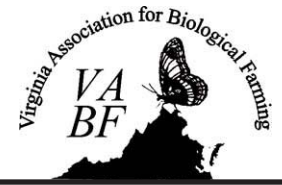


Lettuce: Organic Production in Virginia

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Overview

This information is based on our experiences growing lettuce in central Virginia. Our Climate Zone is 6B, a small pocket within a larger area of zone 7. This means our annual minimum temperature averages -5°F to 0°F . Our average rainfall is 42 inches, statistically fairly evenly spread throughout the year. Our average daily maximum temperatures are 47°F in December and January, 88°F in July: night lows average 26°F in January, 65°F in July. Our growing season, from last frost to first frost, is around 167 days. The average date of the last spring frost is April 30 (later than 5/14 happens one year in 10). The average date of the first fall frost is Oct 14 (earlier than 10/1 happens one year in ten). Our latitude is 38°N , which sets our daylight length. The period when daylight is less than 10 hours and little plant growth occurs (called Persephone Days by Eliot Coleman) lasts from 11/21 to 1/21.

Your micro-climate won't be exactly the same as ours. So collect data and study it each year, and fine-tune your planting schedule. (*See the Lettuce Logbook Page* and the sidebar *Appalachian Region Perspective*.)

We grow lettuce outside from transplants from February to December, in cold-frames from September to December, and in a solar-heated hoophouse from October to April. Notes are also included for options other than the ones we choose.

Crop Requirements

Lettuce seed remains dormant unless triggered by adequate levels of light and temperature. It needs light to germinate, so don't sow too deep: $\frac{1}{4}$ - $\frac{3}{8}$ " is enough. Some sources recommend not covering the seed at all, but this can make it hard to keep the seed damp. The light dormancy is more pronounced in fresh seed, which has higher levels of the hormone that controls germination. Lettuce will germinate between 40 - 86°F , but is slow at low temperatures. The optimum temperature range for germination is 68 - 80°F . Germination takes 7 days at 50°F , 4 at 59°F , 3 at 68°F , only 2 days at 77°F , back up to 3 at 86°F , and

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won't happen reliably at hotter temperatures. Even a few hours at temperatures higher than the optimum can induce dormancy. Store seed in a dark, cool place - in summer, refrigerate seeds between sowings. In warm weather there are various tricks to getting lettuce to germinate (*see the Hot Weather Season Extension section*).

Lettuce prefers a well-draining soil high in organic matter, and with a pH of 6.0-7.0, not lower. Optimum growing temperatures are 60 - 65°F , with a minimum of 40°F for any growth to occur. If nights are cool, 80 - 85°F days can be tolerated. If temperatures are too hot, the plants will bolt (flower and seed). Lettuce is more cold tolerant than many people realize. If plants are sufficiently hardened (prepared by growing in gradually lower temperatures), they can withstand freezing. In an unheated greenhouse they may freeze every night, and thaw every morning with no ill effects. Outdoors, the combination of cold nights, chilly days and wind damage will eventually kill them (*see the Cold Weather Season Extension section*).

Lettuce requires a relatively large amount of water throughout its growth. Lack of water will lead to bolting, and/or bitterness. Keep them growing quickly for good flavor.

Appalachian Perspective

Mark Schonbeck, Floyd County

In the cooler Appalachian region, organic lettuce production is not that much different from the Piedmont. It is somewhat easier to grow summer lettuce because our daily maximum temperatures rarely exceed 90 F, though this is gradually changing with global warming. We used to be able to grow heat tolerant varieties all summer long without shade cloth, though irrigation during dry spells was essential. We harvested the crop younger, and accepted a somewhat stronger (mildly bitter) flavor than from cool-season lettuce. During some of the hotter summers in recent years, we have simply taken a break from planting lettuce from June 1 until early August. I do not know of anyone in this region using shade cloth, though it is certainly worth trying. Planting on the north side of a taller crop and providing sufficient irrigation for both crops might also yield marketable summer lettuce.

Winters used to be harsh enough in Appalachia

to enforce a break from lettuce production unless one had a greenhouse, high tunnel, or a really good cold frame on a south facing slope with full sun (and willingness to shovel-off the deep snowfalls we used to have). Since 1990, we have had many mild, nearly snowless winters, allowing harvests of lettuce and other greens to continue right through the winter. Jonathan Greenberg, the gardener at Light Morning Community in Copper Hill (the county's cold spot) harvests bushels of excellent lettuce and other salad greens all winter long from his well-built cold frames.

One pest problem that we definitely have in this cool, moist region is slugs. They appreciate mulch but don't seem to need it to migrate into, and make a mess of lettuce, particularly in May and early June. Hand picking is effective on a home garden scale, but it is tedious, slimy work. Fortunately, the new, organic-allowable slug bait called Sluggo(TM) (based on iron phosphate at levels harmless to other soil life, pets and people) seems pretty effective, though several applications may be needed for a bad slug infestation.

Planting Details

Lettuce can be direct seeded when the weather is suitable, or it can be transplanted. Direct seeding is used for growing baby lettuce mix, which is cut when a few inches high and then allowed to re-grow, for further cuttings. Mesclun, Salad Mix, Spring Mix and Misticanza are all names for mixtures of baby lettuce and other greens.

One advantage of transplanting for full size leaf or head lettuce is the ability to grow lettuce when outdoor temperatures don't favor germination. Another is getting a jump on the weeds by eliminating the need to weed around seedlings. A third is that there is time for another crop to mature in the space while transplants are growing (and thus increase overall yield). In early spring, an earlier harvest is possible from transplants than from a direct seeded crop, as the transplants grow indoors, while it is still too cold to direct-seed. Transplants are tougher than seedlings in withstanding some pests and fungal diseases.

Sowing: Seeds for transplants can be sown in cell packs or plug flats, putting 3 seeds in each cell, and later reducing to one seedling with scissors.

Cells or pots with diameters from 1-2½" can be used. The 96 cell size (1x1½") works well, although the 200 cell size (1x1") is possible if you can be sure to get the transplants out before they get root-bound. If warm germination space is limited in early spring, sow seed in a small flat, then "spot" the tiny seedlings into bigger flats, 606 (2x2¼") cell packs, or 32-pack square pots to grow on in cooler conditions before planting out. Soil blocks are also possible, but take more time. Another option, from mid-April to October, is to use an outdoor nursery bed, rather than sowing in flats. For us, this is less work. We simply sow four 3' rows for each planting of 120 lettuce, water, weed, then transplant directly from the seedbed. In very hot weather, indoor sowings might give more reliable germination. (*See the Hot Weather Season Extension section*)

Transplant the seedlings at 3-6 weeks of age, (4-6 true leaves), depending on the time of year and how fast they are growing. (*See the Lettuce Logbook Page*). Older transplants generally are slower to head up and do not produce good heads. If plants have become a *little* too large, remove the outer leaves to reduce transpiration losses. Reduce transplant shock

by hardening the plants (exposing them to outdoor conditions gradually before transplanting). Water well one day and again one hour before transplanting.

Handle transplants only by their leaves, or the root ball - try not to damage the roots. Transplant seedlings 8-12 inches apart, firm in and water. Use the 12" spacing outdoors for growing full sized heads, and the closer spacings if you will be harvesting individual leaves. Watering in with seaweed solution helps them recover from transplant shock. Tools to speed transplanting and increase spacing accuracy include measuring sticks or plywood triangles; rollers with accurately spaced blocks attached, transplanting wheels; Johnny's row-marker rake; or pre-set drip irrigation tape run for 15-20 minutes before planting, to make wet spots to plant into. (Accurate spacing saves a lot of time at cultivation).

Water new transplants daily for the first 3 days, then once or twice a week after that. Deeper, weekly, waterings equivalent to 1" of rain, are better than frequent superficial irrigation, as roots will grow deeper, giving the plant greater resistance to drying out. In cooler weather, water late morning or early afternoon, to give the leaves time to dry before sunset. This reduces the chance of fungal diseases. Spraying with seaweed extract can double the size of your lettuce in 1-2 weeks, enabling you to harvest up to 3 weeks earlier. In winter, try to water only when a mild night is forecast. It is thought that freshly watered plants are less resistant to freezing damage. Seaweed spray for a few days before cold weather also protects against frost.

Cultivation will likely be needed to remove weeds, as these compete with the crop and could get mixed in at harvest. All cultivations should be shallow, as lettuce roots are near the surface. Crop rotations including cover crops can do a lot to reduce the weed problem. Winter killed legume cover crops such as soy beans, bell beans or cow peas can be sown in fall where spring lettuce will be planted.

Time to Harvest: In cool weather, leaf types are ready for harvest 50-60 days from direct seeding, 30-45 days from transplanting. Head lettuce needs up to 80 days from seeding, or 60-70 days from transplanting. Baby lettuce can be cut 21 days from seeding, (except from November to mid-February, when it may take 2 or 3 times as long). In warm weather, lettuce can be ready to harvest in 30 days

from transplanting (as baby heads, or as individual leaves), and in 40 days as full sized heads. In summer, heads can be ready in as little as 20 days (*See the Harvest Graph*). In summer you may need to harvest smaller than expected, so be sure to harvest before the lettuce turns bitter. You can always nibble a piece of leaf to test them. Another sign of bitterness is excessive milkiness from the cut stem.

Harvesting methods depend on the size of the crop and the quantity cut at each harvest. Whole heads may be cut with a knife; individual full-size or half size leaves may be cut with knife, scissors or thumbnails. To harvest baby lettuce, use scissors, shears, or a serrated knife, cutting an inch or so above the soil, to preserve the growing point of the plants for re-growth. For large quantities, there is now a specialised tool consisting of a long knife with an attached fabric catching-box, see *Johnny's Seeds*. There are also machines based on mower technology.

After harvest, lettuce should be cooled as soon as possible, as it rapidly wilts. Refrigerate, or immerse in ice-cold water immediately. Nylon mesh bags are useful for washing loose-leaf crops. Thorough washing before sale or serving is most important. If aphids are a problem, cover with water and wait a few minutes until the aphids sink. A salad spinner is the ideal way to dry washed lettuce. An old washing machine, with the agitator removed, works for large quantities. If you use a mesh bag for washing, you can swing this round your head, or set up a plastic laundry basket hanging by ropes from a beam or branch, "wind up" the basket with the bag of lettuce inside, and then let the unwinding spin out the water. Sort the crop, and return it to refrigeration.

Calendar and Succession Planting

Crop scheduling for a continuous steady supply of lettuce is tricky, and worthy of attention. Lettuce grows faster at some times of year than others, and so the times between one sowing and the next need to vary to balance this fact. The short version is that to harvest every week you need to have sowing gaps of more than one week in the spring, one week in the summer and less than one week in the fall. Lettuces for harvest in February will take 2 or 3 times as long (from planting to harvest) as those harvested in September. Sowings made in December and January grow very slowly, and early February sowings will

almost catch up. In the fall, as temperatures and day-length decrease, the time to maturity will take longer, and one day difference in sowing date can make almost a one week difference in harvest date. See the *Lettuce Logbook Page* and the *Lettuce Harvest Graph*, if you want more precise dates to try. Use these guidelines for your first year or two while you are collecting your own data: (this plan is for 100-120 heads per week April - December all from transplants, and lettuce leaves and baby lettuce mix December - March). I recommend sowing several different varieties each time - not only for the beautiful effect, but also to spread your risks, if one kind bolts or suffers disease.

January: Make a first sowing indoors in the latter half of the month, for the first outdoor transplants. If you have a greenhouse or hoop house with empty space, transplant lettuce there until mid-February.

February: Sow fast growing cold-tolerant varieties every 14 days, in flats indoors.

March: Transplant the first 3 sowings outdoors with rowcover, as they reach transplant size and are hardened off. Start harvesting leaves from the earliest plantings, late in the month. Sow in flats every 12 days. Outdoor direct sowing is possible from late March or early April, if you prefer that method.

April: Transplant the March sowings. Sow in flats every 7 days. Whole heads should be harvestable from Mid-April.

May: Switch to heat-tolerant varieties, and an outdoor nursery bed, or carry on sowing in flats if you prefer. Sow every 7 days. Transplant one week's needs each week.

June: Sow only the most heat-resistant varieties, every 7 days, under shade-cloth. Transplant one week's needs each week, using shade-cloth to cover transplants for the first two weeks.

July: Sow only the most heat-resistant varieties, every 7 days, in the evening, under shade-cloth. Use burlap or boards to cool the soil for several days ahead of sowing: soil temperature must be lower than 80F. Lay ice over the soil-covered seed rows. Or switch to sowing in flats in a fridge. Transplant one week's needs each week, using shade-cloth to cover transplants for the first two weeks.

August: Sow every 5 days early in the month, down to every 3 days later in the month. Use heat-tolerant varieties early in the month, then switch to cold-tolerant ones after 8/20. (The heat-tolerant ones are

also cold-tolerant, but you might prefer to try some different varieties by now). Transplant one week's needs each week, with shade-cloth. Mid-August is probably the last chance for outdoor direct-seeding. (80 days before the first expected hard freeze).

September: Sow cold-hardy varieties every 2 days until the Equinox (9/21 approx), then every 3 days. Sowings from the first week will provide the last outdoor plantings, under rowcovers, for December harvest; the second and third weeks' plants will be for coldframes and solar heated greenhouses; the fourth week will be replacements for casualties. Transplant, one week's needs each week. If you plan to over-winter lettuce outdoors with hoops and rowcover, aim to have plants half-grown by the time the very cold weather hits. Try a few different sowing dates, as the weather isn't very predictable.

October: Sow hardy lettuces every 3 to 7 days (assuming you have some covered growing space), until approximately 10/15. Use 8" transplant spacing if you will be harvesting leaves rather than heads. (If needed, sow every 7 days 10/16-10/31, for greenhouse growing.)

November: Sow once between 11/1-11/15 in a greenhouse for January transplants, or take a break. Transplant into coldframes for December and January harvests.

December: The daylight length is less than 10 hours, and little plant growth is happening. Harvest, write up your crop records, and plan for next year. If you have greenhouse or hoop house space, transplant at the end of December, for lettuce heads in February, (or leaves in January and February). If needed, make a sowing between 12/1-12/15 to transplant in a greenhouse, in late January.

Pests and Diseases

Keeping a record of pest outbreaks and controls can provide useful information for future years. Organic gardening involves using the least invasive methods of pest control. Integrated Pest Management (IPM), is a basic framework used to decide when and how to control pests. Organic IPM includes modifying habitat to deter or exclude pests, and cultural, physical and biological practices. Only if all these fail, are botanical sprays or other "biorational" pesticides used.

The starting point in pest control is to grow the crop in ways that are least likely to encourage

pest outbreaks. This includes maintaining balanced soil fertility, irrigation, airflow, daylight, temperature and growing space (including removing competing weeds). Strongly growing plants are less likely to suffer damaging pest outbreaks. “Farmscaping” is a method of encouraging beneficial insects, including predators of pest bugs, by growing particular flowers. See www.drncbug.com. Foliar feeding can be used to boost the plants’ growth and health. Rowcovers or fine mesh netting can keep insects from eating your crop.

The second step is to regularly monitor crops for pests - look and record the level of infestation. Small numbers of pests may not be doing enough damage to worry about. Once the number of pests exceeds the “Action Level”, start with the method which will cause the least damage to other life forms. Often this is a physical killing or removal of the pest: hand-picking, vacuuming, or forcing them off with a jet of water.

If the scale of the outbreak is too large for physical controls to work, the next stage can be to introduce beneficial insects, either relocated from elsewhere on your property, or purchased. If the infestation is large and the rate of increase is too fast for predatory species to manage, it becomes necessary to use some kind of insecticide to save the crop. Some botanicals also kill beneficial species, so if you plan to use those, do not introduce the beneficials until after the pesticide has had time to reduce the numbers of the infestation, and to degrade.

Aphids: Farmscaping with alyssum, clovers, dill, yarrow; row cover (but check aphids have not got in - you may be keeping only the predators out!); water jets, insecticidal soap, horticultural oil, hot pepper wax, flour, diatomaceous earth or other desiccant; *Beauveria bassiana* fungus (kills ladybugs too), sugar esters; syrphid flies, aphid midges, parasitic wasps, ladybugs, lacewings etc. Aphids thrive at lower temperatures than most of their predators, so they are a special problem in early spring, before temperatures reach 45°F, and perhaps again in late fall.

Grasshoppers and crickets: Bait containing the parasitic *Nosema locustae*; praying mantids.

Cutworms: dig gently near plant stem, catch and kill. Sulfur.

Thrips: rowcovers; sugar esters, insecticidal soap; predators (pirate bugs, lacewings, ladybugs); *Beauveria bassiana* (Naturalis), Neem (although these kill other species too)

Groundhogs, rabbits, deer: fencing, deterrents (hair trimmings, carnivore urine, scented soap bars against deer); trapping or shooting.

Damping Off affects young seedlings in cool grey wet conditions. To avoid: reduce watering in chilly weather, increase airflow, foliar feed with seaweed spray and compost tea. Combine 1 part compost with 6 parts water, leave for 1 week, then filter and spray. Use every 5-10 days to prevent damping off. There are now also commercially available organic fungicides which use beneficial fungi.

Sclerotinia fungi attack lower leaves at soil level and produce a cottony growth. The whole plant then collapses flat and limp, leaves spread out around the collapsed stem.

Bottom rot, caused by *Rhizoctinia* fungus, is another soil-borne cool-season problem. It affects fairly full-grown plants, appearing initially as rusty slightly sunken lesions, perhaps with amber ooze. The whole plant may rot into a slimy black mess.

Tip burn is actually a physiological disorder rather than a disease. It occurs when a sudden change to warmer breezy weather (including human-made “weather” resulting from mis-managed irrigation or greenhouse ventilation!) causes rapid transpiration. If transpiration rate is much higher than water uptake rate, the plant cannot get water to the outer edges of the inner leaves, which then brown and die. It is related to soil calcium deficiency, and is worse in very fertile soils, and is a particular problem on those lovely sunny early spring days. Reduce transpiration by shading, and/or shielding from the wind. Consider misting or spraying if this doesn’t seem likely to increase the chance of fungal disease. If Tip Burn seems to be a big problem in your location, look for varieties with resistance.

Season Extension Options: Hot Weather

Store the seeds in the fridge, sow seed in the evening. Use only the most heat tolerant varieties, as others may not germinate at high temperatures and the plants will bolt and taste bitter. (See the *Lettuce Varieties Chart*.) If you have fridge space, put the seeded flats in a plastic bag in the fridge for 2 days to break the dormancy. If fridge space is not available, use a cool basement. If you need to do the seeding outdoors, you can improve your chances by cooling the soil for several days ahead, by watering and covering with boards or burlap bags. Soak the seed

in cool water for a day, then either store in a jar in the fridge for 2 days, then sow; or drain the seed for 2 hours, mix with a dry gritty material such as sand, corn grits or coarse bran, and sow. After sowing (thickly), put ice on top of the soil covering the seeds, and cover with shade cloth, (50% shade is ideal). Substitutes for professional shade cloth (for small plantings) include tent screen windows, nylon window screen, nylon net curtains, net vegetable bags – but be sure to use something the air can flow through, to prevent overheating. Water with freshly drawn cool water at mid-day, and possibly more than once a day, until seed germinates.

Use younger transplants (3 weeks old), than you would in spring. Closer spacings such as 10-12" will enable foliage to grow to cover the complete bed, and keep a cooler microclimate. If possible, plant to the north of tall plants such as corn, tomatoes or pole beans. Transplant in the evening. Develop a fast and efficient technique so that you can get your crop planted and watered in the last hour before sunset. Cover the new transplants with shade cloth for at least one week, preferably until harvest, (which may be as little as 3 weeks from transplanting). Shade cloth on hoops is even better than shade cloth lying on the plants, as it allows better airflow. Ideally, fasten the shade cloth with clips or clothespins to the hoops to hold the bottom edges about 12" above the soil, to maximize airflow. The ultimate solution, for daytime temperatures over 85°F, is Silver Tuffbell 45% shade, from Japan, at a high price. To cool lettuces growing indoors cover hoop houses with shade-cloth, and spray or paint glass greenhouses with shading compound.

Water much more in hot weather - bitterness before bolting is almost always a sign of water stress. Overhead watering early in the morning can be used for mature heads you want to hold in the field for a couple more days.

For some crops, an organic mulch of straw or spoiled hay is used to moderate soil temperature and reduce irrigation needs. This does not work so well for lettuce, as it can be hard to remove stray wisps of mulch from the harvested crop. Also lettuce is a fast-growing, short-term crop, and organic mulches take time to break down. (This would not be a problem if the following crop were to be transplanted into the leftover mulch.). Most people do not mulch lettuce, except for plastic mulches to warm soil in early spring, or for weed control. There are white and silver reflecting mulches sold for summer use.

Season Extension Options: Cold Weather

While heat tolerant lettuces also tolerate cold, there are also specialized cold weather tolerant varieties, which do not tolerate heat. Sow these in fall and winter only. Choose your site with care. Protection from prevailing winds can be important. Bare soils and darker soils absorb and radiate more heat than others. Overhead sprinklers can be used to water overnight on frosty nights and prevent frost damage to foliage, but as noted, lettuces can do surprisingly well at fairly low temperatures and "anti-freezing" night watering is better used for warm weather crops. It is also possible to sometimes save a frozen crop by spraying with water by hand early in the morning and continuing until sunlight reaches the plants.

Rowcovers are lightweight white fabrics of polypropylene or polyester that are permeable to sunlight, water and air. They can be used to cover crops in cold weather, and will provide a temperature gain of 4-6F, depending on the thickness. They do reduce light transmission and air-flow, but the trade-off can be very worthwhile. 9 gauge wire, plastic or fiberglass hoops, 5 or 6 feet apart along the row, to hold the rowcover above the leaves will reduce freezing damage and provide a better microclimate. Rowcovers also exclude some pests and can provide better quality produce by reducing beating by the weather. Edges of rowcover need to be held down with small logs, stakes, rocks or lengths of rebar. Before we built our hoop house, we used to overwinter a bed or two of lettuce, with rowcovers and hoops. It worked, but growth was very slow.

Low Tunnels are hoops, about 18" high at the apex, covered with clear polyethylene. They are more labor intensive to use than rowcovers because they are not permeable to water or air. Drip irrigation can deal with the need to provide all the watering. The need to let hot air escape is addressed by having slits in the plastic. At night the slits stay closed, trapping the heat. When warm, the edges of the slits curl, providing an escape for the hot air.

Cold Frames are traditionally made from blocks, boards or straw bales, with discarded windows over the top. They are very useful on a small scale, although labor intensive. *Solar Gardening* by Leandre and Gretchen Poisson, is the best book I have found on making and using small structures. For large

scale production, the costs of a hoophouse are lower than a comparable area of cold frames. Sometimes single layer hoophouses are even called cold frames. In the past we transplanted lettuces in our cold frames for overwinter harvest of individual leaves. We transplanted in early October, and kept the plants alive by covering them with a selection from three options, depending on temperature. For temperatures of 25-35°F we use thick row cover alone. For 15-25°F we add fiberglass lids. For night temperatures below 15°F we roll quilts over the coldframes until morning. Nowadays we transplant in our cold frames mid-late September and harvest heads in December, after all our outdoor lettuce is finished.

Hoophouses (High Tunnels) are relatively new to the US, and have elevated winter salad growing to new levels of ease and efficiency. A framework of arched piping, tall enough to walk in, is covered with clear UV-inhibited 6mm polyethylene. Many use a double layer of polyethylene, with a bubble of air between the layers maintained by a small fan. The inflation of the double layer holds the plastic taut, improving wind resistance and snow-shedding, as well as the insulation of the interior. Usually solar heating is sufficient to enable a wide range of crops to be grown. Crops are grown in the ground, often in long, intensively planted beds, with drip irrigation. *Walking to Spring* by Alison and Paul Wiediger is an excellent beginners' manual on constructing and using hoophouses. They are in south central Kentucky, a similar latitude and climate zone to central Virginia, so their recommendations make an excellent starting point for growers in our region.

Hoophouses permit lettuce planting in October and November, providing harvests all winter and through till April. Crops continue to grow throughout the winter whenever temperatures are warm enough. Spinach, chard, and many leafy brassicas will also be productive all winter. The hoophouse can then be planted in warm weather crops about 3 weeks earlier than outdoor plantings. Tomato harvests will run for a whole month before outdoor crops are harvestable. Using hoophouses for summer crops in Virginia is still in the experimental stages, but bell peppers, sweet potatoes, melons, eggplant and other heat-loving crops are worth trying.

Heated Greenhouses of a more traditional kind will also grow lettuces all winter, as will unheated greenhouses with a masonry north wall (in

central Virginia at least).

Economics of season extending bear consideration. All season extension techniques require the input of more energy (time and/or money) than outdoor growing, to gain extra production. For each grower there comes a break-even point, beyond which the diminishing returns make the extra energy inputs counter-productive. At some point you might do better to turn your attentions to some other crop (kale?) and not chase after lettuce regardless of costs. Before investing a lot of money, you might visit other growers, or talk with them. You might discover that you can grow more lettuce per dollar invested in a large hoophouse than a smaller heated greenhouse constructed of expensive materials.

Reducing Nitrate accumulation. During periods of short daylight length, there is a health risk associated with nitrate accumulation in leafy greens. Nitrates are converted in the body to toxic nitrites which reduce the blood's capacity to carry oxygen. Additionally, nitrites can help form carcinogenic nitrosamines. In winter, leafy vegetables can easily contain the acceptable daily intake level of nitrate for an adult in a mere couple of ounces of crop, unless special efforts have been made to reduce the nitrate levels. Spinach, mustard greens and collards contain about twice as much as lettuce; radishes, kale and beet roots often have 2½ times lettuce levels. Turnip greens are especially high at 3 times lettuce levels.

To reduce levels to the minimum possible during the high-nitrate-accumulating winter period, harvest only after at least 4, and preferably 6, hours of bright sunlight. If possible, avoid harvesting on overcast days. Keep soil moisture adequate, and ensure soil has adequate P, K, Mg, Mo. Use organic compost. Keep the crops as warm as practicable. Avoid over-mature crops and discard the outer leaves. If your crops are in a greenhouse, ensure that CO2 levels don't get too low, by adequately ventilating as soon as temperatures reach 68F. Once lettuce is harvested, nitrates will convert into nitrites as long as temperatures are merely cool, rather than cold. So for healthy lettuce, refrigerate immediately after harvest.

Plastic mulches can be used in early spring to warm the soil. On the garden scale, old glass windows can be used. Another way to solar-heat the soil is to use kraft paper or newsprint painted with cooking oil. The oil makes the paper more durable, and allows sunlight through to warm the soil.

Plastics Disposal is an issue for organic

growers using agricultural plastics. If you cannot find any local place to recycle your old plastic, try USAg Recycling Inc www.usagreycling.com

Intercropping: lettuce can be interplanted to increase the productivity of an area, and provide better habitat for one or both crops. Cultivation is reduced, and the relay planting allows maximum use of the space. Rowcover can be shared by the two crops, and as the warm weather crop gets larger, the lettuce is harvested. Examples include sowing or transplanting warm weather crops such as peanuts, tomatoes, peppers into the center of beds of lettuce at the transplanting stage, or one month or more after direct seeding. Research has shown that relay planting of transplanted lettuces and tomatoes does not delay the date of first harvest of the tomatoes, or reduce the lettuce yields. But lettuce seeded *immediately* before tomatoes are transplanted will have a significantly lower yield, as the tiny lettuce seedlings cannot compete with the quickly growing tomatoes.

Lettuce Varieties

There are several different general types of lettuces, suited for different tastes and different situations. For our particular favorites see the *Lettuce Varieties Chart* and consult seed catalogs. Iceberg (Crisphead) and Butterhead/Bibb/Boston types are usually grown as full heads, and are less useful for leaf lettuce mixes. Icebergs mature in 75-100 days. Butterheads mature in 60-75 days, and are high in vitamin A, folacin and fiber, compared to Icebergs. The Bibbs, which have soft, sweet tender leaves, can be used at the baby stage in mixes, along with other kinds. Romaines are upright lettuces, usually green, often very crisp and flavorful. They have double the vitamin A, and vitamin C of other kinds of lettuce. Batavian lettuces (also called French Crisp) are tasty, thick-leaved varieties which have excellent heat and cold tolerance. Leaf lettuces include the more familiar oakleaf types, as well as very frilly ones which add interesting texture and appearance to mixes, and important “loft” which prevents mixtures from falling into unpleasant flat heaps. The Leaf lettuces are usually the quickest to produce harvestable sized leaves, and they have more heat-tolerance than Romaines. The bolt-resistance generally goes from Leaf types (first to bolt), through Romaines, Butterheads, Bibbs, to Crispheads, with Batavians as the best, apart from the outstanding Jericho romaine.

Lettuce Logbook Page

This is based on several years' experience here at Twin Oaks.

#	(⁰⁶ sown)	Sow Date	Sown	Days to T/pl	T/plant	T/pl Gap	Trans-planted	Harvest Start	Harvest Finish	Notes (Varieties, Success/Failure)
1		17-Jan		46	4-Mar					
2		31-Jan	14	45	17-Mar	13				
3		14-Feb	14	43	29-Mar	12				
4		28-Feb	14	40	9-Apr	11				
5		14-Mar	14	32	18-Apr	9				
6		26-Mar	12	32	27-Apr	9				
7		5-Apr	10	31	6-May	9				
8		14-Apr	9	30	14-May	8				
9		26-Apr	9	26	22-May	8				
10		1-May	8	27	28-May	6				
11		9-May	8	25	3-Jun	6				
12		17-May	8	23	9-Jun	6				
13		25-May	8	22	16-Jun	7				
14		1-Jun	7	22	23-Jun	7				
15		8-Jun	7	22	30-Jun	7				
16		15-Jun	7	22	7-Jul	7				
17		22-Jun	7	21	13-Jul	6				
18		29-Jun	6	21	20-Jul	6				
19		5-Jul	6	21	26-Jul	6				
20		11-Jul	6	21	1-Aug	6				
21		17-Jul	6	21	7-Aug	6				
22		23-Jul	6	21	13-Aug	6				
23		28-Jul	5	21	18-Aug	5				

#	('06 sown)	Sow Date	Sown	Days to T/pl	T/plant	T/pl Gap	Trans-planted	Harvest Start	Harvest Finish	Notes (Varieties, Success/Failure)
24		2-Aug	5	21	23-Aug	5				
25		7-Aug	5	21	28-Aug	5				
26		12-Aug	4	21	2-Sep	5				
27		16-Aug	4	22	7-Sep	5				9 beds total
28		20-Aug	4	24	13-Sep	6				Cold Frames
29		23-Aug	3	27	19-Sep	6				Cold Frames
30		26-Aug	3	27	22-Sep	3				Cold Frames
31		29-Aug	3	27	25-Sep	3				Cold Frames
32		1-Sep	3	26	27-Sep	2				Cold Frames/Glass greenhouse
33		3-Sep	2	26	29-Sep	2				Glass Greenhouse
34		5-Sep	2	26	1-Oct	2				Glass Greenhouse
35		7-Sep	2	27	4-Oct	3				Glass Greenhouse
36		9-Sep	2	29	8-Oct	4				Glass Greenhouse
37		11-Sep	2	30	11-Oct	3				Glass Greenhouse
38		13-Sep	2	30	13-Oct	2				Filler
39		15-Sep	2	30	15-Oct	2				Filler & Hoophouse #1 sowing
40		17-Sep	2	30	17-Oct	2				Filler
41		19-Sep	2	30	19-Oct	2				Filler
42		21-Sep	2	30	21-Oct	2				Filler
43		24-Sep	3	30	24-Oct	3				Filler & Hoophouse #2 sowing
44		27-Sep	3	30	27-Oct	3				Filler
45		30-Sep	3	30	30-Oct	3				Filler
46		3-Oct	3	30	2-Nov	3				Filler

Lettuce Varieties

Early Spring

Sow Jan-Mar
(6 plantings)

Allstar Gourmet Mix (Jan)	
*Antares Oakleaf	Rd/G L
Australian Yellow (Jan)	G L
*Buttercrunch (fast, small)	G B
*Cocarde (till 2/14)	Rd L
*Aruba (Jan/Feb)	Rd L
*Esmeralda (slow, big)	G B
Freckles	Rd/G
*Green Forest	G R
*Hyper Red Wave (till 3/14)	Rd R
Ice Queen	G Bt
Integrata Red	Rd R
Kalura (large)	G R
*Merlot (Galactic)(sm)	Rd L
*Oscarde	Rd L
*Outredgeous (Jan/Feb)	Rd R
*Pirat/Marvel/Red Cross	Rd B
Red Sails (comp Vulcan)	Rd L
*Red Salad Bowl	Rd L
*Salad Bowl	G L
Sunfire	Rd L
*Tango	G L
*Vulcan (Jan/Feb)	Rd L

Spring

Sow Apr1-May 15
(5 plantings)

*Buttercrunch (fast, small)	G B
Coastal Star	G R
*De Morges Braun	Rd L
Ermosa (Kag)	G B
*Esmeralda (slow, big)	G B
*Green Forest	G R
*Kalura (large)	G R
*Red Salad Bowl	Rd L
*Salad Bowl	G L
Summertime	G C

Summer

Sow May 15 –Aug 15
(14 plantings)

*Anuenue (small)	G Bt/C
Cardinale	Rt Bt
Coastal Star	G R
*Concept	G Bt
*De Morges Braun	Br R
Ermosa	G B
*Jericho	G R
Kagraner Sommer	G B
*Kalura	G R
Loma (small)	G Bt
*Magenta	Rd Bt
*Nevada	G Bt
*Pablo	Rd Bt
*Sierra/Michelle	G Bt
*Summertime	G C
Sun Devil	G C

Fall

Sow Aug 15-Sept 7
(9 plantings)

Allstar Gourmet Mix	
Buttercrunch (fast, small)	G B
H*Cocarde	Rd L
Coastal Star	G R
H*Esmeralda (slow, big)	G B
Freckles	Rd/G L
Green Forest	G R
H*Hyper Red Wave	Rd R
H Integrata Red	Rd R
Kalura (large)	G R
H* Lollo Rossa (slow)	Rd L
Magenta	Rd Bt
H*Outredgeous	Rd R
Pablo	Rd Bt
H* Red Salad Bowl	Rd L
H* Salad Bowl	G L
Sierra/Michelle	G Bt
H* Tango	G L
H* Vulcan	Rd L
H* Winter Marvel	G B

See key to abbreviations and symbols on next page.

Aug 15-25 Less hardy varieties
Aug 26-Sep 7 Cold hardy varieties

Winter

Greenhouse and Frames

Sow Sept 7-Oct 3

(11 plantings + sown for hoophouse)

Allstar Gourmet Mix	
H* Cocarde	Rd L
Aruba	Rd L
Green Forest	G R
H Hyper Red Wave	Rd L
* Kalura	G R
H* Lollo Rossa (slow)	Rd L
H* Merlot/(Galactic) (sm)	Rd L
H* North Pole (if we find it)	G
* Oscarde	Rd L
H* Outredgeous	Rd R
H* Red Salad Bowl	Rd L
H* Salad Bowl	G L
H* Tango	G L
H* Vulcan	Rd L
H Winter Density	G R/B
Bibbs for December harvest	
H* Esmeralda/ Optima	GB
Pirat/Red Cross	Rd B
Schweitzer's	Rd
Winter Marvel	GB

KEY

* = one of the best in this category

Rd = Red

G = Green

B = Butterhead, Bibb, Boston

Bt = Batavian

C = Crisphead, Iceberg,

L = Leaf

R = Romaine, Cos

H = Cold Hardy

Resources

Growing for Market articles by Alison and Paul Wiediger, 12/05-1/06. <http://growingformarket.com>

ATTRA: Many useful publications, especially:
Specialty Lettuce and Greens: Organic Production.
<http://attra.ncat.org/attra-pub/PDF/lettuce.pdf>
Sustainable Management of Soil-borne Plant Diseases: <http://attra.org/attra-pub/soil-borne.html>
Integrated Pest Management for Greenhouse Crops:
<http://attra.org/attra-pub/gh-ipm.html>
Biointensive IPM: <http://attra.org/attra-pub/ipm.html>
Season Extension Techniques for Market Gardeners:
<http://attra.ncat.org/attra-pub/seasonext.html>
Farmscaping to Enhance Biological Control: <http://attra.org/attra-pub/farmscape.html>.

Farmscaping, Dr Richard Mcdonald:

www.drmcbug.com

North Carolina University Extension

<http://www.ces.ncsu.edu/depts/hort/hil/hil-11.html>

Much useful information, especially *Lettuce Production and Greens for Market.*

The New Organic Grower, Four Season Harvest, & Winter Harvest Manual, Eliot Coleman
Biconet, www.biconet.com for beneficial organisms, natural predators

Johnny's Selected Seeds, 800-437-4290,
<http://www.johnnyseeds.com>

Walking to Spring, Paul and Alison Wiediger.
<http://www.aunaturefarm.homestead.com>

High Tunnels Website www.hightunnels.org

Nitrate Accumulation: Call ATTRA on 800-346-9140, for a free copy of this valuable document, mentioned in their publication *Specialty Lettuce & Greens: Organic Production* Hall, Bart. 1997. Nitrate Accumulation in Winter Vegetables. Unpublished information leaflet. 6 p.

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