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Evaluation of Several Lettuce (*Latuca sativa* L.) Cultivars Grown Inside a Greenhouse Using Nutrient Film Technique

Robert C. Hochmuth*[1], Wanda L. Laughlin[1], and Aparna Gazula[2]

[1]*University of Florida, IFAS, Suwannee Valley Agricultural Extension Center, 7580 County Road 136 East, Live Oak, FL 32060*

[2]*University of Florida, IFAS, Alachua County Extension, 2800 NE 39th Avenue, Gainesville, FL 32609-2658*

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Small greenhouse and outdoor hydroponic growers in Florida have recently shown an increased interest in growing a wide variety of vegetables for local direct to consumer sales. These markets typically demand a diversity of vegetables to be offered and even diversity within a particular crop. This demand would include leafy vegetables such as lettuce (*Latuca sativa* L.) and would also likely include many different types, cultivars, and colors of lettuce. Very few lettuce cultivar trials have been conducted in Florida to provide recommendations on the best types or cultivars within various types of lettuce that are suitable for greenhouse production. A randomized complete-block design trial replicated three times was conducted at the Suwannee Valley Agricultural Extension Center in Live Oak, FL, during the winter and spring of 2012. The trial was conducted using the nutrient film technique in channels 4 inches wide and 10 ft long. Fifteen cultivars of various types of lettuce were evaluated for yield, color, susceptibility to tip burn, and overall quality appearance. Lettuce types included romaine, bibb, butterhead, and lollo. Several cultivars performed well in yield and quality during the first trial in January when temperatures were moderate. However, during the subsequent trials, temperatures were unusually high and several cultivars showed susceptibility to leaf tip burn, a common calcium-related disorder in lettuces grown in warm greenhouses. The trial results showed the best adapted cultivars for Florida greenhouse production using nutrient film technique culture and also showed varieties that are not appropriate in Florida due to size, quality, or leaf tip burn concerns.

Greenhouse and other types of protected culture in Florida have become very popular in Florida in the last few years. Part of the increased popularity is due to market demand for high quality, fresh, locally grown specialty crops. One of the most popular vegetables sold at local farmer markets is lettuce. A mix of several types and colors of lettuce make it an attractive and diverse offering by farmers. The increased demand for locally grown vegetables has created new opportunities for small and beginning farmers to establish a specialty crop enterprise. Using protected culture, such as a greenhouse, high tunnel, or even open shade structures, allows farmers to extend the market season and produce very high quality products.

Very little research has been done in Florida to evaluate lettuce cultivars for their performance in a greenhouse over a range of climatic conditions (Fedunak and Tyson, 1997). This trial was conducted to evaluate a wide range of lettuce cultivars and colors for their adaptability to production in Florida greenhouses.

Materials and Methods

The trial was conducted in a 30 × 60 ft stand-alone Atlas Greenhouse (Alapaha, GA) with a propane heat system and passive ventilation. The passive ventilation system included screened open sidewalls with automated polyethylene curtains, and an automated ridge vent at the greenhouse peak. The greenhouse glazing was a double layer of clear polyethylene. Environmental controls were set to maintain a minimum temperature of 60 °F and a maximum temperature of 85 °F.

The lettuce cultivar trial was conducted using a standard nutrient film technique (NFT) system with 10-ft channels provided by Crop King (Lodi, OH). This system included an automated pH and electrical conductivity (EC) sensing and dosing system. The pH was set at 5.8 and the EC was set at 1.8 millimos. The nutrient solution provided approximately 120 ppm N, 50 ppm P, 200 ppm K, 48 ppm Mg, 220 ppm Ca, 60 ppm S, 3.5 ppm Fe, 0.3 ppm Cu, 1.3 ppm Mn, 0.3 ppm Zn, 0.7 ppm B, and 0.05 Mo (Hochmuth and Hochmuth, 2008). The 220 ppm Ca is provided by the combination of calcium nitrate (150 ppm) and calcium in the well water (70 ppm). The NFT pumping system recirculated the nutrient solution constantly in channels all day and night. The NFT channels were two piece 10-ft long channels and made of coextruded PVC. The top cap has pre-punched 1-inch-square holes on 8-inch centers.

Seeds of 15 lettuce cultivars were provided by Johnny's Selected Seeds (Winslow, ME). Lettuce types, as described by Johnny's Selected Seeds, included romaine, bibb, lollo, and butterhead. Seeds were placed in 1-inch-square rockwool seed cubes and grown for approximately 4 weeks at which time the transplants were placed into the NFT channels. This research trial included three consecutive crops. The first was seeded on 18 Nov. 2011, the

*Corresponding author; phone: (386) 362-1725 ext. 103; email: bobhoch@ufl.edu

Fig. 1. First crop of 15 lettuce cultivars grown in a nutrient film technique system ready for harvest.

second crop on 22 Dec. 2011, and the third crop on 3 Feb. 2012. All crops were monitored for insects and disease on a weekly basis, yet no pesticide applications were necessary.

Plots were established by using five plants of each of the 15 cultivars (Fig. 1). Plots were arranged in a randomized complete-block design with three replications. A once-over harvest was used to collect yield and quality parameters. Plants were harvested by cutting the stem at the top of the NFT channel. Measurements were taken on fresh weight and height. Observations were also made for leaf color and compactness of heads. A rating for severity of leaf tip burn was also given to each plot, with rating of 0 = no tip burn and rating of 5 = severe tip burn on all plants in the plot.

All data were analyzed using SAS statistical software (SAS Institute, Inc., Cary, NC). ANOVA was performed and significant differences between treatment means were separated using Duncan's Multiple Range Test.

Table 1. Harvest weights of three crops of several lettuce cultivars grown in a greenhouse.

Lettuce cultivar	Harvest 1	Harvest 2	Harvest 3
Coastal Star	1.65 a	1.93 a	2.57 a
Ridgeline	1.61 a	2.21 a	2.67 a
Rex	1.43 ab	1.49 b	1.70 b
Adriana	1.41 ab	2.08 a	2.47 a
Flashy Trout Back	1.40 ab	2.03 a	2.41 a
Bambi	1.18 bc	1.37 b	1.72 b
Livigna	1.11 bcd	1.36 bc	1.79 b
Red Cash	1.09 bcd	1.52 bc	1.70 b
Skyphos	1.08 bcd	1.30 bc	1.62 b
Australe	1.04 bcd	1.10 cd	1.45 bc
Focea	0.84 cde	1.06 cde	1.57 b
Breen	0.75 de	0.93 de	1.05 cd
Rhazes	0.66 e	0.56 f	0.93 d
Amaze	0.58 e	0.45 f	1.03 cd
Antago	0.57 e	0.72 ef	0.80 d
Significance	***	***	***

***Significant at $P < 0.001$.

Results and Discussion

Harvest weights of the five plants per plot in the first trial crop ranged from 0.57 to 1.65 lb per plot (Table 1). Romaine cultivars 'Coastal Star' and 'Ridgeline' were typically among the highest weights in all three harvests, but were not significantly different from 'Adriana' and 'Flashy Trout Back' in all three harvests and 'Rex' in the first harvest. The lowest weights were found with 'Antago', 'Amaze', and 'Rhazes' in all three harvests. The harvested lettuce heads were weighed but not graded further for quality, other than tip burn.

During the first crop harvest, all heads were of marketable quality with no defects noticed. However, during the harvests of both the second and third crops many cultivars exhibited symptoms of leaf tip burn, a calcium-related disorder (Table 2) (Fig. 2). Tip burn is associated with low tissue calcium but is known to be a more common disorder in extremely high temperatures. Even

Table 2. Evaluation of lettuce cultivars for tip burn.

	Tip burn rating (0–5)		
Lettuce cultivar	Harvest 1	Harvest 2	Harvest 3
Bambi	0	5.0 a	4.00 a
Focea	0	4.67 a	2.00 b
Flashy Trout Back	0	4.67 a	4.33 a
Australe	0	4.17 ab	1.67 b
Red Cash	0	4.00 ab	1.67 b
Adriana	0	4.00 ab	0.00 b
Rhazes	0	3.67 abc	0.00 b
Amaze	0	3.00 bcd	2.00 b
Breen	0	3.00 bcd	0.00 b
Ridgeline	0	2.50 cd	0.67 b
Coastal Star	0	1.67 d	0.00 b
Skyphos	0	0.33 e	0.00 b
Rex	0	0.00 e	0.00 b
Livigna	0	0.00 e	0.33 b
Antago	0	0.00 e	0.00 b
Significance	NS	***	***

NS, ***Nonsignificant or significant at $P < 0.001$, respectively.

Fig. 2. Severe tip burn of lettuce in the cultivar 'Bambi'.

Table 3. Observational data for color, height, and compactness of heads in several lettuce cultivars.

Cultivar	Type	Main leaf color	Avg ht (inches)	Compactness rating (1–5)[z]
Breen	Romaine	Red	6.5	2.6
Red Cash	Romaine	Red	9.8	3.2
Flashy Trout Back	Romaine	Red (speckled)	7.4	2.5
Amaze	Romaine	Red	6.1	3.1
Coastal Star	Romaine	Green	10.1	3.1
Ridgeline	Romaine	Green	10.9	3.0
Rhazes	Bibb	Red	5.9	4.0
Bambi	Bibb	Green	6.3	4.7
Antago	Lollo	Red	7.0	1.0
Livigna	Lollo	Green	6.5	2.8
Australe	Butterhead	Red	5.9	3.5
Skyphos	Butterhead	Red	6.0	2.3
Andriana	Butterhead	Green	6.0	4.0
Focea	Butterhead	Green	5.5	4.1
Rex	Butterhead	Green	4.7	4.7

[z]Compactness ratings were taken on the first crop only at harvest and were made on a scale of 1 to 5, 1=loose open heads, 5=very compact heads. Note: Measurements for average height and ratings for compactness of the heads are reported here as observational data, not subjected to statistical analysis since the data were not collected on every crop.

though no plants of any cultivar exhibited tip burn in the first crop, 'Bambi' and 'Flashy Trout Back' showed severe tip burn in both the second and third crops. In addition, 'Focea', 'Australe', and 'Red Cash' exhibited high levels of tip burn in both the second and third harvests. Cultivars with no or very low levels of tip burn in the later two crops were 'Antago', 'Livigna', 'Rex', and 'Skyphos'. 'Rex', a green butterhead cultivar, has been known for tolerance to tip burn. The green Romaine cultivars, 'Coastal Star' and 'Ridgeline', showed moderate levels of tip burn and were not significantly different from each other.

Daily maximum temperatures in the greenhouse were not recorded; however, periodic maximum temperatures were noted. Maximum temperatures during the first crop were typically in the upper 80 °F range, while during the second crop were in the mid to upper 90s (°F) and during the third crop in the low to mid 90s (°F). The most extreme high temperatures during the second crop coincided with the highest level of tip burn.

It is difficult to draw too many overall conclusions in the trial due to the high variability of tip burn in the three crops. However, the best overall performers during the second and third crops would be related to tip burn tolerance. If low to moderate temperatures would be expected, as during the first crop, all cultivars performed very well and could be selected depending on the lettuce type, color, and head quality desired (Table 3). Several cultivars exhibited unique colors, shapes, and sizes to meet the local demands of direct market consumers.

Literature Cited

Fedunak, C.A. and R.V. Tyson. 1997. Lettuce cultivars for low-tech non-circulating hydroponics. Proc. Fla. State Hort. Soc. 110:384–385.

Hochmuth, G.J. and R.C. Hochmuth. 2008. Nutrient solution formulation for hydroponic (perlite, rockwool, NFT) tomatoes in Florida. Univ. of FL Coop. Ext. Serv. EDIS Publ. HS-796:13 p. <http://edis.ifas.ufl.edu/cv216>.