

2014 Southern Wisconsin
Vegetable Production Workshop



Lettuce

Chris McGuire
Two Onion Farm

Mike Noltnerwyss
Crossroads Community Farm

Natalie Ortega
Natalie's Garden and Greenhouse

Location	Belmont, WI	Cross Plains, WI	Oregon
Acres in Vegetables	4	20	22
Acres in Lettuce	0.5	0.71	1
How These Tasks are Done for Lettuce			
field prep/tillage	with a tractor	with a tractor	with a tractor
transplanting	by hand	with a tractor	with a tractor
cultivating	by hand	with a tractor	with a tractor
spreading amendments	with a tractor	with a tractor	with a tractor
mulch laying	do not do this task for lettuce	do not do this task for lettuce	with a tractor
laying irrigation lines	by hand	with a tractor	
laying row cover	by hand	by hand	
spraying for pests, diseases, or weeds	by hand	do not do this task for lettuce	
harvesting	by hand	by hand	by hand
hauling harvested crop from the field	with a tractor	with a tractor	with a tractor
mowing cover crops or crop residues	with a tractor	with a tractor	
incorporating cover crops or crop residues	with a tractor	with a tractor	with a tractor
Farming Style	certified organic	certified organic	sustainable as defined by:

Propagation

Varieties	<p>Spring (sow 3/25-4/22): Adriana (Boston), Bambi & Winter Density (Bibb)</p> <p>Summer (sow 4/25-7/11): Magenta & Concept (Summercrisps), Jericho (Romaine). All are very heat tolerant. Jericho suffers tipburn easily. Nevada is another good Summercrisp, but is smaller than other two Summercrisps and has a lot of internal branching in head.</p> <p>Autumn (sow 7/15-8/26): Panisse, Rouxai, Oscarde (Oakleafs). Gorgeous heads. Have seemed slightly more frost tolerant than upright lettuces to us.</p>	<p>Red Leaf- vulcan, ruby sky</p> <p>Romaine- green towers, jericho</p> <p>Butterhead- red cross</p> <p>Summer Crisp- magenta</p>	<p>Romaine: King Henry</p> <p>Red Leaf: New Red Fire. I like it more than Red Sails because it holds together better in processing and getting to market.</p> <p>Green Leaf: Crisp and Green. It is very tasty and holds together nicely.</p> <p>Bib: Esmeralda</p> <p>During the summer months I use Summer Crisp. It's crunchy and very sweet and holds up in the heat.</p>
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	Two Onion Farm	Crossroads Community Farm	Natalie's Garden and Greenhouse
Soil Mix	<p>Up to now we have used Johnny's 512 mix from Johnny's Selected Seeds.</p> <p>In 2014 we are switching to homemade mix with compost (from Purple Cow Organics), peat moss, vermiculite, kelp meal, soybean meal, rock phosphate.</p>	vermont compost fort v	I use Redi earth.
Seedling Trays	1.5" soil blocks, grown on homemade pieces of 1/2" plywood, 60 blocks per flat	standard 1020 128's (landmark)	I start all my transplants in 200 cell trays, except for onions which I start in 398 tray.
Propagation Schedule	<p>Spring (sow 3/25-4/22): 3/25, 4/4, 4/11, 4/15, 4/22</p> <p>Summer (sow 4/25-7/11): Mostly 7 days apart, every 2-3 weeks add an extra smaller planting in middle of week.</p> <p>Autumn (sow 7/15-8/26): every 3-4 days</p> <p>Early spring plantings are transplanted 3-4 weeks after sowing. This time gradually decreases through April and May plantings. From early/mid June sowings onward, we aim to transplant 14-17 days after sowing.</p> <p>The schedule intentionally includes "extra plantings" At beginning of season we plant an extra early planting which will be overmature at the beginning of the CSA delivery season in most years but which should give us lettuce in cold springs for delivery week 1. During season we plant an extra, small planting every 2-3 weeks to make up for pest outbreaks or weather variations which would otherwise cause a gap in lettuce harvests. We aim for continuous 2x per week harvests for 24 weeks.</p>	<p>seeded on 15-Mar 29-Mar 15-Apr 29-Apr 6-may and then weekly until July 29th 17 total successions</p> <p>transplanting typically occurs 4-5 weeks after seeding</p> <p>this season first lettuce went in on 4/29, next on 5/7</p>	I start seeding lettuce in the tray around March 1st, and transplant the first crop around April 10th. I do successive plantings weekly until the middle of August.

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Germination	After sowing, we cover seeds with vermiculite and cover trays with plastic bag. Place trays in germ chamber dark at 68-70 degrees for 48 hours, then take out and move to cold frame. In summer, we use AC to keep germ chamber at appropriate temp.	in a germ chamber in spring, at around upper 70's if there are other crops in it, but we put the lettuce on the bottom shelf so that it stays around lower 70's. in summer we will move the flats into the pack shed (insulated) where the temps are below 80 degrees if we keep it closed up. we stack flats up on top of each other and put an empty flat on the top flat to keep the moisture in the soil.	For the first few weeks I seed the trays, saturate with water and place in our germinating room at around 70F.
Greenhouse Irrigation	Water by hand. 1x per day, 2x in very hot and windy conditions, skip days when very cool and cloudy.	with hand held water wand, when the cells start to dry out.	We water with a hose when needed. It's usually once a day, sometimes more.
Optimal Greenhouse Conditions	Usually raise lettuce in cold frames. Use bottom heat and row cover to try to keep nighttime lows above 40-50. Generally ventilate when temps reach 60-70. Otherwise minimal temp regulation.	we heat the greenhouse to at least 55 degrees at night. we set the intake louvers to open around 80 degrees and set the exhaust fans to run at around 85-90 degrees. we don't do anything to manage humidity in the greenhouse.	When the temp gets above 75 the fan turns on and we vent the greenhouse.
Hardening-off-off	Increase ventilation in cold frames as plants age.	we have tables outside our greenhouse with some plywood screwed up as a windblock. we typically like the flats to sit outside for at least 2 days before transplanting into the field.	We move the lettuce outside a week before it's transplanted.
Pests or Diseases in the Greenhouse	None	not many problems, other then bad germ if the seed gets too warm and goes dormant.	If we have a lot of cloudy rainy days we sometimes have damping off, so it's best to not water on cloudy days.
Other Notes on Propagation		We like to buy new seed every year as lettuce seed seems to be fickle and can go dormant when exposed to heat.	

Field Prep

Preceding Cash Crop	Very variable. Fall lettuce usually double cropped after onions. Other lettuces fit wherever I can find room for them in field plan.	we don't have a strict rotation, but here is an example of one field's history: winter squash > sweet corn > tomato > greens block (including lettuce) our greens block is what we rotate lettuce in, it also includes quick growing succession crops such as, bok choy, radish, turnip, chard, broccoli raab, spinach and salad mix.	We usually put the lettuce on the ground the onions or beans were planted on the year before. Or where the cucumbers were planted two years before.
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Preceding Cover Crop	Variable.	typically fall planted winter rye for spring head lettuce, for later season lettuce either a spring planted oat cover or a summer planted buckwheat cover	
Soil Amendments	Aim for following nutrients per acre to be available: 125# N, 200# P, 200# K. Apply N via soybean meal, any additional P and K from Rock Phosphate and Potassium Sulfate.	if soil test suggests it, we will add rock phosphate and potassium sulfate as needed after taking into account additions from the composted chicken manure pellets (4-3-2). To feed the crop, we spread 1000 lbs of 4-3-2 per acre for lettuce. If we have a previous legume cover crop we may forego this application. we spread a custom micronutrient blend that also contains 100 lbs of humical, and 100 lbs of kmag to try to maintain calcium and magnesium levels in the soil.	
Bed Prep	Rototill with tractor shortly before planting. Use c-clamps on back of tiller to mark 4 rows per bed 10.7 inches apart	we start with a cover crop that is rotovated in about 2-4 inches deep to kill the crop and incorporate the residue. we try to do this 2 to 4 weeks before planting. after the cover crop disintegrates we typically rotovate or field cultivate with a perfecta the day that we transplant. we have a 84 inch rotovator that will till one bed and cover the tractor tires. our perfecta is 72 inches and covers the tractor tires on our smaller tractor that has 13.6 inch rubber. If we are leaving the field for more then 2 weeks before planting we will periodically field cultivate it with a quack digger to kill any remaining cover crop and disturb weeds that are germinating.	We disk the field once in the fall to break up any plant material. In the spring we disk again and follow with a final pass with a perfecta.
Bed Shaping		we have not done raised beds for lettuce but we are looking into a bed shaper purchase for 2014 for some of our lower ground, to improve drainage and warm up the soil faster in the spring.	

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Mulch	No	we do not mulch lettuce	
Other Notes on Field Prep	We plant many consecutive lettuce plantings in one block of adjacent beds. We have a lot of cases where a particular lettuce planting occupies a partial bed, or parts of 2 beds. We aim to till right before planting for best weed control. Lots of tilling partial beds is annoying.		

Transplanting

Bed Width	5' center to center	48 inch bed top	32"
Lettuce Spacing	4 rows per bed, 10.7" between rows, 12" within row, except 10" within row for Bambi and Winter Density. Used to use 3 rows/bed, 12" between rows, 10" within row for most varieties but switched to current spacing to better utilize space.	3 15 inch rows with plants spaced 12 inches in row	We plant the lettuce 12" apart in rows 32" apart.
Transplanting Process	Lay tape measure down bed. Workers sit in aisles, dig holes with trowels or hand, plant and cover blocks by hand.	we use a waterwheel transplanter with 3 super wheels size c spike on bare ground. 3 people ride the transplanter and 1 person drives the tractor. we make sure the plugs are below soil level but not too deep to prevent disease issues. we use a hydro 84 for the waterwheel so we can drive very slow. We also have a Case Farmall 110a with a creeper gear that we can use for transplanting. We estimate that we need to drive around .5 mph for 12 inch spacing with experienced planters riding the waterwheel. If no need to stop we can plant a 400 foot bed in around 12 minutes. =1200 plants, four people times 12 min = 48 minutes. On average we can plant around 1200 plants per labor hour.	We use an ole Ellis tobacco planter Pulled behind our tractor. The planter is a two row setter , so we plant 2 rows at a time.
Compost or Amendments at Transplant	None	if compost is applied it is done preplant with a manure spreader before the cover crop is tilled in.	

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Water at Transplant	After planting a bed, pull drip tape out by hand from spool at end of row, attach to header line, and irrigate immediately for 8-12 hours to simulate 1-1.5" water.	water wheel transplanter, letting out as little water as possible so as to not have a hole full of water but rather a hole that is moist but not soupy mud.	The setter has a tank for water on it, so we add water in the transplanting stage. We add just enough water to keep the planting "fingers" from getting mudded up.
Row Cover	Use row cover in early spring after planting for warmth. Sometimes also use in late fall for frost protection. Space 76" wire arches (Nolts item WH76) 3' apart down row. Cover 1 bed with 7' wide cover or 2' beds with 14' cover. (Use AG30 cover from Nolts.) Hold down cover with sandbags (item ACB1224 from Nolts) about 6' apart on outsides of bed(s). We only plant 3 rows/bed (12" apart) in early spring and late fall plantings. With 4 rows, cover rubs on outer rows	we only use row cover for the first planting in spring to try and get an earlier harvest. we don't use hoops over lettuce, we tack the row cover down with soil every 5 feet or so.	
Other Notes on Transplanting	In summer, water every 2-4 days for first 7-10 days to help plants past transplant shock. Transplanting at small plant size also helps minimize transplant shock.		

Crop Maintenance

Irrigation	Irrigate with drip tape 8-12 hours per week to simulate 1-1.5" rain if insufficient rain; irrigate less often in cool/cloudy weather.	irrigation is always based on what past and future weather is looking like as well as temperature. we try to look at evapotranspiration rate estimates and meet them if possible. this past season we used a kifco b140 travelling reel with a komet 163 sprinkler. we had about 60 gpm capacity and could put down between a half inch and an inch depending on if was spraying full circle or partial circle. during hot weeks we would try to hit lettuce 2 to 3 times in a week.	We have a center pivot irrigation system and we water when needed.
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Irrigation Modifications	<p>In summer, we irrigate every few days for first 7-10 days after transplanting to minimize transplant shock.</p> <p>We are very wary of wet soil conditions by the crown of the plant leading to bottom rot. Recently we experimented with shutting off two rows drip tape on each 4 row bed once plants are past the vulnerable seedling stage. So for the first 10-14 days in the field we have a row of drip tape by each lettuce row (4 rows/bed). Then we shut off two lines and move the remaining two lines so 1 is centered between rows 1 & 2, and one is centered between rows 3 & 4. Hopefully this will result in less surface moisture around crown. Seems to work well so far, but I don't have sufficient experience to say for sure.</p>	<p>when the plants are young we irrigate to try and cool the soil and keep the plants from desiccating. At this stage we are putting down a quarter to half inch every other day.</p> <p>later, once they head up, we look to put down more volume and wet the soil deeper into the horizon.</p>	
Weeding	<p>In spring and early summer plantings, we sometimes only wheel hoe aisles between beds once, about 2 weeks after transplanting. Plants are in the field for a brief period - if the bed is freshly tilled at transplanting and the weed seed pressure is not too enormous, the lettuce can suppress most weeds within the beds enough that they will not be problematic or go to seed before lettuce is harvested - and we mow and till the bed immediately after harvest to prevent weeds from seeding.</p> <p>Later in the season annual weeds will go to seed at a small size and they will be flowering or seeding before lettuce harvest. In these plantings, we aim to wheel hoe aisles and use a diamond hoe between rows within bed about 2 weeks after transplanting and we do additional handweeding before or right after harvest to prevent weeds from seeding.</p>	<p>Cultivate with allis chalmers g with beet knives, typically 2 times before the crop gets too big. we use scuffle hoes in row usually 1 time. if weeds are bad we may hand pull later on but usually not necessary.</p>	<p>We use a 2 roe cultivator, and follow with a hoe. When the lettuce is really small we use a 6' rototiller that we took some tines out of to cultivate.</p>

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Insects	<p>Corn rootworm beetles can eat lettuce ravenously in some years in late summer/early fall. Usually they concentrate on a few plants and we've ignored problem. May consider Pyganic in future.</p> <p>Various caterpillars problematic in late summer in some years. Have used Bt or Entrust when needed.</p> <p>Aphids can be problematic in late fall lettuce: they contaminate heads in great numbers and leave honeydew covering on leaves. We have sprayed Mycotrol with moderate success.</p>	late in the season if we row cover lettuce for cold protection we tend to get massive amounts of aphids. we have stopped row covering lettuce in the fall.	
Diseases	<p>Bottom rot during wet period or from overfrequent irrigation. Try not to leave plants in a bowl or depression during transplanting. We've begun using the 2-row drip tape system described above.</p> <p>Aster Yellows is constantly present at low levels, tending to be worse in late summer and worst near ends of beds. We generally do not harvest affected heads. We tolerate the disease.</p>	we get rot at the base of the heads when it is hot. We try to harvest the heads high if they are large, cutting above any bad leaves touching the ground. We also harvest the heads at an earlier stage during times of high disease incidence, so they are smaller but cleaner. We will grow some disease resistant varieties, (ruby sky) especially in the fall when we have had more mildew problems.	
Other Notes on Crop Maintenance		we don't have too much deer pressure, but we have noticed that row covering the crop can deter deer when it is an issue.	When the weather gets wet and hot the lettuce will rot in the field quickly, so we try to plant it in a well drained area.

Harvest and Yields

Harvest Dates	Harvest 2x per week, 24 weeks, late May to early November. (Last week of harvest from hoophouse)	in 2013 we had our first lettuce harvest on may 29. we harvested lettuce every single week from then until october 25th. the october harvests this season were an anomaly, as we usually get frozen out before then.	We harvest our first lettuce around mid-June. We try to have lettuce all season until the end of October.
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Harvest Procedure	<p>Harvest 8:00-8:45 AM. Cut heads with Johnny's field knives, peel off dirty/damaged leaves, and place in large vented stackable/nestable harvest crates. Usually 8 per crate, in two layers of 4, arrangement depends on shape of heads. We nest the crate we are harvesting into inside a "dirty bottom crate", which is not used to hold produce but just to protect the lettuce in the top crate from getting dirty when workers drag crates along the ground. When top crate is full we stack it in a covered bin and place a new top crate inside the dirty bottom crate.</p> <p>Sometimes workers sit on a harvest crate with a crate beside them on cart seat - this has worked well but can be hard with multiple workers in the same bed - we've made a wooden version of the cart design at http://sfp.ucdavis.edu/files/143993.pdf</p>	<p>we use a red handled victorinox harvest knife, place heads upside down into black crates. anywhere from 6 to 12 per crate depending on size. we use a flat bed golf cart with stake sides that we can fit 32 crates on. we try to cut the heads above the soil level so some outside leaves drop off. We look at each head and pull off a bad leaf if necessary. Having 32 crates in a load the lettuce is never in the field for more then an hour before heading into the packshed. Lettuce harvest is quick and usually only requires one person. we like to have a field road running as close to the lettuce as possible because one 400 foot bed will yield at least 900 marketable heads which is often over 100 crates worth.</p>	<p>We harvest lettuce the first thing in the morning. We have a 500 gallon stock tank filled with water and we dump our crates of lettuce into the water to hydro cool and clean them. The stock tank is on a flat bed and is pulled behind the tractor. We try finish the job quickly to get the lettuce out of the sun and back to the packing shed.</p>
Cleaning	<p>Crates transported to packing shed in covered bin. Each crate submerged into a tub of cold well water. (If there are insufficient tubs available, additional crates are stacked on pallets and sprayed with cold well water; then those crates are placed into tubs when tubs become available). Washers pick up individual heads, submerge them in another tub, if needed rub dirt off cut stem under water, remove heads from water, gently shake head to remove excess water and place in vented crate on table to drip dry for a few minutes.</p>	<p>In the pack shed it is best to have two people, one unloading the crates placing them on the ground to be sprayed off with a water breaker (same thing we use to water flats in the greenhouse) to wash off the milky sap. Then the we have 60 gallon agrimaster tubs full of water that fit two crates side by side. We give each head a little shake when it is in the water to loosen any dirt, then pull it out and stack the crates 8 high. They can then go into the cooler or get packed directly into boxes for wholesale. The crates are not in the water for very long, we mainly rely on our cooler for bringing the temperature down.</p>	<p>We have another stock tank of water in the packing shed. We take the lettuce out of the tank from the field and put it in the tank in the shed and swish the heads around by hand until clean. we then place them head side down (root end up) in black crates and stack them up to drain. Sometimes we give them a final rinse with the hose before stacking.</p>
Sanitizer in Wash Water		none used	

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Packing	After heads drip dry briefly, workers place them one by one in waxed produce boxes (cabbage boxes) lined with a reusable plastic liner bag (Uline item S-3783) that has several holes punched in bottom.	Lettuce is packed into black crates in the field and never leaves the crate until it goes into a csa box or into a wax box for wholesale. we will send it to farmers market right in the same crate it was harvested in. We make sure the crates are clean before we harvest into them. any dirt on the bottom of the crate usually comes off in the dunk tank process. if it is extremely muddy we will have one crate that is on the ground and another on top of it so that the crate the lettuce is harvested into does not get muddy.	
Storage	Stored overnight in cooler at 32-34 degrees and packed into CSA boxes next morning.	We store lettuce in a humidified cooler around 34 degrees, it stays in black crates stacked 8 tall until its final use.	We pick our lettuce always the day before any market. Sometimes the same day. We store it in the cooler at 45f over night . We are hoping to get a better cooler this year.
Yields	Harvested heads per plant transplanted: -In some plantings this has been as high as 0.95 -When we harvest a planting thoroughly, figure is typically 0.65-0.80 -Sometimes lower (even 0!) - our planting schedule includes occasional extra "safety plantings", and we always have lettuce that we do not have a market for and which we till in. Sometimes an entire planting is tilled in.	we harvested a total of 12,994 heads from roughly .71 acres. Some heads were not harvested because of bad quality or bolting. At the end of the season some heads were left in the field due to freezing or not sizing up in time. This is around 18,000 marketable heads per acre. To get the 12,994 marketable heads, we seeded 232 flats with 128 cells in each flat. That is over 29,000 cells. This large discrepancy involves some flats never getting planted into the fields due to space or timing issues, others could have been bad germination in the flats. Beyond that, the rest of the heads were either not marketable or didn't get recorded properly at harvest time.	We plant one head per foot and try to pick one head per foot.
Other Notes on Harvest and Yields			

Two Onion Farm

Crossroads Community Farm

Natalie's Garden and Greenhouse

Marketing

Markets	CSA, direct to grocery, direct to restaurant	CSA, farmers market, direct to grocery, direct to restaurant, wholesale through a distributor	farmers market
CSA Lettuce - quantity delivered per share	<p>We include head lettuce in every box: 2 heads per "large" box, 1 head per "small" box. Sometimes (especially at beginning of season when other veggies are scarce) we include 3 per large box, 2 per small box.</p> <p>Spring lettuce varieties from late May to late June Summercrisps and Jericho from late June to end of August Fall oakleafs from ~Sept 1 to end of season in early Nov.</p>	<p>butterhead 1 redleaf 3 romaine 2 summercrisp 1</p>	
Farmers Market Prices		\$2.50 per head	\$1.50 per head and \$2.00 per head at a couple of markets.
Direct to Grocery Prices	\$1.35 per head	\$1.33 per head	
Direct to Restaurant Prices	\$1.35 per head	\$1.33 per head	
Wholesale Prices		\$1.33 per head	