

2015 Southern Wisconsin  
Vegetable Production Workshop  
**Spinach**



**Dave Perkins**  
Vermont Valley Community Farm

**Matt Smith**  
Blue Valley Gardens

**Bill Warner**  
Snug Haven Farm

Location	Blue Mounds	Blue Mounds	Paoli
Acres in Vegetables	35	12	less than 2
Acres in Field Spinach	0.15	0.25	none
Acres in Hoophouse Spinach	none	1000sq. ft.	1
field prep/tillage	with a tractor	with a tractor	
hoophouse prep/tillage		with a walking tractor (BCS, Troy-bilt, etc.)	with a walking tractor (BCS, Troy-bilt, etc.)
transplanting	with a tractor	do not do this task for spinach	do not do this task for spinach
direct seeding	with a tractor	with a walking tractor (BCS, Troy-bilt, etc.)	by hand
cultivating	with a tractor	with a walking tractor (BCS, Troy-bilt, etc.)	by hand
spreading amendments	with a tractor	by hand	by hand
laying irrigation lines	with a tractor	by hand	by hand
laying row cover	by hand	by hand	
spraying for pests, diseases, or weeds	with a tractor	do not do this task for spinach	by hand
harvesting	by hand	by hand	by hand
hauling harvested crop from the field	by hand	by hand	by hand
mowing cover crops or crop residues	with a tractor	with a tractor	
incorporating cover crops or residues	with a tractor	with a tractor	with a walking tractor (BCS, Troy-bilt, etc.)
farming style	certified organic	sustainable, no longer certified, don't use pesticides or herbicides, use composted poultry manure and conventional fertilizers	sustainable, following organic practices and currently applying for certification

**Propagation**

Varieties	Tyee (for field grown spinach both transplanted and direct seeded)	Tyee (for field and hoophouse direct seeding) is the variety we have for many years. It has a deep green color, good upright habitat that allows for picking each leaf. There are really no bolting issues except late in spring with high temps indoors.	A dark savoy (for hoophouse direct seeding), the varieties keep changing for disease control in California. By the time we find a variety we like it usually goes out of production. We need to start experimenting with some of the old standards. Currently we have 1 more year of Spargo left, it has been out of production for about 3-4 years. We have enough Carmel for about 2 years.
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Soil Mix	Vermont Compost Fort light		
Seedling Trays	Plantel 192, seeded with Seederman automated seeded		
Propagation Schedule	Greenhouse planting: Tye, 32 flats, 4/13 & 4/20 Harden off: 4/27 & 5/4 Transplant: 5/4 & 5/11 Harvest: 6/8 and 6/15		
Germination	Germination chamber		
Greenhouse Irrigation	Hand wand. As needed		
Optimal Greenhouse Conditions	The spinach must survive with all the other transplants. Set ventilation to maintain hopefully mid 70s. Set heat to low in mid 50s.		
Hardening-off	Move flats into the harden off area. Greenhouse structure with retractable roof and sides.		
Pests or Diseases in the Greenhouse	None		
Other Notes on Propagation	After moistening soil, it is important not to water beyond keeping the soil from drying out. Too much water kills germination.		

**Field Prep - Field Grown Spinach**

Preceding Cash Crop	Lots of choices, usually it would be late season vegetables. We plant spinach early so the ground would have been chisel plowed in the fall.	All of our fields are in annual crops with exception on asp. and ribes. So spring planted spinach would follow incorporated rye grass. Fall spinach could follow, onions, squash, peppers, eggplant, paste tomatoes and maybe potatoes.	
Preceding Cover Crop	Does not follow a cover crop.	We plant rye grass over all our annual fields as soon as we get the crop stubble worked over. The rye grass is then plowed down and followed by rotatiller to get even surface.	

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Soil Amendments	Add 80 to 100 units of N depending on field soil composition. This would be 1100 to 1400 lbs/acre of soybean meal.	We try to broadcast a 5-3-3 composted poultry manure in fall with rye grass and then use corn fertilizer 9-23-30 as side dress if need. The manure rates are about 150-200lbs. per acre. The other fert. is about 100lbs. acre.	
Bed Prep for Transplanting	Usually we rototill right before transplanting.		
Bed Prep for Direct Seeding	Rototill and make a particularly fine seedbed, no clumps or trash.	See above. We have a 2-bottom plow to incorporate the cover crop when the soils dry out enough if the spring. Then we have a 5 foot rotatiller to help smooth out the beds for planting. We have generally silt loam soil but also have clay spot which can present some problems if worked to early.	
Mulch	None		
Other Notes on Field Prep	The fine tractor cultivation we use for spinach call for very little to no trash on the surface of the bed.		

**Hoophouse Prep - Hoophouse Grown Spinach**

Preceding Cash Crop		We are limited in high tunnel production practices due limited space. We grow. tomatoes in summer and usually follow with spinach. We will clean up debris of tomatoes,fences,stakes and then seed down spinach.	In September all of our hoop house space is planted into spinach. On a rotation all of our crops precede spinach. They include tomatoes, flowers, greens and sometimes potatoes.
Preceding Cover Crop		none	We use sorgham-sudan as our cover crop in the hoop houses. It produces mass quickly, doesn't add to much extra nitrogen and suppresses our weeds. It also is a major tool in trying to control our symphytan problem, our number 1 enemy.
Soil Amendments		Same procedure as with outdoors,but after removing tomato debris will broadcast composted poultry manure at same rates.	We normally use only a calcium product. Our rotation, including leaf mulch on tomatoes, keeps our minerals and trace minerals high. The rate is appoximately 20 lbs per hoop per year. That assumes a hoop size as 30x95.

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Bed Prep for Direct Seeding		We work the soil with walk behind rotatiller.	We try to spade the soil 1st. It works in crop residue and cover crop exceptionally well. It also works the soil deeper and is easier on the soil than our tiller. Sometimes that is all the soil prep we do.
Other Notes on Hoophouse Prep		If high outside temps, we put shade cloth on high tunnels to lower temps for germination.	Once we prep the soil, we then need to prep our beds. We use a hiller to make raised beds. We sometimes have time to germinate weed seeds before planting.

**Planting**

Bed Width	<u>Field:</u> 5 foot	<u>Field:</u> depends on location and if in spring and fall. Aver. 60 by 100 <u>Hoophouse:</u> 30 by 100	<u>Hoophouse:</u> 4 feet
Plant Spacing - Transplanted	<u>Field:</u> It has been three rows, 5 inches apart in the row. We are getting a new transplanter and will change it to 4 rows with 4 inches apart in the row,		
Row Spacing - Direct Seeded	<u>Field:</u> Direct seeded spinach has been 3 double rows, rows 15 inches apart,	<u>Field:</u> Our row spacing is about 12 inches and it wavers due to using hand wheel seeders. <u>Hoophouse:</u> As in the field seeding we do 12 inch spacing and now have four bunched rows together. Attempting to max. production with limited space. We stay away from ends and sides by 2-3 feet.	<u>Hoophouse:</u> In a 4' bed we plant 7 rows of spinach.
Transplanting Process	<u>Field:</u> We have been using a Mechanical 5000 transplanter. This is a carousel machine designed to plant pyramid shape plugs. Three people ride the machine and pull the plugs and drop them into the rotating carousel. The machine plants the plugs if everything goes well. The machine also applies water.		

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<p>Direct Seeding Process</p>	<p><u>Field:</u> We use a Seed Spider mounted on an Allis G. The seeder is a precision "drill" for which any rate of seed can be set. I plant at 10 seeds per foot of line, which 2 lines in each row spaced 15 inches apart.</p>	<p><u>Field:</u> We try to keep things simple as possible. Use Seedway seeder with spinach plate and start at one edge and work right to left using marker bar. We do three rows together 3-5 inches apart then 12 inch spacing. Then repeat.til done. <u>Hoophouse:</u> Same as field.</p>	<p><u>Hoophouse:</u> We plant with an earthway seeder using the radish plate. We have some plates 'drilled out' for the larger spinach seed. We walk down the bed for the middle row and then use the isle for the 3 rows on each side. We used to lay 6 strings to plant for more uniform spacing. It was very time consuming and the uniformity wasn't as important as we first thought, because we do every thing by hand. We also used to plant using 3 earthways together using steel rods. To make that work as well as planting with one seeder, you have to have a very even rolled out firm bed to make all 3 planting wheels roll the whole time.</p>
<p>Compost or Amendments at Planting</p>		<p><u>Field:</u> In the spring with the already broadcasted composted manure nothing else is applied. Fall planted might broadcast 9-23-30 at rates of 150-200lbs. acre if needed and that is done before germination with push seeder. <u>Hoophouse:</u> Composted poultry manure at seeding at rates of 150-200lb.acre.</p>	
<p>Water at Transplant</p>	<p><u>Field:</u> We irrigate as needed. The transplanted crops get a small amount of water sprayed onto the soil by the transplanter.</p>	<p><u>Field:</u> We set up drip lines right away and water down beds as soon as possible. <u>Hoophouse:</u> We put down trip tape and irrigate as soon as possible. we leave the tape down til spring.</p>	<p><u>Hoophouse:</u> We sprinkle or drip immediately after planting.</p>
<p>Row Cover</p>		<p><u>Field:</u> We use floating row cover in the fall to help hold in heat and protect from cold. <u>Hoophouse:</u> We use floating row cover with hoops for cold protection.</p>	<p><u>Hoophouse:</u> We use what we call a substructure. We build a 2nd hoop structure that is approximately 28x85x4. It is built using metal conduit made for electricity. It is easy to bend. We cover that with plastic from the hoop house that has been replaced. We use 1/2" and 3/4" conduit in 10' lengths. They fit together to allow more flexibility when building.</p>

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Other Notes on Planting		<p><u>Field:</u> With our seeding three tight rows and space we get good weed suppression and easy cutting and allowing space to walk and harvest between rows.</p>	
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**Crop Maintenance**

Irrigation	<p><u>Field:</u> Irrigate using sprinklers attached to aluminum pipes. Or using a boom cart attached to a traveling gun.</p> <p>Usually, we will add 1/2 to 1 inch of water, depending on conditions and the soil type being irrigated.</p>	<p><u>Field:</u> We like to turn on drip late in day and with small areas 1-2 hours is plenty of time to get good soaking.</p> <p><u>Hoophouse:</u> We run the drip lines in the middle of the bunched rows and usually water at night to get a good soaking.</p>	<p><u>Hoophouse:</u> We use a sprinkler system to water. It has the natural rinsing of the soil like the rain. Drip tape does not keep the soil rinsed and nitrates seem to build up more and that usually makes for a larger aphid problem. We water at least once a week in September and it slowly declines to approximately once a month in December, January and February. In March and April it picks back up until it is about once a week again. This is all very variable depending on sunlight and temperature.</p>
Irrigation Modifications	<p><u>Field:</u> The schedule changes based on rainfall. Spinach is shallow rooted so you are irrigation for the surface conditions.</p>	<p><u>Field:</u> No real modifications. Try not to water to close to picking - it can make harvesting messy.</p> <p><u>Hoophouse:</u> No modifications. We try to get the spinach growing as fast as possible to go into the winter with as much size as possible.</p>	<p><u>Hoophouse:</u> We plant all of our spinach in September. Our watering is more related to time of year than plant size.</p>
Weeding	<p><u>Field:</u> We use a tractor mounted cultivator and do hand weeded as needed.</p>	<p><u>Field:</u> We do three ways, in between we have small Mantis toilers that work great. Hoes and some hand weeders for the tight spaces in between bunch rows. Earlier the better on the weeding.</p> <p><u>Hoophouse:</u> We do only pole and hand hoes in hoop houses to keep down dust that Mantis would create. We find if we attack weeds early, there are no real problems later.</p>	<p><u>Hoophouse:</u> We usually start weeding after the 2nd watering starts to dry down. We initially use a combination of hoeing and hand hoeing. After the next watering it is usually to big to hoe and we hand hoe and hand weed.</p>

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Insect Pests	<u>Field:</u> None	<u>Field:</u> None <u>Hoophouse:</u> None	<p><u>Hoophouse:</u> <b>Symphylan</b> is a root feeder that can wipe out a planting very quickly. When the spinach just has a tap root it will kill it. When the spinach is slightly bigger it will stunt its growth. When the spinach is full size it doesn't seem to be much of a problem. We have lost 3/4 of a planting at a time to symphylan. Symphylan can hide in the soil down to at least 4', can live down there for years, and there is no organic application for them. They come to the top layer of the soil when conditions are right for them: the same conditions as trying to germinate spinach in the fall. They also like great soil - they cannot burrow but can get through healthy soil. Sorgum-Sudan grass seems to minimize the damage for about a year. The other main control we use is to till within 24 hours of planting. They die very easily if they are in the till zone.</p> <p><b>Aphids</b> can be a problem in Feb- April, especially in a warm winter. We have not had much luck with soap or Neem. We now usually start with spot spraying Pyganic as soon as we see them showing up. The sprinkling system vs drip tape is also an aphid fighting tool. They are attracted to nitrogen and the rinsing of the soil with the sprinkler system has helped. Elliot Coleman said that a lot of little rinsing's seem to be better than fewer larger watering's.</p>
Diseases		<u>Field:</u> None <u>Hoophouse:</u> None	<u>Hoophouse:</u> We don't usually have spinach disease problems until the spring and at that time we till it in to plant something else.

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<p>Hoophouse Environmental Control</p>		<p><u>Hoophouse:</u> We use one to two layers of row covers depending on size on spinach . Large pickable spinach can get two layers for cold protection at night and can be pulled back during sunny days to dry out. Small spinach gets one layer and left on til larger size.</p>	<p><u>Hoophouse:</u> We use a very hands on and time consuming system. We leave our endwalls completely off until sometime in late Oct or early Nov. We start putting our substructures up in Dec. with plans to be able to cover everything by late Dec. Our whole goal is to grow the spinach as slow as possible Sept- Feb. I feel if it gets to warm and grows to fast it is more susceptible to damage when it gets real cold.</p>
<p>Hoophouse Heat</p>		<p><u>Hoophouse:</u> We do not heat hoop houses, but have constructed solid end walls with two layers of woven plastic sheets for tighter protection then flex. walls.</p>	<p><u>Hoophouse:</u> We heat to make conditions comfortable for cutting,weeding etc. a few times a winter (none yet this year) we heat to thaw out the spinach if gets well below zero and clouds up. Ideally we want the spinach to thaw out every day. This year, even when it hit -15 outside, the hoops thawed out in the A.M. on their own. On rare occasions we run heaters all night. Last winter we did it on 2 or 3 nights. We had not done that for a few years.</p>
<p>Hoophouse Shade Cloth</p>		<p><u>Hoophouse:</u> We have shade cloth at 50% and use it to help in germination.</p>	<p><u>Hoophouse:</u> In August we try to shade cloth or silo bag as many of the hoops as we can. We want to keep the ground as cool as possible for germination. It also makes it much nicer to prepare beds in. The shade cloths are about 60% shade and the silo bag is 100% shade. We use ropes for the shade cloth and lock or lathe down the silo bags. Once the spinach is germinated we take of the covering and use shade cloth when we want to make conditions comfortable to work in. Ropes make it easy to pull on and off. We keep the shade cloth handy for cutting on warm sunny days. We want the spinach to stay firm and not get wilted.</p>



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Bolting		<p><u>Field:</u> Not a problem unless planted to late in spring.</p> <p><u>Hoophouse:</u> We put cloth back on in early spring if needed and open side walls and take plastic on end walls to allow for heat escape.</p>	<p><u>Hoophouse:</u> Starting in late Feb/Mar the substructures remain open almost all the time to keep the temps down. The endwalls either are kept open most of the time soon after that. As April rolls around we will take off our endwalls to keep it as cool as possible. If it's warm enough to bolt the spinach, we should be on to our next crop.</p>
Other Notes on Crop Maintenance			

**Harvest and Yields**

Harvest Dates	<p><u>Field:</u> We plant spinach for CSA harvest in early June. Generally, the spinach bolts in later June, so we have spinach for 2 to 3 weeks. Fall spinach has been a challenge to bring in when useful for the CSA, so we just do not bother with it.</p>	<p><u>Field:</u> Our spring spinach is seeded in as soon as the ground is ready. Sometimes it can be in the end of March til early May All depends on how the ground is. We have a couple of beds that dry out rather early.</p> <p><u>Hoophouse:</u> We like to start seeding end of August to mid Sept. Any later and spinach really does not get enough size to be pickable in winter.</p>	<p><u>Hoophouse:</u> We harvest from late Oct through late April or early May.</p>
Harvest Procedure	<p><u>Field:</u> Harvest early (first thing, about 6 am) before it warms up. We harvest by hand, selecting leaves individually for harvest. The leaves are placed in harvest containers. Then are walked to the box truck and therefore in the shade.</p>	<p><u>Field:</u> We have serrated cutting knives to harvest spinach. We try to harvest all bunched rows at once moving down the row, We cut close to the ground. We use soft cloth fishing bags that have a draw string on them. Very little damage to spinach in bags. Kept in shade until harvesting is done.</p> <p><u>Hoophouse:</u> We use smaller knives in high tunnels for we are picking each outer leaves. We use the same net bags.</p>	<p><u>Hoophouse:</u> We cut the spinach 1 leaf at a time. Just the biggest ones (it is all relative) . The are cut into a cooler or tub that can sit in the isle or on the bed. Each cooler full is dumped into a bag and covered with a quilt. Every 1/2 hour to hour the bags are taken to the cooler or wash room.</p>

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<p>Cleaning</p>	<p>We triple rinse the spinach using a greens washing machine. Excessive moisture is removed using a commercial greens spinner. The spinach is placed into plastic vented containers, weighted and put into a 34 degree cooler.</p>	<p>We have 50 gallon plastic barrels we cut to make wash tubs. The spinach is left in the bags for the entire procedure including selling. Spinach soaks 15-30 minutes transferred to drain tubs and then we use an old clothes dryer to spin off excess moisture. Then put in walkin cooler. We don't take all moisture off for refrigeration will suck more out.</p>	<p>We wash in a 350 gallon stainless steel tank, with a jacuzzi system. We only need to wash it once. We give the spinach about a 10 minute jacuzzi, then let the dirt settle for a little bit. From there we scoop out with a pool net and spin it in a giant salad spinner. We wash about 20 -22 lbs at a time and spin about 6-7 lbs at a time.</p>
<p>Packing</p>	<p>We bag the spinach for CSA delivery. We use a bagging table which has weight scales, so all members get the same amount.</p>	<p>Most of spinach is sold at Farmers market and is left in net bags for easy sells.</p>	<p>We cut and pack to order size. The bulk orders are packed in boxes in liners and the market or CSA orders are bagged to size after the spin cycle. Our spinach is very scrunchable. We pack a lot into each box.</p>
<p>Storage</p>	<p>The coolers are kept at 34 degrees, and a humidifier is used to keep humidity at 90% as a goal.</p>	<p>Walkin cooler temp is set at 40 degrees.</p>	<p>We don't like spinach in the cooler for more than 48 hours. We love to tell the customer that it will last them 2 weeks and they often respond that it is closer to 3. The temperature is kept around 37-40. We have a cool-bot cooler which is great for flowers, but with the spinach we prefer the compressor. The cool-bot sucks the moisture out and the compressor does the opposite.</p>
<p>Yields</p>	<p><u>Field:</u> Yield varies considerably. The range is 1/2 to 1 pound per foot of bed.</p>	<p><u>Field:</u> Average about 60-80lbs. of cut spinach for 100 ft. row. <u>Hoophouse:</u> That is really hard to figure out because we cut individual leaves. Total is probably more than outdoor rates in some years and less then others depending on overall winter conditions.</p>	<p><u>Hoophouse:</u> In a real good year we can average 1000 lbs a hoop house. There are a lot of factors that go into that. Sun levels in Nov-Jan, germination and symphytan control in Sept. Did we have to cut when the leaves were a little smaller than we prefer to meet our orders and CSA, which relates to did we guess right in Nov on how much production we would have through Jan. When we 1st started winter spinach we thought 75 lbs a bed (350 lbs hoop) was good. Our target is now to get 200 lbs a bed (1000 lbs a hoop). I hope that in time we can keep realistically raising that target number.</p>

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Other Notes on Harvest and Yields		Sometimes we can get a second cut of fall planted spinach if the first is harvested early enough and we have a late fall.	
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**Markets**

Markets	CSA	farmers market, direct to restaurant	CSA, farmers market, direct to restaurant
CSA Spinach - quantity per share	Our goal is an 8 ounce bag for each of the first two weeks at the beginning of our 20 week season. This is the first 2 weeks of June.		We sell about 210 lbs a week in spinach shares over a 24 week period. The shares are 12 deliveries every other week of 1 lb of spinach.
Farmers Market Prices		We have been at \$6.00lb. for outdoor and \$8.00lb for indoor. It is not bagged til day of market.	Our base price is somewhat dependent on how much spinach is at market. Our Nov-Dec price was \$10lb last year, our Jan-mid April price is currently \$11 lb, and when we go outside it will go back \$10 lb to possilbe as low as \$9 lb.
Direct to Grocery Prices			
Direct to Restaurant Prices		Bulk pkg. at \$1.00lb less in two lb. bags.	Restaurants are sold bulk at \$9.50 lb
Wholesale Prices			