

# Spinach

**Tenzin Botsford**  
**Red Door Family Farm**

**Paul & Sandy Arnold**  
**Pleasant Valley Farm**

Location	Athens, WI	Argyle, NY
Acres in FIELD spinach	0.17	Less than 1
Acres in HOOPHOUSE spinach	0.12	Less than 1

## How these tasks are done for Spinach:

field prep/tillage	with a tractor	with a tractor
2022 Organic Vegetable Production Conference – Sweet Potatoes		
hoophouse prep/tillage	with a walking tractor (BCS, Troy-bilt, etc.)	with a walking tractor (BCS, Troy-bilt, etc.)
direct seeding	by hand	by hand
transplanting	do not do this task for spinach	by hand
cultivating	by hand	with a tractor
mulching	do not do this task for spinach	do not do this task for spinach
laying irrigation lines	do not do this task for spinach	by hand
laying row cover	by hand	by hand
spraying for pests, diseases, weeds	do not do this task for spinach	by hand
harvesting	by hand	by hand
farming style	certified organic	organic practices, not certified

## Propagation

FIELD Varieties	<p>Space: Planted in spring and fall, most of our plantings, it is reliable and quick, but not very upright.</p> <p>Lizard: We have planted more mid-season, it does well and is slow to bolt, but it is also slow to establish (leaving it more prone to weed pressure). Haven't found anything better.</p>	<p>Direct seeded mostly but same no matter if direct or transplant</p> <p>Spring -Banjo, Regiment, Space, Seaside++</p> <p>Summer: Space, Lizard, Seaside &amp; Banjo.</p> <p>Fall: Many varieties... ones listed plus Whale, Emperor, Carmel, Escalade, Reflect. Some do better with excess rain like reflect, some with cold, etc. We do several types so some always do well.</p>
HOOPHOUSE Varieties	<p>Space: very hearty, very reliable, gets big, but stays nice (not very upright, but flatter growth habit may be beneficial to overwintering and row-cover success?)</p>	<p>Whale, Regiment, Space in spring in tunnels/hoop houses; Fall plantings in tunnels for winter production: Ever changing 15 varieties and trials, esp for DM and cladysporium resistance. Apache, Banjo, Equinox, Gazelle, Lizard, Matador, Reflect, Regiment, Sioux, Space, Tasman are top ones. Always trialing.</p>
Soil Mix		We mix our own using Cornell recipe: 2 bales peat moss, 1 bag perlite, North Country non-Chilean pro-gro 5-3-4, and Solucal lime.
Seedling Trays		Winstrip 128's

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Planting Schedule	<p><u>Field:</u> 4/15, 4/30, 5/15, 5/30, 6/15, 6/30, 7/15 sometimes one more with fall brassicas 8/1</p> <p><u>Hoophouse:</u> 9/2, 9/10, sometimes a third 9/20</p>	<p><u>Field:</u> Seed in GH March 1st to transplant outside 1st week of April or so. Will do one or two more plantings a week apart depending on weather and if we can direct seed in the field.</p> <p><u>Hoophouse:</u> Sept 15-30th Can be both seeded in GH or direct seeded. Depends on tomato rotation and if crops need to stay in tunnel longer. If GH, then transplanted out a month later (4-5 weeks).</p>
TRANSPLANTS Seeding		2-3 seeds per cell by hand or vibrating wand
TRANSPLANTS Germination		If it is hot, they are stacked in our potting shed area till they germinate; if cooler, they are put on radiant heated benches in our GH. No extra lights used.
TRANSPLANTS Irrigation		Water with warm water by hand with watering wand.
TRANSPLANTS Greenhouse		Keep on the dry side after initial watering to completely soak; Best is 68-72 degrees and we move off the heated benches to harden off once well established as they like cooler temps to grow
TRANSPLANTS Hardening Off		We place the spinach trays on the outside edges of the benches as we have high rollup sides that gives them sun/wind. Can be for a few days or a week.
TRANSPLANTS Diseases/Pests		Cladysporium can be a problem if the transplants are stressed. Aphids can be around and we use M-pede. Soil gnats have been a constant issue for years and beneficial nematodes are our best control,

### Bed Prep

Preceding Cash Crop	<p><u>Field:</u> Spring planted spinach (most of our field production) is going into a field that just came out of a full season of cover crop. The season before would have been dry beans and popcorn. Fall planted spinach is going into beds that were cucurbits the previous season, followed by an overwintered cover crop.</p> <p><u>Hoophouse:</u> Each fall we sow spinach in two of our four hoophouses. One of them will have had Cucurbits in it that are planted through landscape fabric. The other will have had early season carrots, beets, broccoli, and kohlrabi planted for our first few CSA shares.</p>	<p><u>Field:</u> First spring planting would be on open ground or where previous fall crops with straw mulch were turned under. Later ones can be on land where the winter rye/vetch CC has been turned under in the spring. Previous year crop can be CC land or a variable cash crop. We rotate families on a 4 year rotation as best we can.</p> <p><u>Hoophouse:</u> Variable with so many other types of crops we rotate. One tunnel is out of production each year with a CC, so it could be that one.... or could be the Tomato/cuke tunnel or Squash/pepper/ginger tunnel. Diversity of crops .... Try to rotate nightshades and Cucurbits.</p>
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Preceding Cover Crop	<p><u>Field:</u> Spring plantings: Are mostly going into a field preceded by a winter-killed cover crop (oats, peas, buckwheat, millet) which was sown in early fall following a bare fallow period of a couple weeks coming out of an overwintered rye and clover cover mix from the previous season. The very first bed of spinach planted will go into a bed that was worked up in fall to ensure we can get the first planting in.</p> <p>Fall plantings are preceded by a rye and clover mix (also containing some oats and peas) cover crop overwintered prior to shaping beds.</p> <p><u>Hoophouse:</u> In the early-season carrot/beet/brassica tunnel, we try to plant a quick crop of oats and buckwheat.</p>	<p><u>Field:</u> We use Winter Rye/Vetch for most of our overwintered CC..... sometimes use Clover. Fall crops maybe are preceded by Buckwheat.</p> <p><u>Hoophouse:</u> Can be Buckwheat, Cow peas</p>
Soil Amendments	<p><u>Field:</u> We use a basic mix for the whole farm that is somewhat customized for our soil. It is primarily CPM and Gypsum based with additional nutrients/micronutrients added. For field spinach we would typically apply it at a rate of 500-1000 lbs/acre (more in colder early season) Ideally, we try to mix it 50/50 with screened compost and double the rate (1000-2000 lbs/acre) in order to add biology and OM along with the ration.</p> <p><u>Hoophouse:</u> Same basic mix of primarily CPM and Gypsum about 500 lbs/acre (hoophouses get compost applied on a different schedule)</p>	<p><u>Field:</u> Totally depends on the soil tests and which field we use! We sidedress 100# of N 2 weeks after transplanting and 3 weeks after seeding. Any other nutrients needed are pre-plant.</p> <p><u>Hoophouse:</u> Varies according to soil tests for micronutrients. Apply 200# N in a 5-3-4 mix</p>
Soil Prep	<p><u>Field:</u> Primary tillage is typically mowing, disking (sometimes twice), then raised bed shaping (Buckey shaper), rain or water beds in, wait 1-2 weeks, fertilize (front mounted Clamco applicator) and power-harrow (Kuhn) immediately before planting.</p> <p><u>Hoophouse:</u> Mow or remove previous crop/cover residue. Till with BCS. Water well and keep the hoop closed for a week (if possible). Apply fertilizer and shallow till to form seedbed and kill germinated weed seeds. Sow spinach the following day, if possible.</p>	<p><u>Field:</u> Chisel plowing, tractor mounted rototiller, and mark beds for planting so they follow the cultivation equipment.</p> <p><u>Hoophouse:</u> Same as the field unless we are not re-doing all the beds. If re-planting beds, we use a walk behind BCS and till the tops of the beds, rake and plant</p>

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Notes on Bed Prep	<p><u>Field:</u> This is our basic system for low-demand, direct seeded crops on our farm, it was not developed specifically with spinach in mind. We typically plant 1 bed of spinach when we are out planting other crops.</p> <p><u>Hoophouse:</u> The buckwheat cover will turn over quickly and allow us something to keep biology in the soil while we try to run 6-12 inches of water through the soil to help leach any salt build-ups that may be occurring from repeated shallow irrigation. This happens in each hoop once every 4 years on our long-term rotation and spinach happens to be the next crop in there.</p>	<p><u>Field:</u> Work the soil when it is dry enough!</p> <p><u>Hoophouse:</u> We use raised beds in the tunnels.</p>
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## Planting Field

Bed Width	62" centers, 48" bed top	54"
Plant Spacing	<u>Direct Seeded:</u> 3 rows/bed, 15" apart, 1.5-2" spacing in row	<u>Transplanted &amp; Direct Seeded:</u> 4 rows per bed, 14" between rows
Transplant Process		Rows are pre-marked with tractor. We use an 8' stick with marks on it 6" apart placed in middle of bed. Plant 2 rows from each side. Plant by hand. With 2-3 plants per cell left together. Irrigate.
Direct Seeding Process	Sown with a 3 row, 3 point mounted Wizard vacuum seeder.	Same as transplanted but use a Jang seeder to direct seed, diff plates as needed for diff size seed.
Amendments at Planting	We add a mix of a customized CPM (composted poultry manure) and Gypsum based fertilizer mixed 50/50 with Compost at a rate of about 1000 lbs/acre as we prepare the seedbed for planting.	None.
Water at Planting	We always try to plant before a rain, but if not, we will overhead water within 1 day of seeding to ensure soil contact and germination. Usually 1/4-1/2" depending on soil moisture.	Overhead irrigation with impact sprinklers. Runs 2 hours at a time average.
Row Cover	Typically we don't, but sometimes we'll cover with floating agribon row cover to protect from hard freeze in late fall.	Used in early spring, late fall, 30 Weight. and can use for deer protection. use rocks to hold down on edges every 6 feet. Rolled up when not in use and labeled for grade and size. Most are 30' wide.
Other Notes on Field Planting	We use the vacuum seeder because we already have it for other things. It would not be worth it for the amount of spinach we plant alone. It allows for mechanical cultivation, which is typically necessary for us.	

## Planting Hoophouse

Bed Width	5' centers, 4' bed tops	33 inch
Plant Spacing	<u>Direct Seeded</u> : 3 rows/bed, 12-18" between rows (intentionally spaced far apart, as we let spinach get very large), 5-6" between plants in row	<u>Transplanted &amp; Direct Seeded</u> : 6 rows about 6" between rows and 5" in row
Transplant Process		Plant by hand. Lay out evenly by eye.
Direct Seeding Process	Sown with the radish plate on our Earthway seeder (basically the only place we still use the earthway). Rows are kept wide apart, and if germination is good, we will thin at first weeding.	Use Jang seeder... seed by eye for 6 rows.
Amendments	CPM and Gypsum based fertilizer blend added at about 500 lbs/acre incorporated with a BCS tiller to about 3"	Peat moss is applied replant. 2 bales per bed (135' long). Fertilizer and any micros are spread. All tilled in and beds formed.
Water at Planting	Overhead irrigation immediately after planting	Irrigate with overhead after planting and as needed over the weeks. sometimes use a Moisture meter or Monnit sensing device.
Row Cover	Fall spinach is occasionally covered with floating row cover to help germination. Then cover is withheld until temps drop below freezing. After that row-cover will be applied or removed daily as needed until freeze-up (usually late December) when it will be left on until early spring (usually mid march, for us) when temps begin to climb, it will be covered/uncovered daily again (as needed).	It depends! Temperature dependent... season. etc. In winter, 1-2 layers of P30 put down.
Notes on Hoophouse Planting	We plant 3 plantings in the fall, because we never know when winter is actually coming! Occasionally some of it won't get harvested until spring.	Row cover can be used to push crop on or can be left off and they get colder to slow down. Ventilation is done 24/7 to keep humidity down.

## Crop Maintenance

Irrigation	<u>Field</u> : Overhead watering with Micro-rain 32 irrigation reel. Aim for 1"/week total precipitation, but often achieve less. <u>Hoophouse</u> : As needed (approx. 1/2", twice weekly)	<u>Field</u> : 2" per week with overhead impact sprinklers... use every 5-7 days. about 1" per session. <u>Hoophouse</u> : Overhead as needed. Run about 90 minutes.
Changes to Irrigation	<u>Field</u> : More diligent, more often, less volume when young/establishing. <u>Hoophouse</u> : less water more often when younger. Mature leaves tend to split when on us when moisture fluctuates especially on the too wet side. So we keep them maybe just a touch on the dry side depending on how drying the weather is. We basically don't water in the hoophouses from mid-November through mid-March. Row cover keeps moisture in and helps to even it out, as the hoophouse tends to move moisture away from the middle, toward the outsides.	<u>Hoophouse</u> : Older and bigger plants need more water... soil moisture monitoring devices can assist

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Weed Control	<p><u>Field:</u> Stale seed bed prior to planting whenever possible. Shallow, gentle cultivation with Steketee 3 row cultivator mounted under an Allis G ("Franken G" ala Hans Bishop) as early as possible post emergence. Followed by a more aggressive shallow cultivation including finger weeder on same system 10-14 days later, depending on conditions. Hand weeding/stirrup hoeing if/as necessary.</p> <p><u>Hoophouse:</u> Try to effectively stale seedbed. Then weed by hoe and hand once early on, thinning if needed. After that more hand/hoe work as needed, typically one more time. Ideally we will water one morning, then weed the following morning, and water back again the next day after letting the sun desiccate the weeds for a day.</p>	<p><u>Field:</u> Combination of tractor cultivation with basket weeders, tinweeders, and shovels in paths</p> <p>Series of push hoes, hand weeding with wireweeders and triangular hoes if needed.</p> <p><u>Hoophouse:</u> Steaming, hand weeding with push hoes, wire weeders.</p>
Pests	<p><u>Field:</u> We rarely have significant pest pressure in the field.</p> <p><u>Hoophouse:</u> Aphids: We try to keep the row cover off as long and often as possible in the fall, often letting it frost uncovered even down into the low twenties. This keeps it colder and drier, seems to help with both aphids and downy mildew.</p> <p>Rodents: keep cats around and keep anything tempting like food or bedding out of the hoops.</p>	<p><u>Field:</u> Leaf minor/. Use row cover to exclude or netting. Deer--electric fencing</p> <p><u>Hoophouse:</u> aphids---Ladybugs; Crown mites--Azadirect</p>
Diseases	<p><u>Field:</u> very unusual</p> <p><u>Hoophouse:</u> Downy Mildew: try to keep cover off as long as possible and keep sides open to allow breeze through even at night long into the fall. Focus on prevention through managing the environment.</p>	<p><u>Field:</u> Not much</p> <p><u>Hoophouse:</u> Fusarium and other soil diseases--Root shield plus, actinovate, Soil serenade used in GH transplants and as drench via tractor sprayer 2x over winter. Cladysporium --varieties, venting,</p>
Bolting	<p><u>Field:</u> Overhead irrigation (during the heat, if necessary) only if close to harvest and hoping to delay a few days.</p> <p><u>Hoophouse:</u> Not usually a problem.</p>	<p><u>Field:</u> Keep irrigated, pick good varieties, keep nutrients up</p> <p><u>Hoophouse:</u> Same as for field spinach</p>
Notes on Crop Maintenance	<p><u>Field:</u> Field spinach is not a crop that we rely on heavily. Our primary focus for spinach is fall-sown in the hoophouses for late fall early spring harvest. As such, our field system is not designed specifically around spinach--we often seed an extra bed here or there along with other plantings and take what we can get.</p> <p><u>Hoophouse:</u> Anything that hasn't been harvested in the fall gets chopped and the old leaves raked out before covering it up for the winter. Seems to offer the best regrowth in the spring.</p>	<p><u>Hoophouse:</u> Monitor crop carefully and scout often. Control things ahead of time and be proactive.</p>

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Hoophouse Environment	<u>Hoophouse:</u> Try to keep moisture even, to minimize splitting, try to keep hoops as cool as possible.	<u>Hoophouse:</u> rollup sides automatically vent, end vents open 24/7 ; fans as needed to keep humidity down and temp where needed to slow or promote growth. Don't want wide swings in temps. Harden off gradually if can to adjust to cold temps.
Hoophouse Heat		<u>Hoophouse:</u> Minimal emergency heat. Not used for spinach.
Hoophouse Shade Cloth		No

## Harvest and Yields

Harvest Window	<u>Field:</u> Spring sown: 6/1-7/1 Fall sown: 9/1-10/31 <u>Hoophouse:</u> Fall: 11/1-1/30 (some years) Overwintered: 3/15-5/15 (Planning to start sowing a couple beds in spring for 5/15-6/15 harvest window.)	<u>Field:</u> Spring planted harvested for 2-3 weeks after each seeding, summer is 1-3 weeks per seeded crop, fall crop is continuous late Sept till buried in snow. <u>Hoophouse:</u> Winter crop is harvested Nov till May.
Harvest Procedure	<u>Field:</u> Morning (we start harvests at 6am when it's warm). Knife cut into bulb crates, straight to our packshed (which is cool) and watered in until it can be washed/bagged. <u>Hoophouse:</u> When it's warmish: harvest early and quickly snapping off leaves by hand to facilitate full-leaf regrowth. Knife cut at last harvest of the season. Typically we get 1-3 harvests in the fall and 1-3 harvests in the spring (per planting). When it's below freezing at night: Uncover when thawed, wait until about 40 degrees when the plants perk up. Pluck leaves until final harvest of the season, then knife cut.	<u>Field:</u> Hand pick just leaves into 5 gallon buckets, sorting firsts and seconds. Early morn. <u>Hoophouse:</u> Harvest into crates, sorting firsts and seconds whenever it is warm enough.
Cleaning Procedure	Watered in gently and immediately upon arrival to the packshed. Washed 1-2x in a water tank. Try to let them drip dry for a day in the cooler in bulb crates covered by a large bag but open on the bottom, before bagging.	Use a bubbler with sanitizer, mesh bag then spun in SS washing machine. If not washed immediately after harvest, is put into cooler and sprayed off first.
Sanitizers in Wash Water	None.	Tsunami is used in the wash waters for the bubbler
Packing Procedure	Packaged in plastic bags 5oz./bag (CSA gets 8oz./compostable bag)	Bulk spinach goes in Buckhorn crates with lids; retail goes into 8x4x12 plastic bags at about .3-.35 pounds per bag.
Storage	In bulb crates with a plastic bag upside down over each stack of 4 crates, open to the bottom for drainage. Our cooler runs cold (about 38 degrees) and dry due to the A/C unit Coolbot combo.	Walk in cooler in closed crates at 35-37 degrees.
Maximum Storage Time	Winter: 1 week (could probably go longer) Summer: 2 days	3 days summer, 7-10 days winter +

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Yield	Field: 0.5 lbs/bed foot (harvested smaller, 3 rows, 1-2 cuttings) Hoophouse: 1.5 lbs/bed foot (harvested larger, 3 rows, 1-3 cuttings) = 0.50 lb/row foot	Field: variable Hoophouse: 3.74 lbs/bed foot (6 rows) = 0.62 lb/row foot
Notes on Harvest and Yield	Reported somewhat best-case scenario. Varies widely depending on number of cuttings, but spring regrowth will eventually out-pace what we can sell.	Quite variable!!

## Equipment

General	Wizard seeder: \$7000 new. Micro rain Water reel: \$3500 new	Jang seeder - \$450 new for both field and tunnels Field: Bed prep is chisel followed by tiller; irrigation is semi solid Hoophouse: Bed prep is BCS Grillo - \$500 used; irrigation is overhead spinners
Biggest Impact	Hoophouse: Row cover Field: water reel	

## Marketing

Markets	CSA, farmers market, direct to grocery, direct to restaurant	direct to grocery, direct to restaurant, Online sales direct to customers
CSA	Main season full shares: 1/2lb bags 2x in spring, 1x in fall Extended season shares: 1/2lb bag EOW (every other week), 3-4x	
Farmers Market	\$4/5oz bag (\$5/bag early in the year)	.3 to .35# in bag for \$4 for salad spinach; 1/2 # seconds for cooking spinach \$5
Grocery	Bulk in bulb crates, \$10/lb	\$9 per pound wholesale bulk
Restaurant	Bulk in bulb crates, \$10/lb	\$9 per pound bulk wholesale
Other	Seconds grade spinach in winter to friends who have a small pasta company, trade for pasta!	Same as retail