

2016 Southern Wisconsin  
Vegetable Production Workshop  
**Brussels Sprouts**



**Jillian Varney**  
Small Family Farm

**Jake Jakubowski**  
Westridge Organic Produce

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Crossroads Community Farm

Location	La Farge, WI	Blue River, WI	Cross Plains, WI
Acres in vegetables	9	8-10	20
Acres in Brussels sprouts	1/8 acre or 1500 plants or 2250 row feet.	1	0.66
How these tasks are done for Brussels Sprouts			
field prep/tillage	with a tractor	with a tractor	with a tractor
transplanting	with a tractor	with a tractor	with a tractor
cultivating	with a tractor	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 Brussels sprouts	do not do this task for Brussels sprouts	do not do this task for Brussels sprouts
laying irrigation lines	by hand	do not do this task for Brussels sprouts	with a tractor
laying row cover	do not do this task for Brussels sprouts	do not do this task for Brussels sprouts	by hand
spraying for pests, diseases, or weeds	with a tractor	by hand	with a tractor
harvesting	by hand	by hand	by hand
hauling harvested crop from the field	by hand	with a tractor	with a tractor
mowing cover crops or crop residues	with a tractor	with a tractor	with a tractor
incorporating cover crops or crop residue	with a tractor	with a tractor	with a tractor
farming style	certified organic	certified organic	certified organic

**Propagation**

Varieties	<p><b>Nautic:</b> Certified Organic, 105 day variety with tall plants and uniform production of sprouts. The seed is expensive but we have had great luck with it.</p> <p><b>Diablo:</b> Not available in organic. A 110 day variety that also has tall, uniform plants with much less expensive seed.</p> <p><b>Churchill:</b> A variety we have tried in the past that didn't do as well for us. It was a shorter day variety (80 days) and we think we planted it too early and the lower sprouts poofed out and the stalks weren't as uniform. It was also more susceptible to black rot or alternaria as the sprouts sat on the plants.</p>	Diablo	<p><b>Diablo</b> - later maturing, good in cold, nice shape.</p> <p><b>Gustus</b> - earlier maturing, more elongated shape, not as nice later in the season, sometimes less uniform in size.</p>
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Soil Mix	We use Cowsmo potting soil mix which is a relatively local source of potting soil coming out of Winona, MN that has worked well for us for the last few years. Since we make soil blocks, our transplants get a little more soil medium per transplant.	Vermont Compost, fort vee light	vermont compost, fort v
Seedling Tray	We seed them by hand into a home-made wooden tray that holds 120 1.5" blocks and then lightly cover them with a sprinkling of potting soil. First true leaves emerge about 2 weeks after seeding.	128 cell trays	standard 1020, 98 cell
Propagation Schedule	We just do one seeding around mid April. We are scheduled to seed April 7th. We move the flats out of the heated greenhouse after four weeks to allow them to harden off for a week or so. We usually transplant them around the second or third week of May. Last year we transplanted on May 20th.	Greenhouse seeding date: April 12, No up-potting, Transplant date: June 1	3 plantings in the greenhouse 3/15, 3/21 and 3/30
Germination	We seed them into our 1.5 inch soil block trays, lightly cover them with potting soil mix. They sit in the full sun and germinate within a few days. They sit in our greenhouse that is heated with wood-burning hot water boiler. We keep daytime temps below 80 or 85 and we try to keep nighttime temps above 50 even if it gets very cold. Brussels Sprouts are very hardy and will germinate in temps as low as 40 degrees up to 80 degrees. They aren't as fussy but your germination percentages will be much higher in temps above 60 degrees.	No special germination requirements, keep trays moist, brassica's germinate quickly, usually.	germ chamber
Greenhouse Irrigation	We water by hand with a stainless wand. We use the Fog-It nozzle for the first week or so during germination so as not to blast the seeds out of the cells or tumble them too much during germination. Once the plants are setting out their first true leaves it is safe to start watering them once or twice daily or as needed with the wand.	Water daily with hand wand or as needed, water in the morning. Covering trays with a light coating of vermiculite will help prevent green algae growth.	by hand with dramm yellow or red head wand, as needed, check several times per day.

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Optimal Greenhouse Conditions	<p>Keep it around 70 during the day and above 50 at night for the first three to four weeks. Because they are brassicas, we move them down off of the greenhouse tables that sit about 3 feet high to pallets on the floor to keep them cooler and from getting leggy.</p>	<p>I adjust our greenhouse heater and exhaust fan to maintain a nighttime temp of 45 degrees and a daytime temp of no more than 80 degrees.</p>	<p>at night we heat our greenhouse to around 58 degrees early on and bump it up to 63 once there are peppers in there. Brussels do fine in colder temperatures at night, the bigger differential in day night temps the leggier the plants will be. during the day we try to keep the greenhouse under 85 degrees using exhaust fans on a thermostat.</p>
Hardening-off	<p>They sit in the heated greenhouse space for 3-4 weeks. They move the cold-frame part of greenhouse for about a week and then sit outside for about a week before transplant. It depends on the weather a bit. If it is a very warm Spring, we will move them out quicker, but if it is a cold, cloudy and very windy Spring, we will take longer to move them out.</p>	<p>To harden off our transplants I place trays on a hay wagon outside one to two weeks before transplanting. In this time I will ease off on the watering and occasionally let the plants wilt slightly, this encourages root growth. Before transplanting I will water them thoroughly.</p>	<p>bring them out of the greenhouse onto benches that have plywood sides to protect from some wind. as soon as plants will pull from the cell we bring them outside, usually around 3 weeks after seeding. if it is still cold at night (below 34) we will put the tables on pallets and jack them in and out of the pack shed garage doors for protection at night.</p>
Pests or Diseases in the Greenhouse	<p>We have never had a problem with pests or diseases in the greenhouse in the spring on Brussels Sprouts.</p>	<p>If you water in the morning you shouldn't have any disease issues in the greenhouse. Sterilize your starting trays with bleach and water and always use new potting mix. I get aphids occasionally in the greenhouse and a spraying of pyganic will help get rid of them.</p>	<p>none</p>
Other Notes on Propagation			<p>the sooner they get transplanted the better. as long as they can pull from their cells and have had a couple of days to harden they are good to go into the ground.</p>

**Field Prep**

Preceding Cash Crop	<p>We rotate our families of vegetables. The year before the Brussels Sprouts were carrots. The year before that was potatoes. The year before that was cucurbits.</p>	<p>Our preceding crop is alfalfa and grass, this is the best way to avoid disease problems and provide a good amount of fertility.</p>	<p>we usually grow tomatoes, peppers and eggplant before brassicas. before tomatoes is less set in stone, we have done sweet corn, carrots, onions in different years before the tomato crop depending on the situation and acreage available.</p>
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Preceding Cover Crop	Generally, our brassicas do not have a preceding cover crop due to land limitations. But in a perfect world you could seed a legume cover crop such as peas or hairy vetch to plow down for nitrogen as Brussels sprouts are very high nitrogen feeders.	Alfalfa/grass	generally we grow winter rye after solanaceous crops. some is tilled down very young for the first plantings of brassicas. then we continue to till down as many beds as we need. we try to get the rye tilled down about 3 weeks before planting.
Soil Amendments	We take a soil test every three years and amendments are added to balance the soil by field. Applications rates are determined by recommendations from our soil agronomist. Our phosphorus and potassium and zinc are good and do not need adding. This year we will be spreading gypsum, feather meal, tiger90, sulfur, manganese, borate, and copper. The application rates will be different for every farm. We are trying to add the minerals that our soil is low on to bring all of the minerals into balance and up to the recommended levels for vegetables. You could foliar feed or side dress with your preferred nitrogen fertilizer since Brussels are heavy nitrogen feeders.	I use Compost manure crumbles, broadcast at a rate of 600# to the acre. I like using them because they're easy to apply and very cost effective. I also like to use a fish fertilizer when we transplant.	we spread a custom micronutrient blend over all of our vegetable ground every year. we order a custom blend from midwest bioag that includes 100 lbs humical (for calcium) 100 lbs of kmag (for magnesium) and 70 lbs of microhume (contains many trace elements including boron). in addition we spread 1000 lbs of 4-3-2 dehydrated chicken manure pellets mainly for the nitrogen source but also providing a lot of calcium and p and k. 1000 lbs of chicken manure is about 40 lbs of Nitrogen, if we are concerned about the nitrogen level in a specific field due to past management or experience (or not much of a cover crop) we may double the chicken manure rate to 2000 lbs.
Bed Prep	We disc the field one or two times before preparing beds with our spading machine.	Moldboard plow in spring or fall, preferably the fall before. As soon as soil is workable in spring, I start discing. Disc over about four times or passes, then one or two passes with the rototiller, then until planting weekly passes over the field with the perfecta field cultivator. Ideally I want the soil worked very well and no perennial weeds or grasses re-emerging between the last week of field cultivating. Annual weeds should only be very small weed sprouts in-between field cultivations. I make the final pass of field cultivating a day or less before transplanting.	we like to subsoil in the fall, going right through the winter rye. it continues growing and the roots penetrate the open slots from the subsoiler. in spring we rotovate the rye down going just deep enough to make sure it is chewed up and killed, about 3-4". we wait 2-4 weeks and then rotovate again the day of transplanting to make nice soft soil for transplanting. if the rye isn't entirely killed from the first rotovation or there are weeds, we will go through with a field cultivator (usually a quack digger) to stir the soil and bring and plants to the surface to dry out. when there is not too much residue, we will use a perfecta II field cultivator instead of a rotovator for preplant soil prep and field levelling the day of transplanting

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Bed Shaping	We do not shape our beds yet before transplanting.	None	no raised beds for brassicas
Pre-Planting Mulch	We do not lay plastic or straw mulch of any kind before transplanting. Brussels are transplanted into bare soil.	None	

## Transplanting

Bed Width	52 inches	around 38"	inside of tire tracks is about 48 inches
Brussels Sprout Spacing	2 rows per bed, 18" between plants and 36" between rows. This spacing is very important.*** Closer will result in smaller plants. It will reduce the light each plant gets, the plants will be competing for nutrients, and will also reduce the air flow between plants causing favorable conditions for disease. We have had plenty of failures planting at closer spacing!	Rows 38", space between plants is 24"	2 rows 30 inches apart 17 inches apart in row
Transplanting Process	We use the Rain Flow Water Wheel Transplanter. We set our spikes at 18" apart with two rows per bed, 36 inches between rows. We can transplant two rows (or one bed's worth) in one pass. The transplanter inserts water into each hole and the people riding on the back of the transplanter plug the transplants into the ground. The soil blocks get ripped apart a bit during this process, but they don't seem to mind- this is a little root pruning.	We transplant into bare ground using a water wheel transplanter, we use a fish fertilizer solution. Plants are thoroughly watered in with transplanter. We set plants just deep enough to fully cover the root ball.	we use a waterwheel transplanter with spikes set at 17 inches. one person per row. we make sure that the root ball is covered with soil after it is placed in the wet hole
Fertility at Transplant		Fish/seaweed fertilizer, full recommended rate.	we have used some dramm one in the transplant water in the past, but don't feel that it is a necessary addition based on visual results.

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Water at Transplant	The water wheel transplant gravity feeds water into each hole. The worker riding on the back of the transplanter monitors the water output. We like to plant into a muddy hole with a small amount of water at the bottom of the hole. It really depends on how fast we're transplanting, how moist the soil is at transplant and our time limitations to get the job done. We like there to be plenty of water per hole.	The plants are soaked in at planting with the transplanter	water is placed with the waterwheel transplanter. we try to run as little water as possible that will come out of the spigot, this still gives a pretty soaked wet spot for the plant, but by using smaller amount of water and running the spikes so they are just barely touching the ground allows so that the spikes don't clog with mud and have to be cleaned off
Mulch at Transplant	We would not recommend using mulch of any kind for Brussels sprouts.	None	no mulch

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<p>Row Cover</p>	<p>We do not use row cover.</p>	<p>None</p>	<p>we use row cover on all brassicas for the first 4 weeks, pulling it off after 10-14 days to cultivate. we use heavy weight .9 oz row cover in 26x800 foot rolls, \$588 per roll. a half roll will cover 4 of our 400' beds. we typically get 3-4 uses out of a sheet, so the cost breaks down to around \$25 per bed (500 plants). we put soil on the edges every 5' or so and add around 8 sand bags evenly spread 5 to 10 feet in from the edge to help keep it in place. the sand bags can also keep the cover from blowing away should it get lifted up out of the soil, which usually happens at least once a year. we try to plant 4 beds at a time so we can effectively lay the big sheets over all 4, when this does not work we will cover 3 beds with a big sheet and then open it up to do the 4th bed later. or if we have an odd number of beds we will also use 83" wide single bed row cover for a bed or two in a planting. it takes about the same labor to cover a single bed as it does to cover 4 beds with the big sheet, but single beds are easier if it is very windy. we use row cover for flea beetles, so all the plants get established and vigorously growing early on leading to very nice crops later. the row cover also protects against cabbage maggot flies from laying eggs and heats up the soil and air for quicker growth.</p>
<p>Other Notes on Transplanting</p>			<p>in 2015 we planted quite early and one of our sheets of row cover was short. the plants that were left uncovered all perished, most likely from a frost and/or insect stress. weeds under the row cover are a serious issue and we have to be prepared to deal with very thick carpet of germinated weeds when we pull the row cover off.</p>

**Crop Maintenance**

Irrigation	If rain is less than 1 inch per week, the Brussels are drip irrigated with drip tape for 2 hours once or twice per week.	We do not irrigate	we use overhead water reel to irrigate. the rate depends on the weather and stage of plants. in general we shoot for an inch per week but if it is hot and windy we may put down twice that.
Irrigation Modifications	It is totally dependent on weather. It is crucial they receive plenty of water the first month or so after transplant during a major growth period. Try to irrigate so that they receive about 1 inch of rain per week.	None	later in the season when the Brussels are established, they are lower priority as they will set some deep roots and be able to withstand dry spells more then other crops. but you can't starve them of water or you won't get as good of yield.
Supplemental Fertility	No supplemental fertility. But this year we are going to add fish emulsion to the irrigation water or through foliar feeding at the rate recommended on the side of that particular fish emulsion's recommendations.	None	all preplant, we have never done it, but i imagine that side dressing would have yield benefits especially for if you wanted larger sized sprouts.
Weeding	1st cultivation (about 2 weeks after transplant)- Kress finger weeders with side knives. 2nd cultivation about 2 weeks later with Kress finger weeders with side knives. Spot hoe through the remainder of the summer.	I start tractor cultivating 3-5 days after transplanting and will continue weekly until crop is to big to go under the tractor. The first couple cultivation's are made with a finger weeder attached. This will eliminate about 95% of all annual weeds if it's done when they very small, it will not kill perennial weed's or grasses, that's why those should be out before you transplant. The remaining cultivation's are made using usual cultivator sweep's and shovel's. If needed I will do one hand hoeing when the plant's have been in for a few week's, for this I prefer using a long handle collinear hoe with a 7" blade.	2-4 people pull back the row cover. to prevent a 4 bed sheet from blowing away, we pull up one side and cultivate 3 beds, then put that side down and pull up the other side for the 4th bed. we use a kress 3 point steerable cultivator that we can put fingerweeders on for in row cultivation. our crew hoes in row with 8 inch scuffle hoes while i cultivate. they put the row cover right back on afterward. when the weeds are tall (due to rainy weather or bad timing) it can look like a lost cause. then we run the cultivating tractor through several times to get the weeds down. when they are thick and more then a couple of inches tall, it is slow going as everything gets clogged. we just lift up, and move forward a bit to unclog. its not pretty, but we can usually get the crop ahead of the weeds. later, when Brussels are over 2 feet tall we do to 1 or 2 more hand weedings. after that the plants are vigorous enough to compete with any weeds.



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Diseases	For several years we have had issues with Alternaria and/or black rot. Crop rotation away from brassicas and sourcing of disease free seed are the 1st two control measures. We have used copper hydroxide in the past to suppress these diseases. Not quite sure of efficacy because no plants were left untreated. These diseases tend to mostly affect the lower sprouts- so we have cut them off a bit higher and removed rotten sprouts.	Wide row spacing helps give plants better air circulation, we use 38" rows, 24" between plants. Striping bottom leaves would also encourage better air movement but may not be time efficient.	we get rot on the sprouts that are closest to the ground. so we start harvesting early in the season to try to create a barrier from those sprouts with the ones that are actively sizing up.
Insects	Flea Beetles can cause problems early in the season on establishing transplants and can also cause damage on the actual Brussels. Suppression of flea beetles can be achieved with a well timed application of Spinosad with a spreader/sticker.  Worms can defoliate plants throughout the season and weaken them. We use Bt for worm pests.	Flea beetles and caterpillars probably the biggest pest challenge. Weekly or bi-weekly sprayings of a dipel and pyganic mix give acceptable results and keep insect levels tolerable.	other than row cover we rarely do much for insect control. we don't really spray for cabbage loopers or other caterpillars and haven't seen major populations. if we saw the need we have the ability to spray dipel on a crop when necessary with a 20 foot side boom sprayer. our harvest schedule helps reduce insect damage by continually harvesting sprouts from the bottom of plants as they size up and look good.
Topping	We top our Brussels 3 weeks before we begin to harvest. This forces the Brussels on the tops of the plants to grow bigger faster.	We top all our Brussel sprout plants 6 weeks before the first hard frost. We begin topping around August 15. Topping encourages the plants to fill out each sprout instead of putting on more leaf growth.	no topping. we continue to let them grow throughout the fall, some years this allows harvest to continue into december as they continue to grow and size up.
Other Notes on Crop Maintenance			We break off the lower leaves as we harvest

**Harvest and Yields**

Harvest Type	on the stalk only	off the stalk only	off the stock only
Harvest Window	We mainly harvest Brussels on the stalk. We use a loppers and cut the plants at the base. 1st harvest is usually Oct. 1st and sprouts are harvested until they are gone or until 1st hard freeze.	We harvest sprouts from Early Sept.- Early Dec. Main harvest is Early-Mid Nov. We only harvest once over.	In 2015 we started harvesting on August 11th. We do a lot of wholesaling of Brussels, so we like to have a long harvest window to increase sales and have consistent supply. We then harvest weekly based on orders. We don't put Brussels into CSA boxes until mid to late October. Wholesale sales increase dramatically as we get closer and into November.

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<p>Harvest Procedure</p>	<p>First we go through and remove any leaves by ripping them off (usually side to side works best.) Then we use a loppers to cut them off at the base while others gather the stalks.</p>	<p>Strip leaves from plant by forming a large open circle with your hand's, in one forceful push, snap all the leaves off the plant. After removing the leaves from the plants in the row we cut the whole stalk down using a pole-saw chainsaw. When row is cut gather plants into harvest crates and load onto wagon. We then haul them back to the packing shed and stored on the stalk in apple bins. They will store this way for 6 weeks if kept cool. Ideally kept at 35-45 degrees. When it's time to pick sprouts off we simply hold the stalk in one hand and pop them off with the other, we do any kind sorting at this time as well, bad one's are not picked off the stalk and thrown away with the stalk . We've found this way to be much more efficient then crawling down the row in the field. After picking them off we only do minimal amounts of trimming and leaf picking, if any. They are then dunked in fresh cold water and directly packed into 10-20# boxes.</p>	<p>We harvest from the bottom of the plants as soon as the sprouts are sized up to a marketable size, and we have enough labor to work on the crop. We leave the small ones for later in the season to allow them to size up. We don't spend any time peeling ugly leaves from the sprouts, if they are ugly we drop them on the ground and move on.</p>
<p>Cleaning</p>	<p>We ship Brussels on the stalk, so we don't do much for cleaning other than removing any Brussels that don't look good.</p>	<p>Minimal trimming, preferably none</p>	<p>we harvest into bins with solid bottoms so that there is no mud getting on the sprouts. we expect all the culling to take place at harvest and we don't do any postharvest treatment other then cooling in open containers. we harvest 2 to 3 times per week so we are only bringing them in as we have orders for them.</p>
<p>Packing</p>	<p>We take a sharp knife and cut each stalk about half-way with a knife... whack! The stalks will then snap in half to fit in a 3/4 bushel box.</p>	<p>Packed into 10-20# wax boxes covered with a piece of plastic.</p>	<p>we sell case sizes of 10 lbs, but for larger orders we often pack 40 lbs into a 1 1/9 box. we usually put a plastic bag or cut a piece of cardboard on the bottom of the box to keep the sprouts from falling out of the bottom of the box. we will do the same at the top of the box.</p>

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Storage	We do not store them for long, but when we do it's in the cold cooler at 36 degrees and high humidity.	Storage on the stalk up to 6 weeks, temps ideally 35-45 degrees	we store them in closed sealed containers or in black crates covered with a plastic pallet cover bag.
Yields	Average of 5 lbs. of sprouts per bed foot. Roughly 1 1/4 lbs. per plant.	7,000 plants yielded 4,000 pounds or just over half pound per plant. Yields were low in 2015. Unfortunately we only received only 1/2" of rain in the months of July and August, and do not have irrigation capabilities at this field.	in 2015 we sold 7080 lbs of Brussels from .66 acres. this was from 16 300' beds. 2 rows per bed equals about .75 lbs per row foot. we got hit with a hard freeze in mid november and left a lot of potential yield out in the field as well. this translates to about 10,800 lbs per acres
Other Notes on Harvest and Yields			the larger the sprouts the more lbs per hour that one can harvest. it is crucial to train employees to pick sprouts quickly as there can be large differences on how many lbs of Brussels one can pick per hour. when the picking is good a fast picker can pick 80 lbs per hour, but this rarely happens with hired help. we expect average employees to pick 30-40 lbs per hour unless the sprouts are particularly small or other issues are at play.

## Marketing

Markets	CSA, farmers market	CSA, farmers market, direct to grocery	CSA, farmers market, direct to grocery, direct to restaurant
CSA	We offer Brussels in weeks 19 and 20 of our regular season. Each box gets a whole stalk on each of these 2 deliveries. So each share gets about 2 1/2 pounds in a season.	1-2 pounds per share, 2-3 times.	we give them at least once to the summer 20 week shares, sometimes twice to the regular members. we give around 1 lb per delivery for the summer shares. for the winter shares we distribute them 2-3 times. we usually give a 1 lb bag per delivery but sometimes will give a 2 lb bag if supply is large.
Farmers Market Prices	\$5 per stalk.	Farmer's market price between \$4.50-\$3.50 per pound	\$5 lb
Direct to Grocery Prices		\$3/lb.	\$4 lb
Direct to Restaurant Prices		\$3.50/lb.	\$4 lb
Wholesale Prices to Distributor	N/A	N/A	N/A