fruit per plant for 'Omega' during fall 1999. Mean fruit weight during the fall was mostly in the range of the extra small fruit grade category (0.5-0.69 kg). Yields increased during spring 2000 to nearly 5 fruit per plant for all cultivars except 'Arava-H', 'Arava-Z', and 'Capri'. Mean fruit weight ranged from 0.7 kg per fruit for 'Golan' to 1.2 kg for 'Capri'. The European market generally prefers 'Galia' melons around 1.0 kg or less each (Shaw et al., 2001), therefore, melons produced in spring 2000 were similar to those most desired. Increased yields in spring 2000 were attributed to good climate conditions and the researchers' improved experience with producing 'Galia' and 'Galia-type' melons in soilless culture.

'Galia' was used for the N experiments in spring 2001 and fall 2002. In spring, mean fruit weight, fruit per plant, fruit weight per plant, and total marketable kg/m^2 were similar among the levels of N (Table 2). Orthogonal contrasts were used to compare the results from plants receiving the ALT-N treatment to all other N treatments (Rodriguez, 2003). Again, there was no difference for average fruit weight, in which the average over all six N levels was 0.7 kg. However, the ALT-N treatment was significantly better than the other N treatments for fruit per plant, fruit weight per plant and total marketable kg/m^2 (6.4 vs. an average of 5.2 fruits, 4.7 vs. an average of 3.5 kg, and 15.5 vs. an average of 11.6 kg/m^2, respectively). In fall, mean fruit weights were similar between treatments and averaged 0.9 kg per fruit. Significant differences were found for the variables fruit per plant, fruit weight per plant, and total marketable kg/m^2. Plants which received 160, 200, 240 mg/L and the ALT-N treatments produced higher yields than plants which received 80 or 120 mg/L (Rodriguez et al., 2005).

The 'Galia-type' cultivar 'Gal-152' was used for the container and media experiments in spring 2001 and 2002. There were no differences between seasons for any measured variable, therefore the data were combined over season (data not presented). Fruit per plant, fruit weight, and total marketable kg/m^2 were similar among container and media treatments. The averages were 6 fruit per plant, 1.7 kg per fruit, and 32.5 kg/m^2.

Recommendations based on economic savings for a container and media combination for melon production in Florida are pine bark and pots. Plastic pots have a life expectancy of 10 years while bags break down under solar radiation and generally only last one-year in a Florida greenhouse thus increasing annual material expenses. When in a pot, pine bark media can be reused for several seasons, however, it is unknown if perlite media can be reused this long. The individual cost per pot is amortized over the 10 yr life-span of the container, while bags must be repurchased annually. Bags filled with perlite annually cost \$2.25/m^2 and \$0.72/m^2 when filled with pine bark. Plastic pots annually cost \$1.85/m^2 when filled with perlite and \$0.63/m^2 when filled with pine bark. This ability to recycle pots filled with pine bark can lower annual materials costs (based on a 10 yr average) over using bags filled with perlite by \$18,200 per ha. The additional labor expense required to remove, fill and place new bags inside the structure annually has not been included and may increase the cost of using bags over pots substantially. Also, discarding perlite has become problematic due to environmental concerns. Pine bark can be resold as a landscape mulch product.

'Gal-152' was also used for the plant density experiments in fall 2001 and spring 2002. In fall, there were no significant differences among the four plant densities for fruit per plant (4.7 fruit), average fruit weight (1.2 kg), fruit width (132 mm), length (140 mm), or soluble solids content (10.1°Brix) (Table 3). Fruit and weight per unit area (m^2) increased linearly with increasing plant density. In spring, similar to fall, fruit per plant (7.1 fruits) and soluble solids content (10.3°Brix) were similar among plant densities (Table 4). Mean fruit weight, fruit width, and fruit length decreased with increasing plant density. Similar to fall, fruit and weight per m^2 increased linearly with increasing plant density. Based on results of fall and spring, melon plants should be produced at no less than 3.3 plants/m^2 when trellised vertically under protected conditions using soilless culture (Rodriguez, 2003; Rodriguez et al., 2003; Rodriguez et al., 2002).

Selected squash cultivars were grown as 'baby' squash in spring 2003 (Table 5) and 2004 (data not presented). For all variables measured, there were significant differences among the cultivars. Overall, the highest yielding squash types were the patty pan/scallop-types, especially 'Sunburst' which produced 67 baby squash per plant (Shaw and Cantliffe, 2004). The other patty pan/scallop cultivars 'Butter Scallop', 'Patty Green Tint', and 'Starship', produced on average 51 baby squash per plant. The yellow summer-type cultivars 'Seneca Supreme', 'Sunray', 'Supersett' and 'Yellow Crookneck', produced the next greatest yield of baby squash with an average of 43 fruit per plant. The cultivar 'Zephyr' produced the lowest yield of the yellow summer-types at 27 fruit per plant. The two cousa-types averaged 31 fruit per plant. Cousa-type squash are commonly found in Mediterranean countries (cousa is the Arabic word for squash). The zucchini-types produced the lowest baby squash yields of the squash types evaluated. Yields ranged from 16 fruit per plant for 'Bareket' to 25 fruit per plant for 'Raven'. Baby squash yields followed the same trend in 2004, however, due to powdery mildew, the experiment was terminated after 15 harvests and yields were overall lower than in 2003 (Shaw et al., 2007a). Cull fruit numbers were low in both seasons, however, the cultivar 'Yellow Crookneck' produced nearly 18 cull fruit per plant in 2003 (Shaw and Cantliffe, 2004). Though this cultivar produced one of the highest baby squash yields, it would not be recommended for baby squash production based on the number of cull fruit that would need to be manually removed from the plant and disposed of (Shaw et al., 2007a; Shaw and Cantliffe, 2004).

Though most cucurbit crops are traditionally open-field cultivated, we have demonstrated several crops that triumph under protected agriculture systems using soilless culture: 'Beit Alpha' cucumber, 'Galia' muskmelon and baby squash. Economic studies are currently being conducted for BA cucumber and baby squash and will be available through the UFPAP website (http://www.hos.ufl.edu/protectedag). One economic report for 'Galia' muskmelon is available in this publication, and provides evidence that a successful melon crop would potentially gross $1.5 million annually (Shaw et al., 2007a). Though all of these crops are produced in various places of the world using protected structures, to this date, there are some growers in the U.S. producing BA cucumbers and none that are producing 'Galia' or baby squash under greenhouse conditions. There is great potential for all of these crops based on the availability of research material and market demand. Furthermore, these crops can be produced under pesticide-free conditions which increase food safety and possibly certified organic methods which lead to an ever-increasing market/price potential.

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Tables

Table 1. Total marketable fruit number per plant and average fruit weight of 'Galia' and 'Galia-type' muskmelon cultivars for three seasons. Gainesville, Florida. Spring 1999, Fall 1999, Spring 2000.

Cultivar	Total marketable fruit number (per plant^z)			Mean fruit weight (kg/fruit)^z		
	Spring^{xy} 1999	Fall 1999	Spring 2000	Spring^{xy} 1999	Fall 1999	Spring 2000
Arava-H	2.2	3.5 a	3.1 b	1.40	0.63	0.99 b
Arava-Z	2.5	2.8 abc	3.4 b	1.28	0.66	0.97 b
Capri	-	3.2 ab	2.9 b	-	0.62	1.20 a
Gal-152	-	3.3 ab	4.7 a	-	0.72	0.92 bc
Gal-52	3.2	3.2 ab	4.9 a	1.55	0.66	0.89 bcd
Galia-H	2.7	1.8 c	4.4 a	1.51	0.61	0.80 cdef
Galia-Z	2.9	3.1 ab	4.7 a	1.52	0.61	0.77 cdef
Galor	-	2.3 bc	4.6 a	-	0.62	0.86 bcde
Golan	2.8	1.8 c	4.7 a	1.23	0.57	0.68 f
Jalisco	3.6	3.3 ab	4.8 a	1.34	0.66	0.84 bcde
Omega	-	3.8 a	5.0 a	-	0.58	0.71 ef
Revigal	3.5	3.2 ab	5.0 a	1.20	0.68	0.75 def
C.V.	31.0	19.9	12.2	15.8	9.2	8.9

^{z}Total marketable fruit number and total marketable fruit weight per plant is the accumulated total of extra small (0.5-0.69 kg), small (0.7-0.99 kg), medium (1.0-1.19 kg), large (1.2-1.49 kg) and extra large (> 1.50 kg) size fruit. Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

^{y}Spring 1999 was 31 March – 16 July 1999 with 13 harvests. Fall 1999 was 14 October 1999 – 11 February 2000 with 9 harvests. Spring 2000 was 3 March – 28 July 2000 with 17 harvests.

^{x}'Capri', 'Gal-152', 'Galor', and 'Omega' were not grown in spring 1999. Source: Shaw et al., 2001.

Table 2. Total marketable yield and fruit quality of 'Galia' muskmelon grown with six different nitrogen treatments in soilless culture. Spring and Fall 2001.

Nitrogen level (mg/L)	Spring 2001[z]				Fall 2001[z]			
	Mean fruit weight (kg)	Fruits per plant	Fruit weight per plant (kg)	Fruit weight per unit area (kg/m^2)	Mean fruit weight (kg)	Fruits per plant	Fruit weight per plant (kg)	Fruit weight per unit area (kg/m^2)
80	0.60	5.1	3.1	10.5	0.97	3.9	3.8	12.5
120	0.58	5.7	3.1	10.2	0.98	4.1	4.0	13.1
160	0.75	4.9	3.7	9.2	0.93	4.7	4.3	14.3
200	0.74	4.8	3.7	13.8	0.90	4.9	4.3	14.4
240	0.78	5.3	4.1	14.1	0.90	4.7	4.2	14.1
ALT-N[y]	0.74	6.4*	4.7*	15.5*	0.90	4.9	4.4	14.5
LSD[x]	NS	NS	NS	NS	NS	0.33	0.29	1.7

[z] Spring: total yield equaled 14 harvests from 5 May to 8 June, 2001. Fall: total yield equaled 12 harvests from 3 Oct. to 3 Dec., 2001.

[y] ALT-N = increasing and decreasing N levels throughout the season based on plant growth stage (120-160-200-120 mg/L). * = significant orthogonal contrast between the ALT-N treatment compared to all other N treatments.

[x] NS = Non-significant or significant at $P<0.05$. Source: Rodriguez, 2003.

Table 3. Effects of plant density on total yield and soluble solids content of 'Gal-152' muskmelon grown in a passively-ventilated greenhouse using soilless culture. Fall 2001.

	Total yield[x]				Fruit quality parameters		
Plant density (plants/m^2)	No of fruits per plant (fruits/plant)	Mean fruit weight (kg)	Fruits per square meter (fruits/m^2)	Weight per square meter (kg/m^2)	Width (mm)	Length (mm)	Soluble solids content (°Brix)
1.7	4.6	1.4	7.8	11.0	132	139	10.0
2.5	4.7	1.3	11.7	15.3	132	140	10.2
3.3	4.5	1.2	14.8	17.8	133	141	9.9
4.1	4.8	1.0	19.7	20.0	130	138	10.4
Significance	NS	NS	L*	L*	NS	NS	NS

[x] Total yield includes all 15 harvests from 13 October to 5 December, 2001.
[*] Significant and non-significant (NS) at P<0.05. L = linear effect. Source: Rodriguez, 2003.

Table 4. Effects of plant density on total yield and soluble solids content of 'Gal-152' muskmelon grown in a passively-ventilated greenhouse using soilless culture. Spring 2002.

	Total yield[x]				Fruit quality parameters		
Plant density (plants/m^2)	No of fruits per plant (fruits/plant)	Mean fruit weight (kg)	Fruits per square meter (fruits/m^2)	Weight per square meter (kg/m^2)	Width (mm)	Length (mm)	Soluble solids content (°Brix)
1.7	7.1	1.8	12.1	21.9	138	146	10.4
2.5	7.3	1.7	18.2	31.7	137	144	10.5
3.3	7.2	1.7	23.7	40.5	136	144	10.3
4.1	7.2	1.5	29.5	48.3	132	139	10.1
Significance	NS	L*	L*	L*	L*	L*	NS

[x] Total yield includes all 15 harvests from 23 April to 5 July, 2002.
[*] Significant and non-significant (NS) at P<0.05. L = linear effect. Source: Rodriguez, 2003.

Table 5. Yield of 18 squash cultivars grown hydroponically in a passively-ventilated greenhouse. Spring 2003.

Cultivar[z]	Baby squash number per plant	Baby squash weight (g)	Cull number per plant	Marketable number (fruit/m^2)	Marketable weight (kg/m^2)
Zucchini-type					
Bareket	16 h	409 i	< 1 b	45 g	1.4 gh
Eight Ball	20 gh	546 ghi	< 1 b	56 fg	2.0 h
Gold Rush	21 gh	435 hi	< 1 b	54 fg	1.4 h
Goldy	19 gh	420 hi	< 1 b	49 fg	1.4 h
Raven	25 gh	631 g	< 1 b	73 ef	2.6 ef
Revenue	22 gh	679 fg	3 b	81 e	3.8 bcd
Sebring	17 h	379 i	< 1 b	46 g	1.2 h
Yellow summer-type					
Seneca Supreme	48 bcd	1015 bcd	< 1 b	148 abc	4.0 bc
Sunray	40 de	843 c-f	2 b	118 d	3.2 cd
Supersett	43 bcd	850 c-f	4 b	119 d	3.0 de
Yellow Crookneck	42 cd	820 ef	18 a	133 cd	3.2 cde
Zephyr	27 fg	588 gh	3 b	95 e	3.0 de
Patty pan/Scallop-type					
Butter Scallop	51 b	961 b-e	2 b	161 ab	4.2 ab
Patty Green Tint	50 bc	1050 b	2 b	166 a	4.8 a
Starship	51 b	1022 bc	< 1 b	139 bcd	3.6 bcd
Sunburst	67 a	1229 a	2 b	170 a	3.8 bc
Cousa					
HA-187	34 ef	1004 bcd	< 1 b	94 e	3.6 bcd
Magda	27 fg	838 def	< 1 b	89 e	3.6 bcd
C.V.	13.6	12.6	124.8	13.1	13.5

[z] Yields are an accumulation of 28 harvests. Plants were grown from 14 Feb. to 15 May 2003. Source: Shaw and Cantliffe, 2004.