Extended Season Lettuce Production

Lewis W. Jett[1]
West Virginia University Horticulture Specialist

Figure 1. High tunnels can be used for extended season head lettuce production.

Lettuce (*Lactuca sativa* L.) is a high-value crop for many retail and wholesale markets. Lettuce is a cool season crop with an optimal temperature for growth of 60-65°F, yet it may be possible to grow a lettuce crop year-round in the Mid-Atlantic region using a combination of suitable varieties and season extension technology (Figure 1).

Lettuce is the second most widely grown crop within high tunnels in the United States behind tomatoes. Bibb and romaine head lettuce are two popular head lettuces. Bibb lettuce or butterhead lettuce has loose, open heads with soft or tender leaves while romaine or cos has long, firm leaves with prominent midribs (Figure 2). Bibb lettuce is an excellent choice for expanded local production because it does not ship well over long distances. Romaine lettuce has a more vertical or upright growth and produces a very dense head of leaves. Both types of head lettuces can be harvested at the baby stage for specialty markets,

Figure 2. Romaine (left) and bibb (right) lettuce for extended season production.

Recommended Varieties:

Table 1. List of lettuce cultivars recommended for high tunnel production in West Va...

Cultivar	Days to maturity[z]	Description
Bibb types:		
Alkindus	60	Red bibb
Nancy	52	Boston bibb type
Rex	50	Hydroponic type with good heat tolerance
Skyphos	47	Red buttercrunch
Red Cross	48	Red buttercrunch with heat tolerance
Buttercunch	46	Green bibb
Batavian types:		
Nevada	48	Green batavian; heat & cold tolerant
Magenta	48	Reddish green batavian
Cherokee	48	Red batavian
Romaine types:		
Dov	76	Heat tolerant summer romaine for extended season production
Monte Carlo	53	Green romaine
Jericho	58	Green romaine with heat tolerance
Coastal Star	58	Green romaine with heat tolerance
Breen	45	Red mini romaine
Green Forest	56	Green romaine
Salvius	58	Green romaine
Winter Density	54	Dark green romaine
Pomegranate Crunch	54	Miniature red romaine

[z]From direct seeding under optimal conditions.

Table 2. Yield and quality of cold weather lettuce trials 2016-17.

Variety	Type	Wt./head (lbs.)	Diameter (in.)	Quality	Marketable (%)
Green Forest	*Romaine*	1.1	10.5	4.8	72
Truchas	*Romaine*	0.6	9.2	4.6	56
Monte Carlo	*Romaine*	1.2	10.3	5.0	83
Bambi	*Romaine*	0.8	8.2	4.2	89
Dragoon	*Romaine*	0.8	10.4	3.7	61
Muir	*Batavian*	1.1	11.9	4.4	78
Concept	*Batavian*	1.1	11.7	4.6	72
Nevada	*Batavian*	0.9	10.7	4.1	72
Magenta	*Batavian*	1.3	11.3	4.8	89
Cherokee	*Batavian*	0.8	11.3	5.0	89
Ilema	*Lollo rosa*	0.7	11.3	4.6	72
Mirlo	*Bibb*	1.1	11.0	4.5	92
Red Cross	*Bibb*	0.8	12.6	5.0	89
Skyphos	*Bibb*	0.7	10.6	5.0	78
Buttercrunch	*Bibb*	0.9	10.2	3.7	94
Green Star	*Leaf*	1.0	12.3	3.5	84
Green Sweet Crisp	*Salanova*	1.0	12.5	4.4	94
Standard error		*0.03*	*0.2*	*0.1*	*3*

Transplant Production

For high tunnel lettuce production, the crop should be established from transplants. Transplants allow for earlier and more uniform harvest. Pelletized seed if available should be chosen. The container cell size should be approximately 1in^2.Suitable containers such as 96-128-cell plug trays can be used for growing lettuce plugs (Figure 3). The optimal temperature for transplant growth is 65-75°F. A 200 ppm nitrogen solution can be used to fertilize the growing transplants each week. The plugs are ready to be transplanted approximately 28 days from seeding

Figure 3. Head lettuce should be established as transplants for early and uniform maturity.

Figure 4. Shade cloth (30-50%) and white polyethylene plastic mulch are used to grow lettuce in mid-summer while black plastic mulch and rowcovers are used for spring and winter lettuce production.

C. Planting Within a High Tunnel

Lettuce can be established within a high tunnel every season of the year. Under optimal conditions, 50-75 days from seeding will be needed to begin harvest. When planted later in the year, the length of time from seeding to harvest increases. However, head lettuce for winter production should be planted before mid-November in West Virginia. Sequential planting for uninterrupted supply can be done every 2-3 weeks until mid-late November. Bibb lettuce should be spaced 8-10" apart within the row and 8-12" between rows. Romaine and Batavian lettuce should be spaced 10- 12" between plants and between rows on the bed. Typically a 3-4 row bed is optimal for lettuce production within a high tunnel. Plastic mulch is recommended since the mulch will be effective in regulating soil temperature and reducing soil moisture evaporation. In addition, the mulch helps to reduce soilborne diseases. Black plastic mulch (embossed) is recommended for early spring, fall and winter lettuce production, while white or reflective mulch should be used for summer lettuce production (Figure 4).
Lettuce requires frequent irrigation for optimal yield and quality. Drip irrigation with medium flow drip tape should be used for full season lettuce production. Each bed should have 2-3 drip line laterals. A 6-9 hour irrigation cycle per week should be followed depending on the season of the year. Beginning in mid to late November, irrigation can be curtailed.

D. Nutrient Management

The optimal pH for lettuce production is 6.5-6.8. Approximately one pound of actual nitrogen (N) per 1000 ft^2 is applied prior to planting lettuce. The remaining 0.5 lbs. of actual N per 1000 ft^2 of bed space can be applied through the drip system over the remaining 4-6 weeks of growth. Phosphorus (P) and potassium applications should be based on the most recent soil test. If phosphorus and potassium levels are optimal, fertilizer such as calcium nitrate (15.5-0-0) is recommended for lettuce production.

Six pounds per 1000 ft^2 can be applied prior to planting and the remaining 3.2 lbs. injected in the irrigation water over a 4-6 week period.

E. High Tunnel Temperature Management

The optimal temperature for production of head lettuce is 65-75°F. Thus, venting should be controlled to reach this temperature range. Most head lettuces will grow if the temperature is >40°F. When air temperatures exceed 85°F for extended periods of time, the lettuces will often bolt (produce a seedstalk), devlop tipburn or become bitter. A 30-50% shade cloth can be used to reduce air temperature within the high tunnel. Summer lettuce should be grown on white plastic mulch and irrigated daily. Row covers should be used to modify temperatures for lettuce growth. A 0.8-1.0 oz. /yd^2 row cover is recommended. When the minimum (night) temperatures are forecast to be lower than 40°F, row covers should be applied to the lettuce crop. The following morning (temperature permitting) the rowcovers can be removed. Avoid growing lettuce for extended periods of time under row cover since this will often produce tip burn symptoms on the leaves.

F. Pest Management

Common pests of lettuce and other leafy greens include aphids, slugs and grasshoppers. Routine scouting of the rows should be done to detect aphid "hot spots". These areas can be treated before the pest invades the rest of the crop. There are several organic and "soft" pesticides for aphid control. Consult the *Mid-Atlantic Commercial Vegetable Guide* for more information. Slugs can be controlled with iron phosphate baits while larger insects such as grasshoppers or crickets can be controlled with insect exclusion screens.

G. Harvest and Postharvest Handling

Lettuce is very perishable and must be harvested very carefully. Bibb and romaine lettuce are ready to harvest when the head diameter is 6-12 inches wide. Fresh weight of the head will range from1/4 to 2 lbs. Individual heads are hand-cut and any discolored leaves removed. Harvest containers such as plastic lugs are ideal for harvesting and storing lettuce (Figure 5). Individual heads can be washed prior to marketing. If the lettuce is stored, the optimal temperature is 32-36°F and 95% relative humidity.

Figure 5. Plastic harvest lugs are used to harvest, wash and store head lettuce.

G. Economics of High Tunnel Head Lettuce Production

Table 2. High Tunnel Head Lettuce Enterprise Budget per 1000 ft^2 (≈1980 heads).

Production Expense	Unit	Quantity	Price ($)	Labor (rate/h)	Type	Hours	Total Costs ($)
Variable Costs:							
Pre-planting:							
Soil test	Entire high tunnel		12.00	10.00	M	0.5	17.00
Tillage			5.00	10.00	M	0.5	10.00
Raised bed formation				10.00	M	3.0	30.00
Fertilizer and lime		1.3 lbs. N	7.80	10.00	M	0.5	12.80
Plastic mulch		189 linear ft.	7.56	10.00	M	1.5	22.56
Irrigation drip tape		189 linear ft.	4.70	10.00	M	0.5	9.70
Plant Costs:							
Planting trays	128 Plug trays	1 case	89.00				89.00
Transplant labor	1980 plugs	15 trays		10.00	M	17.0	170.00
Seed (pelleted)	1000 seeds	5000	1.95				3.90
Rooting media	3.8 ft^3	1 bale	19.00				21.00
Starter fertilizer	20-20-20	1 lb.	2.50				2.50
Production Costs:							
Insect/Slug control		6 sprays		10.00	M	3.0	90.90
Fungicide	Oxidate	18 ozs.	9.28	10.00	M	3.0	39.28
Irrigation/ Fertigation	15.5-0-0	6 lbs.	10.00				10.00
(Quick Hoops)	pipe	38 pipe	2.50	10.00	M	2.0	(114.50)
Row covers	roll	1.0	67.00				67.00
(Shade cloth)	roll	1890 ft^2	0.25/ft^2				(472.50)
Anchor pins	box	500 pins/box	35.00				12.00
Fuel and oil	gallons.	10.0	3.50				35.00
Temp. mgt[z].	hrs.	1.2 h/week		10.00		7.5	75.00
Transplanting	hrs.			10.00		8.0	80.00
Harvesting Costs:							
Cutting/washing	hrs.	1 h/bed		10.00		2.2	22.00
Postharvest Costs:							
Boxes/Lugs	lugs	12	14.00				168.00
Total Costs							**987.64**
Total Revenue[y]	heads	**1782**	**1.50**				**2673.00**
		1782	***2.00***				*3564.00*
Net Revenue							**1685.36**
							2576.36

[z]Venting labor varies with growing season.
[y]Assumes 90% marketable yield.

This publication was s based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number ONE16-264, "Developing farm-to-institution grower capacity for leafy green vegetables in the Eastern Panhandle Region of West Virginia."

AG12-137