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Brightly Colored Pepper Cultivars For Greenhouse Production In Florida

Nicole L. Shaw and Daniel J. Cantliffe

University of Florida
Institute of Food and Agricultural Sciences
Horticultural Sciences Department
P.O. Box 110690, Gainesville, FL 32611-0690

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Abstract. Bell pepper (*Capsicum annuum* L.) grown in Florida has traditionally been field-grown and harvested at a mature-green stage. However, the demand for high-quality colored pepper has led producers to look at pepper grown under protected structures. Thirty-six colored pepper cultivars (red, orange, yellow, chocolate, and purple) from both Israeli and Dutch seed companies were compared during the Fall 2000-Spring 2001 season in Gainesville, FL. Seedlings were transplanted 28 July 2000 into 11 L black-polyethylene pots filled with medium-grade perlite and grown in a double-layer polyethylene-covered high-roof greenhouse with passive ventilation. Plants were pruned once to two stems and trellised during growth using the Spanish-style growing method. Plants were harvested 20 times from 13 October 2000 until 8 March 2001. Total marketable yield varied from 6.9 to 11.3 $kg \cdot m^2$ depending on cultivar. 'Amos', 'Pekin', and 'Lion' produced the greatest marketable yield of the red, yellow, and orange cultivars, respectively. Marketable number of fruit per plant varied from 10.8 for larger fruited cultivars (greater than 64 mm diameter) to 20 for smaller fruited cultivars (less than 64 mm diameter) even though marketable weight per plant was the same (2.6 to 3.4 kg per plant). Number of fruits with blossom-end rot disorder or those that were culled, ranged from less than one fruit per plant to 5 fruit per plant depending on cultivar. Fruit quality characteristics such as average fruit weight, fruit height, fruit diameter, pericarp thickness, and presence of cracking or speckling were dependant on cultivar. Red cultivars 'Torkal' and 'Zambra'; yellow cultivars 'Kelvin', 'Neibla', 'Taranto', and 'Bossonova'; and orange cultivars 'Paramo', 'Lion', and 'Boogie' have proven suitable for production in Florida under protected conditions.

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U.S. growers produced 771,000 MT of bell peppers (*Capsicum annuum* L.) for all uses during the 1999-2000 season with 34% of the U.S. production coming from Florida (USDA, 2001). Florida pepper is shipped from October through the following July with supplemental winter imports coming from Mexico. However, increasing volumes of imported greenhouse pepper are available during the winter months at substantially higher prices (USDA, 2001). In 1982, the Dutch introduced colored greenhouse peppers to North America and due to overwhelming acceptance by the consumer, high returns have been stable (De Ruiter Seed Inc., newsletter 8).

While the Florida pepper industry has been traditionally field-grown and harvested at a mature-green stage, consumer demand for high-quality colored pepper, competition with other production areas, and the upcoming loss of methyl bromide may lead the industry into hydroponic greenhouse production. The leading worldwide producers of colored-greenhouse pepper are Holland, Spain, and Israel (Hassall & Associates Pty Ltd, 2001). U.S. commodity brokers can import peppers from Holland, March to November, from Spain, December through April, and from Israel, November through April (Merex Food Corporation, Miami, FL). Other pepper imports come from Canada, March to December, and Mexico, from late November through May. Florida, with a warmer climate, like Spain and Israel, has a major environmental advantage over Holland. In Holland, inputs for fossil fuels used to cool and heat the greenhouse are a large portion of the cost of production (Costa and Heuvelink, 2000), as well as, the added price of labor, marketing (Cantliffe and VanSickle, 2002), and shipping or air-freighting the commodity. Florida's mild-winter climate and proximity to market gives the grower a desirable advantage over the competition.

Yield of greenhouse pepper in Holland has been reported at 24 $kg \cdot m^{-2}$ yearly with low inputs of biocides (7 kg active ingredient per year; Costa and Heuvelink, 2000). On the other hand, production in Spain is about 7 $kg \cdot m^{-2}$ yearly with a 6.5 times greater use of biocides (46 kg active ingredient per year). Factors contributing to the high use of biocides in Spain include, the high greenhouse density, the continuous cultivation of crops resulting in a continuous host for pests and disease, disposal of organic waste near the greenhouse, lack of insect screens to prevent pest entrance into the greenhouse, and developed pest resistance to biocides (Costa and Heuvelink, 2000). More recently, the Spanish have adopted many of the production techniques used in Holland with successful results and continue to market excellent product in Europe. Spain will soon increase its market share in other parts of the world, including the U.S. (Cantliffe and VanSickle, 2001).

The Protected Agriculture Project of the Horticultural Sciences Department at the University of Florida (www.hos.ufl.edu/protectedag) is working to promote and improve the greenhouse industry in the southeastern U.S. Past research has been conducted on new commodities such as the Beit Alpha cucumber (Shaw et al., 2000) and the Galia muskmelon (Shaw et al., 2001), both of which are dominate in the European market. The objectives of this research were to identify suitable colored pepper cultivars for greenhouse production in Florida in order for Florida producers to be highly competitive with the import market.

Materials and Methods

Seeds of thirty-six pepper cultivars were donated for the trial. The following cultivars were from Hazera Seeds, Inc. (El Segundo, CA): 19, 866, 867, Amos (1589),

1711, 1931, 1972, 1976, 2001, 3367, 3378, 3839, 3841, 3843, 3845, ICO398, and Paso Real. Pekin was received from Semillas Fito, S.A. (Barcelona, Spain). De Ruiter Seeds C.V. (Bergschenhoek, The Netherlands) contributed: Cubico, Kelvin, Lorca, Paramo, Parker, Torkal, and Neibla. Enza Zaden B.V. (Enkhuizen, The Netherlands) donated: Campino, Choco, Lion, Mavras, and Triple 4. Rijk Zwaan Export B.V. (DeLier, The Netherlands) contributed the following: Boogie, Bossanova, Emily, Flamenco, Taranto, and Zambra.

Pepper seeds were sown in 2.54 cm x 2.54 cm Speedling styrofoam trays (Speedling Inc., Sun City, FL) on 16 June 2000. Transplant medium was a mixture of 60% peat and 40% vermiculite. After emergence, seedlings were fertilized twice weekly with a 100 ppm solution of N-P-K made from Peters Professional All Purpose Plant Food (Spectrum Group, St. Louis, MO). Seedlings were grown in a fan and evaporative pad-cooled glasshouse at temperatures of 28°C day and 22°C night.

Peppers were grown at the Horticultural Research Unit in Gainesville, Florida in a passive-ventilated greenhouse. The greenhouse structure (Top Greenhouse Ltd., Israel) was covered in double-layer polyethylene with 3.6-m high sidewalls and a 1-m roof vent. Both the sidewalls and roof vent were covered with 0.6 mm insect screen (Klayman Meteor Ltd., Petah-Tikva, Israel). On 28 July 2000, six-week old seedlings were transplanted into 11 L black-polyethylene nursery pots (Lerio Ltd., Kissimee, FL) filled with medium-grade perlite (Airlite Processing Corp. of Florida, Vero Beach, FL).

Irrigation scheduling was based on plant need to achieve 10-20% daily leachate from the container. A programmable timer was used to schedule irrigation length and frequency (Superior Controls, Co., Inc., Valencia, CA). Irrigation and nutrients were delivered to the plants via individual pressure-compensating emitters (Netafim, FL). Plants were fertilized in accordance with University of Florida recommendations for tomato (Hochmuth and Hochmuth, 1998). The level of nitrogen (N) was gradually increased during the season from 70 ppm at transplanting to 150 ppm during fruit maturation. Due to the heavy vegetative growth and fruit load on the plants, N was maintained at 150 ppm during the winter months. Potassium levels increased from 120 ppm at transplant to 170 ppm during fruit maturation and remained at 170 ppm for the rest of the season. Magnesium was increased in early October from the recommended level of 50 ppm to 80 ppm due to noticeable leaf chlorosis. Phosphorus, calcium, sulfur, and all micronutrient concentrations remained the same throughout the crop at 50 ppm P, 135 ppm Ca, 65 ppm S, 3 ppm Fe, 0.2 ppm Cu, 0.8 ppm Mn, 0.3 ppm Zn, 0.7 ppm B, and 0.06 ppm Mo. The pH of the final delivered nutrient solution was maintained between 5.5 and 6.5.

Peppers were pruned and trellised using the Spanish-trellising system (Jovicich et al., 2002; Jovicich, 2001). The Dutch pruning system for pepper laboriously uses twists and trellising on twines throughout the season while the Spanish-style requires plants be pruned once to two stems with no further pruning required, thus reducing labor requirements significantly. Pepper grown with the Spanish-style are held upright with horizontal twine placed about every 20 cm beginning at the first node of the plant. This system is similar to how field-grown tomatoes are trellised in Florida. As the pepper plant grows, the excess side shoots and leaves provide additional canopy for the developing fruit, as well as, potential increased sites for fruit set.

Pests and disease were minimal until late in the season. Because bumblebees (*Bombus impatiens*, Koppert Biological Systems, Inc., Romulus, MI) were used for pollination, compatible pest control measures were necessary including biological control. Daily scouting records were maintained to monitor for insects and disease occurrence. Broadmites (*Polyphagotarsonemus latus*) were found on the pepper at transplanting and subsequently controlled with a weekly rotation of Kelthane (Rohm & Haas, Philadelphia, PA) and Agri-mek (Novartis Crop Protection, Inc., Greensboro, N.C.) for four weeks. The bumblebees were introduced during September and further chemical applications were limited. For additional control of mites and the green peach aphid (*Myzus persicae*), approximately 2000 larvae or adult lady beetles (*Coleomegilla maculata*) and 500 big-eyed bugs (*Geocoris punctipes*, Entomos LLC, Gainesville, FL) were augmentatively released each month. About 1500 parasitic wasps (*Aphidius colemani*, IPM Laboratories, Inc., Locke, NY) for aphid control, were released in November and December 2000.

Powdery mildew (*Leveillula taurica*) developed during late January 2001. Due to the presence of beneficial insects, sulfur was not recommended as a control measure. Therefore, a biological fungicide, AQ 10 (Ecogen, Inc., Langhorne, PA) was used on a weekly basis. The powdery mildew subsided, however, by late February, the disease had been severe enough to partially defoliate the plants. Due to the level of powdery mildew on most of the peppers, the experiment was terminated 8 March 2001.

The experiment was conducted using a randomized complete block design with three blocks. Each plot consisted of five plants, with one plant per pot. Rows were 1.2 m from center to center and plants within each row were 30 cm apart. There were 20 harvests approximately one week apart. Those dates were: 13, 19, and 26 October 2000, 4, 9, 16, 21, and 28 November 2000, 5, 12, 19, and 29 December 2000, 4, 19, and 25 January 2001, 2, 9, 16, and 23 February 2001, and 8 March 2001. Fruit were graded according to standards used in Holland (Jovicich, 2001; DeRuiter Seed Inc., newsletter 8) into marketable or culled fruit, and then each lot was counted, and weighed per plot. Culled fruit were further separated if blossom-end rot was present, a nutritional disorder that may be more susceptible in some cultivars. Marketable fruits were divided into four size categories based on fruit diameter, small (55 - 64.9 mm), medium (65 - 74.9 mm), large (75 - 83.9 mm), and extra-large (> 84 mm). Total marketable yield was the combined total of fruit graded extra-large, large, and medium and free from blemishes, insect damage or blossom-end rot. For reasons associated with the marketing of colored pepper (i.e. commodities brokers in Holland handle only one color) data was analyzed within each color.

Fruit quality characteristics were recorded at four harvests, 13, 26 October and 9, 17 November 2000. Two medium, large, or extra-large fruit from each plot were measured for lobe number, fruit height, diameter, pericarp thickness, and presence of cracking (at the flower end of the fruit and pericarp), and color specking. Fruit height and diameter were measured using a slide-ruler. Pericarp thickness was performed at the equator of each fruit. The fruit were sliced and two random measurements within a lobe were taken using a Venier caliper (Bel-Art Products, Pequannock, NJ). The presence of cracking or color specking was either present or not present.

The data were subjected to analysis of variance and means were separated using Duncan's multiple range test, 5% level (SAS Institute, Cary, N.C.).

Results and Discussion

Plants were harvested 20 times from 13 October 2000 until 8 March 2001. Total marketable yields of each fruit color category are reported in Tables 1, 2, 3, and 4. Of the 23 red pepper cultivars little difference was observed in total marketable yield or fruit number per square meter (Table 1). Cultivars that produced less than 9.0 $kg \cdot m^{-2}$ were 1711, 1976, 3378, 3839, 3841, Cubico, and Parker. The remaining red cultivars had total marketable yields ranging from 9.0 to 11.3 $kg \cdot m^{-2}$. While the yields from this research were greater, they were comparable to those in Almeria, Spain (6 to 7 $kg \cdot m^{-2}$) for colored pepper harvested during the winter months (Costa and Heuvelink, 2000). Marketable fruit number per square meter was the same for most red cultivars, which ranged from 39 to 60 fruit. Of the 23 cultivars compared, 17 produced more than 50 fruit per square meter during the season; cultivars on the lower end were 1711, 1976, 3367, 3378, and Parker which produced 45 or less fruit per square meter. Average fruit weight for the red pepper cultivars varied from 150 g for 3841 to 231 g for 3367. The majority of the red cultivars ranged from 180 to 207 g per fruit. Among red pepper cultivars, there was no difference in cull number or weight per plant (Table 5). Cull number ranged from 1 to 5 fruit per plant and cull weight ranged from 0.11 to 0.42 kg per plant depending on cultivar. Some red cultivars produced significantly more fruit with blossom-end rot, however, the cultivars 3841, ICO398, Triple 4, and Torkal did not produce fruit with the disorder. Of all red cultivars, 1976 produced the greatest amount of fruit with blossom-end rot, with 5 fruit per plant over the season. The remaining 18 cultivars ranged from 1 to 3 fruit per plant with blossom-end rot. Blossom-end rot fruit weight was greatest for 1976 and 1711 at 0.6 and 0.4 kg per plant, respectively. There was little variation among the remaining 21 red cultivars for blossom-end rot fruit weight, ranging from 0 to 0.2 kg per plant.

There were no significant differences for total marketable yield, marketable fruit per square meter, and average fruit weight within each color for yellow, orange, chocolate, and purple colored cultivars (Tables 2, 3, and 4). Yields from the yellow cultivars ranged from 7.2 $kg \cdot m^{-2}$ and 38 fruit per square meter for Campino to 10.7 $kg \cdot m^{-2}$ and 52 fruit per square meter for Pekin (Table 2). Average fruit weights ranged from 165 to 212 g for the yellow cultivars. Yields from the orange pepper cultivars ranged from 6.9 $kg \cdot m^{-2}$ and 42 fruit per square meter for Emily to 9.6 $kg \cdot m^{-2}$ and 54 fruit per square meter for both Paramo and Lion (Table 3). Average fruit weights ranged from 161 to 178 g for the orange cultivars. Choco and Mavras, the chocolate and purple cultivars respectively, had the smallest fruit weight averages of all cultivars grown, 135 g and 140 g. However, the total marketable yields from the chocolate and purple cultivars were comparative to the other colored cultivars (approximately 9 $kg \cdot m^{-2}$ and 65 fruit per square meter, Table 4). Similar to the red cultivars, there was no difference among cultivars within each of the other fruit color categories for cull number or weight per plant (Table 5). The means for each fruit color for cull number produced were 2, 1, and 4 fruit per plant for yellow, orange, and purple and chocolate cultivars, respectively. More fruit per square meter were produced by the purple and chocolate cultivars than all other colors, which may lead to a greater potential of non-marketable fruit production. The average cull fruit weights were less than 0.2 kg per plant for the yellow and orange cultivars and 0.3 kg per plant for the purple and chocolate cultivars. Fruit with blossom-end rot were not produced within the orange cultivars. Of the yellow cultivars, only Campino

produced fruit with the disorder (0.8 fruit per plant). Fruit with blossom-end rot were minimal in the chocolate and purple cultivars at less than 0.2 fruit per plant over the season. Blossom-end rot fruit weight from Campino, Choco, and Mavras was 0.11 kg per plant.

There were significant differences among the red colored pepper cultivars for the individual fruit quality characteristics measured (Table 6). Most red pepper had less than 4 lobes per fruit, however, 1711, 3367, 3378, and 3343 generally had fruit with more than 4 lobes. Fruit height and diameter varied among the red cultivars and ranged from 66 to 105 mm in height and 78 to 89 mm in diameter, depending on cultivar. Pericarp thickness ranged from 5.0 mm for Lorca to 7.8 mm for 3367. The significant difference among red cultivars for pericarp thickness may be important in postharvest handling. For example, thicker pericarp may create a heavier fruit, therefore, less fruit may be required to fill a 5 kg shipping container, or thin pericarp may crack easier during handling.

Other quality characteristics recorded were the appearance of cracking at the flower end of the fruit and on the fruit pericarp, as well as, appearance of color specking. Causes of cracking and color specking disorders are unknown, but may be related to nutrition, irrigation, temperature and solar radiation at time of fruit maturation. Regardless of cause, some cultivars seem to be more susceptible than others to these disorders. Red cultivars with the most cracking at the flower end were 19, Amos, 1711, 1931, 1976, 3367, 3378, 3839, 3843, 3845, ICO398, Paso Real, and Flamenco. Red cultivars with cracking on the pericarp were 19, 1711, 3367, 3378, 3839, and 3841. Only 3841, 3843, and 3845 had higher amounts of fruit with color specking than all other red cultivars (data not shown).

There were significant differences among the yellow pepper cultivars for lobe number, fruit height, fruit diameter, and pericarp thickness (Table 7). Lobe number was greatest with 2001 at nearly 4 lobes, but was not significantly different than Neibla. Pekin fruit were significantly taller than fruit from all other yellow cultivars at 103 mm. Fruit diameter was 77 mm for 2001 and Kelvin compared to greater than 80 mm for all others. The cultivar, 2001, had the thickest pericarp at 6.5 mm. Pericarp cracking and color specking were not apparent for any yellow cultivar, however, the cultivar 2001 showed some cracking at the flower end of the fruit (data not shown).

There was no difference among the orange cultivars for fruit lobe number or pericarp thickness (Table 8). The average lobe number was about 3 lobes and the average pericarp thickness was 6.2 mm. Fruit from the cultivar Paramo were significantly taller than all other orange cultivars, 84 mm, but Paramo had fruit with the smallest diameter, 77 mm. Cracking at the flower end of the fruit or on the pericarp were not found with any orange cultivar, however, color specking occurred with the cultivar Emily (data not shown).

Choco and Mavras generally had fruit with 3 lobes and a pericarp thickness of 5.4 mm (Table 9). The purple cultivar, Mavras, was significantly taller and wider than Choco, 85 compared to 72 mm and 75 compared to 71 mm, height and diameter, respectively. Both Choco and Mavras showed signs of cracking at the flower end of the fruit and on the pericarp. Color specking was not apparent in either cultivar (data not shown).

In summary, the total marketable yield was acceptable for all cultivars when grown in a protected structure and harvested during the winter months. The red and

yellow cultivars produced yields 9 to 11 $kg \cdot m^{-2}$, the orange cultivars had yields of 7 to 10 $kg \cdot m^{-2}$ and the chocolate and purple cultivars were about 9 $kg \cdot m^{-2}$. When comparing cultivars for those with the highest yield and fruit quality characteristics with low amounts of culls or other disorders, the best red cultivars were: Lorca, Torkal, Triple 4, and Zambra; yellow cultivars were: Pekin, Kelvin, Neibla, Bossanova, and Taranto; and orange cultivars were: Paramo, Lion, and Boogie. Both Choco and Mavras produced high yields and quality fruit and may be desirable for specialty market production.

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Table 1. Total marketable yield and average fruit weight of red colored pepper cultivars. Gainesville, Fla. October 2000 – March 2001.

Cultivar	Total mkt. yield[z] ($kg \cdot m^{-2}$)	Fruit number per sq. m.	Average fruit weight (g)
19	9.9 a-d	51 a-f	196 bc
866	10.7 abc	58 abc	187 cd
867	10.4 abc	58 ab	180 cde
Amos	11.3 a	58 ab	193 bc
1711	7.5 f	39 f	194 bc
1931	9.5 a-f	51 a-f	186 cd
1972	10.7 abc	59 a	182 cde
1976	7.6 ef	42 def	182 cde
3367	10.2 a-d	45 c-f	231 a
3378	8.3 c-f	40 ef	207 b
3839	8.5 b-f	50 a-f	169 de
3841	8.0 def	53 a-e	150 f
3843	9.6 a-f	54 a-d	179 cde
3845	9.8 a-f	59 a	165 ef
ICO398	10.3 a-d	53 a-e	195 bc
Paso Real	10.3 a-d	52 a-e	197 bc
Cubico	8.5 b-f	51 a-f	167 ef
Lorca	9.0 a-f	49 a-f	189 bcd
Parker	8.8 b-f	45 b-f	194 bc
Torkal	10.8 ab	60 a	182 cde
Triple 4	10.5 abc	58 abc	182 cde
Flamenco	10.1 a-d	56 abc	181 cde
Zambra	9.9 a-e	57 abc	173 de
Significance[y]	0.0047	0.0022	0.0001
R-Square	0.59	0.62	0.79

[z] There were 20 harvests total from 13 October 2000 until 8 March 2001. Total marketable yield includes extra-large, large, and medium size fruit.

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

Table 2. Total marketable yield and average fruit weight of yellow colored greenhouse pepper. Gainesville, Fla. Oct. 2000 – March 2001.

Cultivar [z]	Total mkt. yield [z] ($kg \cdot m^{-2}$)	Fruit number per sq. m.	Average fruit weight (g)
2001	8.9	53	168
Pekin	10.7	52	212
Kelvin	9.1	54	169
Neibla	9.9	50	197
Campino	7.2	38	189
Bossanova	8.6	52	165
Taranto	9.8	52	186
Significance [y]	NS	NS	NS
R-square	0.68	0.61	0.59

[z] There were 20 harvests total from 13 October 2000 until 8 March 2001. Total marketable yield includes extra-large, large, and medium size fruit.
[y] Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

Table 3. Total marketable yield and average fruit weight of orange colored greenhouse pepper. Gainesville, Fla. Oct. 2000 – March 2001.

Cultivar [z]	Total mkt. yield [z] ($kg \cdot m^{-2}$)	Fruit number per sq. m.	Average fruit weight (g)
Paramo	9.6	54	177
Lion	9.6	54	178
Boogie	7.8	44	176
Emily	6.9	42	161
Significance [y]	NS	NS	NS
R-square	0.71	0.59	0.41

[z] There were 20 harvests total from 13 October 2000 until 8 March 2001. Total marketable yield includes extra-large, large, and medium size fruit.
[y] Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

Table 4. Total marketable yield and average fruit weight of chocolate and purple colored greenhouse pepper. Gainesville, Fla. Oct. 2000 – March 2001.

Cultivar [z]	Total mkt. yield [z] ($kg \cdot m^{-2}$)	Fruit number per sq. m.	Average fruit weight (g)
Choco	8.6	63	135
Mavras	9.1	65	140
Significance [y]	NS	NS	NS
R-square	0.28	0.47	0.59

[z] There were 20 harvests total from 13 October 2000 until 8 March 2001. Total marketable yield includes extra-large, large, and medium size fruit.
[y] Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

Table 5. Means of non-marketable fruit per plant for each pepper fruit color catagory. Gainesville, Fla. October 2000 – March 2001.

Cultivar color[z]	Cull fruit number	Cull fruit wt. (kg)	Blossom-end rot fruit number	Blossom-end rot fruit wt. (kg)
Red	2.2	0.21	**	**
Yellow	1.9	0.17	*	*
Orange	1.4	0.13	0	0
Chocolate and purple	4.1	0.32	0.12	0.01

[z] Where means are reported, statistical differences between cultivars were non-significant; *, ** significantly different at P ≤ 0.05 and 0.001, respectively.

Table 6. Fruit quality characteristics of red colored pepper cultivars. Gainesville, Fla. October 2000 – March 2001.

Cultivar [z]	Lobe number	Fruit height (mm)	Fruit diameter (mm)	Pericarp thickness (mm)
19	3.8 bcd	78 efg	88 ab	6.6 cde
866	3.5 bcd	84 c-f	85 bc	7.2 ab
867	3.7 bcd	78 e-h	82 cde	6.7 cde
Amos	3.6 bcd	80 d-g	82 cd	6.2 c-g
1711	4.3 a	105 a	78 ef	6.5 cde
1931	3.4 cd	86 cd	85 bc	6.8 bc
1972	3.6 bcd	75 gh	79 def	6.2 c-g
1976	3.6 bcd	84 c-f	80 def	6.5 cde
3367	4.0 ab	93 b	89 a	7.8 a
3378	4.0 ab	90 bc	88 ab	7.7 a
3839	3.3 d	86 cd	79 def	6.4 cde
3841	3.6 bcd	66 i	80 def	6.3 c-f
3843	3.9 abc	80 d-g	86 ab	7.3 ab
3845	3.4 cd	75 gh	85 bc	6.7 cd
ICO398	3.3 d	87 cd	80 def	6.3 c-f
Paso Real	3.5 bcd	84 cde	78 ef	6.2 c-g
Cubico	3.4 cd	83 def	80 def	5.1 hi
Lorca	3.5 bcd	80 d-g	82 cde	5.0 i
Parker	3.7 bcd	76 gh	79 def	6.3 c-f
Torkal	3.3 d	81 d-g	80 def	5.7 fg
Triple 4	3.5 bcd	77 fgh	80 def	5.7 gh
Flamenco	3.6 bcd	78 efg	80 def	6.1 d-g
Zambra	3.4 cd	71 hi	78 f	6.0 efg
Significance[y]	0.0021	0.0001	0.0001	0.0001
R-Square	0.14	0.58	0.46	0.53

[z] Fruit quality was recorded on 13, 26 October and 9, 17 November 2000.

[y] Means separation within each column using Duncan's multiple range test, P ≤ 0.05.

Table 7. Fruit quality characteristics of yellow colored greenhouse pepper. Gainesville, Fla. Oct. 2000 – March 2001.

Cultivar [z]	Lobe number	Fruit height (mm)	Fruit diameter (mm)	Pericarp thickness (mm)
2001	3.9 a	75 bc	77 b	6.5 a
Pekin	3.4 b	103 a	83 a	5.4 b
Kelvin	3.3 b	73 c	77 b	5.4 b
Neibla	3.6 ab	83 b	82 a	5.7 b
Campino	3.5 b	83 b	83 a	5.5 b
Bossanova	3.2 b	79 bc	81 a	5.6 b
Taranto	3.5 b	79 bc	83 a	5.7 b
Significance [y]	0.0060	0.0001	0.0001	0.0001
R-square	0.22	0.47	0.33	0.35

[z] Fruit quality was recorded on 13, 26 October and 9, 17 November 2000.
[y] Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

Table 8. Fruit quality characteristics of orange colored greenhouse pepper. Gainesville, Fla. Oct. 2000 – March 2001.

Cultivar [z]	Lobe number	Fruit height (mm)	Fruit diameter (mm)	Pericarp thickness (mm)
Paramo	3.4	84 a	77 b	5.0
Lion	3.6	76 b	81 a	7.5
Boogie	3.5	74 b	81 a	6.2
Emily	3.2	75 b	79 ab	6.0
Significance [y]	NS	0.0001	0.0188	NS
R-square	0.12	0.39	0.19	0.12

[z] Fruit quality was recorded on 13, 26 October and 9, 17 November 2000.
[y] Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.

Table 9. Fruit quality characteristics of chocolate and purple colored greenhouse pepper. Gainesville, Fla. Oct. 2000 – March 2001.

Cultivar [z]	Lobe number	Fruit height (mm)	Fruit diameter (mm)	Pericarp thickness (mm)
Choco	3.3	72 b	71 b	5.4
Mavras	3.6	85 a	75 a	5.4
Significance [y]	NS	0.0004	0.0006	NS
R-square	0.21	0.41	0.44	0.12

[z] Fruit quality was recorded on 13, 26 October and 9, 17 November 2000.
[y] Means separation within each column using Duncan's multiple range test, $P \leq 0.05$.