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UF IFAS Extension UNIVERSITY of FLORIDA

HS1258

An Overview of Lettuce Production Systems and Cultivars Used in Hydroponics and Protected Culture in Florida[1]

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Lettuce (*Lactuca sativa*), a member of the sunflower family Asteraceae, follows only potatoes as the most widely grown fresh vegetable in the United States today. Originally cultivated from its wild parent thousands of years ago in ancient Egypt, lettuce consumption had spread by the late 1900s to be enjoyed the world over (Harlan 1986). Americans eat 30 pounds annually per capita—five times more than a century ago. Lettuce is an excellent source of vitamins A and K as well as a good amount of C, some B vitamins, and other phytonutrients. Darker green and red leaves of certain lettuce varieties provide more overall nutrition than lighter green ones (Bunning and Kendall 2012).

Ranking behind only California and Arizona as the US's third-largest producer of lettuce in the country, Florida enjoys nearly year-round growing potential. Though typical commercial lettuce production extends from late September through May, with correct variety selection and protected culture strategies, lettuce is a crop that can present even the novice grower with a fast-growing commodity for market sale. Given more marketing opportunities for specialty crops than ever before, such as farm-to-school programs, restaurants/chefs, farmers markets, and CSAs (Community Supported Agriculture programs), farmers can rely on lettuce as a steady and profitable commodity for any size operation (Hochmuth and Cantliffe 2012).

Why Hydroponics?

The "local food movement" in the U.S. continues to grow as consumers of produce are interested in knowing specifically where their foods originate, how far they have traveled from farm to market, and what health benefits can be provided by these fresh offerings. This trend has brought about significant gains in Florida, particularly in the numbers of small- and medium-scale farm operations, which aim to target this hungry marketplace of consumers. However, with urbanization (particularly in south Florida) of once-plentiful agricultural lands, issues over water availability, loss of key chemical inputs necessary to overcome soil-borne pathogens and insect pressures, and market preferences, the hydroponics industry presents itself as a viable alternative growing method to address many of these issues. In the past 40-plus years, Florida has seen a recent very rapid increase of protected culture agriculture from 20–30 acres in the 1970s, to 95 acres in 2001, to over 385 acres in 2013 (Hochmuth and Toro 2014). Hydroponic farms of all sizes operate year-round within greenhouses, high tunnels, shade houses, open field systems, and many variations in between.

Hydroponic Lettuce Systems in Brief

Regardless of the methods of protecting crops in Florida, several hydroponic systems serve as the industry preference for lettuce cultivation. The predominant design in

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greenhouse lettuce production remains the Nutrient Film Technique (NFT). Consisting of plastic or other lightweight channels, gutters, or tubes, there are compartments in each container holding multiple transplants, while a thin film of nutrient solution trickles over the bare roots of each plant. The nutrient solution is initially stored in a reservoir, pumped out into these channels at a sloped angle, drained down to a catchment system, then filtered or aerated and cycled back to the reservoir for reuse (Figure 1).

Figure 1. Nutrient Film Technique (NFT) lettuce production
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Another common but less complicated technique is the floating raft method of lettuce production. The simplest of all production systems, it consists of a thick sheet of extruded polystyrene foam (i.e., Styrofoam™), which floats on top of a container of a nutrient solution. Some variations exist in the design of the holding containers and in the types of protected culture under which the floating rafts are used (Figures 2 and 3).

Figure 2. Example of floating raft system
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Figure 3. Example of backyard floating raft system
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A third system gaining a great deal in popularity, especially in areas where land is at a premium, is the vertical tower method. Consisting of an upright pole with several polystyrene or plastic pots stacked one on top of another, these towers can be configured in many ways and suit many different types of crops. A second type of vertical system features an aeroponic tower (used without water culture or media), usually fabricated from plastic with various growing compartments. Whether placed outdoors or within greenhouses, these growing systems make use of vertical growing space, yielding efficient and dense plant capacity (Figures 4 and 5).

Figure 4. Vertical tower method of lettuce production
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Figure 5. Vertical aeroponic towers of lettuces
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A final model for hydroponic lettuce production is the ground/landscape pot or upright plastic bag model. Usually filled with media such as coconut coir, perlite, or composted pine bark, these upright containers provide another cost-efficient way for farmers in Florida to efficiently produce lettuce for market (Tyson et al. 2013) (Figure 6).

Figure 6. Lettuce in lay-flat ground bags
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Regardless of the hydroponic production methods or systems used, there remain agronomic challenges for all farmers throughout the state. Any selection of protected agriculture will depend upon the predominant issues specific to the locale (e.g., protection from frost may be more of a consideration in Tallahassee than in Homestead), and wide variations will occur in the farm operations. In more northern Florida latitudes that bring sub-freezing temperatures on a regular basis, greenhouses are the industry standard for wintertime hydroponic lettuce production. Central and southern farmers often rely upon ventilated high tunnels during colder months and use shade structures to extend the season on either end when tropical temperatures and humidity are present. Depending widely upon the growing zone and what a farm operation is using to address adverse weather conditions, protective structures may allow for more versatility than traditional, field-crop models. Additionally, one must be careful to consider that the following specific lettuce cultivars are suggestions for farmers and do not actually guarantee successful cultivation techniques or profitable economic returns.

Lettuce Types

Lettuces generally are characterized by their head formation or leaf type. While crisphead or "iceberg" is by far the most common staple type grown in the United States, it is not yet considered appropriate or profitable for typical hydroponic production. The other main categories of lettuce types can be divided as follows:

Butterhead, Boston, or Bibb: This type is by far the primary greenhouse type overall. A delicate type, Butterhead is creamy-colored to light green on the inside and loose, soft, and ruffled green on the exterior. It is almost exclusively grown to full-head size for harvest (Figure 7).

Figure 7. Butterhead/Bibb lettuce
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Looseleaf, Leaf, or Cutting: This is the second most commonly grown hydroponic lettuce type behind the Butterhead. The category of "leaf" lettuce includes many subcategories, such as oakleaf, lollo, multileaf, summer crisp (somewhat of a cross between crisphead and true looseleaf, also referred to as French crisp/Batavia), and "Salanova." These types can be found in a wide variety of shapes, sizes, and colors, depending upon preference (Figure 8).

Figure 8. Loose leaf lettuces
Credits: Natalie B. Parkell

Romaine or Cos: These lettuce types are typically a robust 8–12 inches tall and upright growing, with spoon-shaped, tightly folded leaves and thick ribs. Usually darker green on the exterior, they mellow to light green/white on the interior leaves. Romaine types of lettuce are grown equally for their full head as for their baby leaves for salad blends (Figure 9).

Lettuce mixes/blends: A combination of several of the above types, these are often sold as pre-mixed seeds and are often grown in combination with other leafy greens for baby salad blends. This lettuce category is gaining in popularity as a marketing type for local farmers markets and restaurant sales (Figure 10).

Figure 9. Romaine lettuce
Credits: Kevin S. Osburn

Figure 10. Baby lettuce blend
Credits: Natalie B. Parkell

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Table 1. Summary of lettuce cultivars, descriptions, and types successfully grown in Florida using protected agriculture and hydroponic techniques.

LETTUCE TYPE	CULTIVAR NAME	COLOR	HARVEST STAGE FOR MARKET[z]	COMMENTS[y]
BUTTERHEAD, BOSTON, or BIBB	Charles	green	H, M	Medium sized, thick leaves, slow to bolt and strong against tip-burn
	Laurel	green	H	Replaces variety "Salina," great for indoor or outdoor production
	Rex	green	H	Industry standard, performs well year round in many hydroponic systems
	Rhazes	red	M	"Little Gem" type, dark-red foliage with bright green heart, slow to bolt
	Skyphos	red	H	Excellent flavor and texture, consistent performance, large size, slow bolting
LOOSE LEAF	Cherokee	red	H, M	*Summercrisp*, very slow bolting, excellent heat tolerance, thick dark burgundy leaves with good flavor
	Concept	green	H	*Summercrisp*, good winter performer, excellent color and taste
	Dark Lollo Rossa	red	H, B	*Lollo*, heavily frilled leaves, good color even in low light indoors or under row cover
	Mottistone	speckled	H	*Summercrisp,* medium-sized upright plants, unusual coloring for diverse markets
	Navara	red	H, B	*Oakleaf*, compact, attractive shiny red leaves, slow to bolt
	Nevada	green	H	*Summercrisp*, excellent year-round, grows well under shade for summer, excellent color and taste
	New Red Fire	red	H	*Leaf*, heat tolerant and slow to bolt, heads are heavy with frilly leaves
	Oscarde	red	H	*Oakleaf*, deep cherry-red large-lobed leaves even under low light
	Panisse	green	H	*Oakleaf*, large lime-green leaves, dense heads, excellent flavor
	Tropicana	green	H, B	*Leaf*, heavy bright-green leaves, good heat tolerance, slow to bolt
ROMAINE	Coastal Star	green	H	Darkest green leaf of all types, heat tolerant, heavy heads
	Counter	green	H	Exceptionally fast to maturity, highly adaptable for greenhouse and heat tolerant
	Green Forest	green	H	Best overall performer for tip burn and bolt resistance
	Parris Island	green	H, B	Standard variety for green baby leaf mixes
	Flashy Trout Back	speckled	H, B	Eye-catching color (spots darken from red to maroon as it matures), good performer
	Outredgeous	red	H, B	Consistent performer, maintains color even under low light, ruffled leaf edge
	Thumper	green	M	Compact "Little Gem" type, strong against tip burn and very slow bolting
LETTUCE BLENDS	Allstar Gourmet Lettuce Mix	Green/red	B	Includes green oakleaf, red oak, green romaine, red romaine, red lollo and red leaf—dark colors even under low light conditions. Great baby salad blend.
	"Multy" lettuces (Paramount)	Green/red	H, B	Sold as full-sized heads or cut as baby leaves and blended for salad mix.
	"Salanova" (Johnny's)	Green/red	H, B	Multiple marketing possibilities, very heat tolerant, no bolting even in summer greenhouse production.

Z: Typical harvest stages for market = H for full sized head, M for mini-head, or B for baby leaf or salad blend. Each of these harvest stages is priced and sold as a different product option in the marketplace.

Descriptions for all lettuce cultivars adapted from the following grower and industry sources: Johnny's Selected Seeds, Paramount Seeds and Glen Kaufman, Tim Carpenter, Dr. Howard Resh, Wanda Laughlin, and Natalie B. Parkell. The selection of a cultivar as being "successfully grown" was based on the combination of University of Florida research, industry trials, and grower experiences in Florida.