



# Broccoli

**Nate Drummond**

**Six River Farm**

**Abby Benson**

**Featherstone Farm**

Location	Bowdoinham, ME	Rushford, MN
Acres in vegetables	30	140
Total acres in broccoli	1.5	13

## How these tasks are done for Broccoli:

field prep/tillage	with a tractor	with a tractor
transplanting	with a tractor	with a tractor
cultivating	with a tractor	with a tractor
mulching	with a tractor	do not do this task for this crop
laying irrigation lines	by hand	with a tractor
laying row cover	by hand	do not do this task for this crop
spraying for pests, diseases, weeds	with a tractor	with a tractor
harvesting	by hand	with a tractor
farming style	certified organic	certified organic

## Propagation

Varieties	Emerald Crown, Imperial	Spring: Green Magic Fall: Diplomat and Imperial
Seed Treatments	None	Sometimes we hot water treat, but haven't for a couple years (122 degrees for 20 minutes)
Soil Mix	Compost based mix - Living Acres Light Mix (from a local Maine company)	Vermont Compost Fort Light
Seedling Trays	Black plastic 128	Black plastic 128 trays or 192 plantlets
Propagation Schedule	See attached	Three spring plantings seeded 4/1, 4/8, 4/15 and transplanted one month later. We take a break from broccoli during the warmest part of summer and then seed five successions for fall seeded 5/29, 6/5, 6/12, 6/22, 7/1 and transplanted a month later.
Germination	Nothing special. In prop house.	We germinate right on transplant benches, not a fussy crop for germination.
Greenhouse Irrigation	Hand watering. Usually 1-2 per day.	By hand, as needed.
Greenhouse Conditions	65-75 degrees. Aim to keep well watered and under shade cloth in the summer.	All brassica transplants are grown in the cooler of our two greenhouses which we aim to keep below 85 degrees during the day. We vent the house with hand crank roll up sides, open doors, and utilize thermostat controlled louvers that open and shut automatically. Greenhouses are heated in the early part of the season as needed and closed overnight.
Hardening Off	Ideally move outside 2-5 days prior to planting	Plants from greenhouses outside onto hay wagons at least one week before transplant to harden off. The wagons can be pushed inside a third greenhouse if needed due to cold or storms. With a truck or tractor we can quickly move transplants out to the field for planting.

	Six River Farm	Featherstone Farm
Greenhouse Pests or Diseases	Cabbage worm (regular BT spray); DM (good ventilation (have tried spraying bio-fungicides to unclear success)	I haven't had many issues with pests or disease in the greenhouse, other than the occasional flea beetle. (may choose to use Entrust if they're bad enough) Hot spots can lead to stunted/unhealthy plants, so we use a 30% shade cloth during the hottest part of the season along with fans and ventilation.
Other Notes on Propagation	Broccoli seeding/gh management is usually done as part of a larger Cole Crop block of crops	

## Bed Prep

Preceding Cash Crop	Highly variable since we grow over 40 crops. It makes for a highly complex rotation scheme. Broccoli is planted out as part of larger blocks of Cole crops. We usually have 4 different blocks of Cole crops rotated around the farm each season, each block consisting of 3-4 successions.	With a land base (mostly rented) that has seen a lot of change over the years, and a crop plan heavy in brassicas, we do not have a set rotation that would dictate a particular preceding cash crop. We aim for a 5 year rotation ideally following a rye/vetch or oat/pea cover crop.
Preceding Cover Crop	Again, variable. Ideally following winter killed Oat/pea for early successions; buckwheat for mid summer plantings; barley/peas for late summers plantings.	Spring broccoli will ideally follow a fall seeded oat/pea cover crop that winter kills for easy field prep in the spring. Fall broccoli ideally follows a fall seeded rye vetch cover that will continue growing until we need the field, providing organic matter and nitrogen.
Soil Amendments	Poultry litter fertilizer: Sustane 8-4-4 or Krehers 7-3-6 at 1000lb per acre. Sol-Po-Mag and lime per soil tests	We work with an independent soil consultant to amend fields based on soil tests taken each fall. Since black rot became more of a problem for us in brassicas in 2016, we focused a lot of attention on balancing soils through micronutrient management and mineralization. We put down different amounts of raw turkey litter or composted chicken pellets (chick magic), and minerals based on recs from our soil consultant.
Soil Prep	Mow and harrow to incorporate cover crop Subsoil Harrow Perfecta or Rototiller depending on soil conditions Fertilize Bed Shape/Lay	We will flail mow any living cover crop 3-4 weeks before planting and then do a combination of chisel plow and discing depending on how much debris is in the field with a finish disc right before bed press so the soil is fairly smooth for the bed maker.
Bed Shaping	We plant all broccoli on raised plastic beds. We use a rainflo 2600 layer/shaper.	We plant everything on raised beds. Some on plastic and some bare. The raised bed helps in case of excess moisture. We shape the beds with a Rainflo 2600. Plastic beds can be formed right before planting, and bare beds are formed a couple weeks before planting to allow for stale bedding. When making bare beds, we follow the 2600 with a rotovator to create a better soil texture and to widen bed tops to 34-40".

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Mulching	Black (spring plantings) or White plastic (summer plantings) depending on season; 2 rows drip tape.	We use plastic mulch for our spring plantings as it tends to be wetter, and the plastic helps to manage excess moisture. It is laid with the Rainflo 2600. We will also do 1 of our fall broccoli plantings on plastic as a hedge against certain weather conditions. It keeps roots dry in case of a really wet fall, and we are also able to water it with the drip tape below the plastic in case of drought. All other plantings are grown dry with no added irrigation.

## Planting

Bed Width	Raised beds; 72" on center with a 45" bed top	About 36"
Plant Spacing	3 rows at 12" for spring successions; 2 rows at 12" for summer and fall successions	2 rows per bed spaced 22" between rows, 14" between plants
Transplanting Process	We transplant using a water wheel transplanter; with 2-3 people planting depending on rows; Rain flo 1670 planter. When plugs are well formed, broccoli is one of the fastest crops to transplant!	For plastic mulch we use a water wheel transplanter. For bare ground we use a 5000 Mechanical Transplanter carousel. A transplant team is usually made up of 4 people. One person drives, two people are seated and handling the plugs. The fourth person is a walker who ensures proper placement of plugs into the ground, water flow, continuous supply of plants, and machine adjustments as needed to keep the whole operation moving along continuously and smoothly. This person is usually essential for the 5000 transplanter but could be done without for waterwheel transplanting.
Amendments at Transplanting	No amendments at planting	5 gallons per acre fish emulsion is added to transplant water
Water at Transplanting	Usually only water at transplanting	Water is applied through the transplanter. We can adjust how much flows out depending on soil moisture or how much water we need to make a complete down and back pass before having to refill the tank.
Mulch at Transplanting	Raised Plastic mulch with a living mulch (barley and crimson clover) applied between beds prior to planting	We use black plastic mulch for all spring broccoli. For fall broccoli we mostly plant bare ground (no mulch) but will usually do 1 succession in the valley on plastic as an insurance policy. If we were to have an exceptional wet period, the plastic would keep the roots from becoming water logged. I prefer growing brassicas on bare ground, but it's probably smart to hedge bets against increasingly unpredictable weather.
Row Cover	Usually the first 4-5 successions in the spring/early summer are covered with row cover to both provide extra warmth and flea beetle protection; we use covertan pro-19 covers; 26' wide which cover 3 beds. Beds are hooped prior to covering. Covers are removed approximately 4-5 weeks after planting	We generally do not use row cover on broccoli

## Crop Maintenance

Irrigation	Broccoli is irrigated via drip irrigation from fresh water drawn from Merrymeeting Bay. Irrigation schedule varies depending on soil moisture and season. We typically irrigate Cole crops weekly in July and August; less in spring and fall.	As part of the disease prevention plan on the farm, we generally do not overhead irrigate any brassicas (except to germinate direct seeded crops). In fields where we have the irrigation capacity, we may use plastic mulch with drip tape to irrigate- aiming for about 1" per week if needed. Currently we grow most broccoli dry (almost half are on ridge top fields that do not have reasonable access to water) and have had good luck with this. In an emergency, we can set up overhead irrigation on valley fields.
Changes to Irrigation	We pay extra attention to irrigation on newly planted beds in hot summer months; likewise special attention to irrigation during head formation of soil conditions are dry.	No, we don't really change the schedule. We water once per week until harvest.
Weed Control	Hand weeding of planting holes; generally 2-3 weeks after planting; mow living mulch between beds 2-3 times.	1) stale seed bedding with baskets and tines on the Super C twice before planting. After transplanting we aim to cultivate once a week or as needed until plants are too big. We use a Kubota 245 and then switch to a Ford 1710 when taller plants call for more clearance. 2) The first cultivation is with baskets and tines 5-7 days after transplant when weeds are at the white thread stage. If root balls are well buried, we can be pretty aggressive with the tines, allowing for good in-row weed control. If needed, we'll do this one more time, using baskets until plants are too big. 3) We may also use the alleyway cutaway discs with knives- heavy duty telescoping knife-disc assemblies than can be adjusted for many uses. As the plants get larger, I take off the disc part, which allows one to get under the leaves, as close to the plant as possible with the flat knife part of the setup. We pair these with 3-pt wheel track sweeps. 4) As plants get larger, we'll use sweeps as needed until plants are too big. 5) hand weed if needed.
Insect Pests	Flea Beetles (row covers; pyganic/Azaguard) Imported Cabbage Worm (Bt; Entrust; Azaguard)	Imported cabbage worms and cabbage loopers are the main pests we deal with on broccoli, We use Bt to control worms as needed, applying 1# per acre with a boom sprayer that covers 4 beds at a time. If flea beetles become a problem, we will use Entrust. Entrust can also be used for worms and in rotation with Bt if high pest pressure calls for multiple sprays and Bt resistance is a concern.

	Six River Farm	Featherstone Farm
Diseases	<p>-Alternaria</p> <p>-Downy Mildew</p> <p>No great solutions; mix of variety selection, spacing, raised beds; have trialed several Organic fungicides (Serrenade, double nickel, Howler), but have not seen string efficacy</p>	<p>Alternaria and black rot, especially Our disease management plan includes: 5 year brassica rotation, hot water seed treatment, trials with disease resistant varieties, roguing diseased plants are necessary, sanitation of equipment and workers, avoid moving through plants when wet, improving soil, transplant, and crop health for more resilient plants, high standards for weed control to allow good air flow.</p>

## Harvest and Yields

Harvest Window	<p>Usually first harvest in early June with aim for continual harvest through late October or early November. Sometimes we have weather related gaps in supply in mid/late summer.</p>	<p>In a good broccoli planting, we will likely go through each area about 4 times. Usually we will pick for about 2+ weeks on each 2 acre succession, especially when it's cooler out. However, it could be only 4-7 days of picking if its rainy and hot. By planting two varieties with a few days difference in maturity in each succession, we extend the picking time off of each planting.</p>
Harvest Procedure	<p><b>Harvest Equipment:</b> Green Totes (carry 2), large harvest knife</p> <p><b>Body Position</b> -Standing, bent over position</p> <p><b>Technique</b></p> <ul style="list-style-type: none"> <li>-Harvest 1 row at a time</li> <li>-Cut stalk 4"-5" below head</li> <li>-Peel-off leaves with hand. Ok to leave 1-2 small leaves at top of stalk.</li> <li>-Place heads directly in tote or in small piles in pathway to pick up after cutting.</li> <li>-Place heads gently in green totes. Alternate heads to fit more. Totes must be stackable; beads can easily get crushed</li> </ul> <p><b>Size</b></p> <ul style="list-style-type: none"> <li>-Depends on growing conditions</li> <li>-Avg: 4"-6" diameter</li> <li>-Stem: 4"-5"</li> </ul> <p><b>Quality</b></p> <ul style="list-style-type: none"> <li>-Heads are dark-green and slightly rounded. Beads are fully formed but still tight.</li> <li>-In warm/hot weather beds must be checked for harvest every two days.</li> <li>-Do not harvest heads that are open and loose or that have black or yellow beads.</li> <li>-Watch for heads with sunken areas, which can lead to water pooling and rot.</li> </ul> <p><b>Look Out For</b></p> <ul style="list-style-type: none"> <li>-Black or yellow beads</li> <li>-Yellow beads on underneath of heads</li> <li>-Sunken areas on heads</li> <li>-Bird droppings</li> </ul>	<p>For the first pick, we wait until 20% of the heads are ready. We may lose some, but we want it to be worth our time to go into the field. The first and last picks may be lighter and we may go out with just harvest totes. The second and third picks are the heaviest. We use a fabricated harvest platform that is hydrocally powered and hooked up on the three point of a high crop tractor. The platform is about 4' x 6' with a ledge to stand on in front of the bunching machines. These are 1' x 1' metal boxes that rubber band and trim the bottoms of the broccoli. The bunchers are run by a mobile air compressor pulled behind the platform on a hay wagon where we also stack cases. On both sides of the conveyor are 6' conveyor belts that reach across 1.5 beds of broccoli. Depending on expected yield, 1-4 workers cut on each side of the platform, 1-2 people go ahead of the tractor cutting the bed straddled by the tractor, and 2-3 people are on the platform bunching and boxing. A total of 9-13 people. Workers cut the broccoli stem, trim off leaves, and place heads on the conveyor which moves broc to the buncher who makes bunches of 1-3 heads. The rubber band has a PLU for stores. We pack bunches directly into 1 1/9 wax boxes (18# cases). Or if we are picking for CSA, we will place bunches directly into macrobins. Placing a harvest tote upside down in the binhelps with airflow and quicker cooling of product out of the field.</p>
Sanitizers in Wash Water		Do not use sanitizers in the water.

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Cleaning Procedure	<b>Procedure</b> -Top with ice if hot or going into storage -Fill 2 Sinks. Make sure water is cold. -Place heads gently in sink. Put as many heads in sink as possible so heads can soak for a few minutes.	We do not clean broccoli. It is field packed directly into cases for stores.
Packing Procedure	<b>Procedure</b> -Pack into folding tote for market in alternating pattern. -Top with 2-3 scoops of ice -Folding totes must be able to close without damaging heads. -Heads can be damaged easily if dropped or crushed! <b>Quality</b> -Green, tight heads -Stems no longer than 5" -No crushed or pressed heads <b>Size/Grade</b> -For market and most wholesale customers head size can be variable.	Cases or bins are brought back to the warehouse on flatbed picks or a trailer. Cases are stacked and watered down with a hose. They are put in the 34 degree "cool down cooler" overnight to bring them down to temp. The next day we put ice in each box. Getting and keeping broccoli as cold as possible is important for increasing shelf life. Usually we don't have to keep it around long in cases because it sells quickly.
Storage	In walk in cooler at Approx 34 degrees and high humidity	Late season we will pack some directly into bins to store for winter CSA. Like cases, we water them down, put them in the cooler overnight, and ice the next day. Then we cover with a plastic bin cover to keeps heads from getting rubbery/soft.
Maximum Storage Time	Up to 1-2 weeks	We may be able to keep broccoli like this for 2-3 weeks, but breakdown increases over time.
Yield	Yields are of course variable depending on conditions. We average 1.5-2lb per bed foot; have had yields as high as 3lb per bed foot (usually late June harvest) and as low as .5lb per bed foot when Alternaria damage is significant	Broccoli yield is so variable! I don't have harvest yields in front of me- but will look into some numbers to have on hand for the presentation! ;)

## Equipment

General		Waterwheel transplanter, 5000 Mechanical Transplanter, Broccoli Belt Harvester
Biggest Impact	Rainflo 1600 waterwheel transplanter Kencove bedmower for mowing plastic beds before ripping and cleaning up Shappelle Snowmobile sled for moving harvested totes out of the field Ice Machine that we keep in our packshed for top dressing broccoli with ice	Broccoli belt harvester makes harvesting large fields possible in a reasonable amount of time

## Marketing

Markets	farmers market, on-site farm stand, direct to grocery, direct to restaurant	CSA, direct to grocery, wholesale through a distributor
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**Six River Farm****Featherstone Farm**

CSA		We aim to have broccoli available for our CSA shares almost every week from late June through July, and then again every week or every other week September through November. We will also bring some in to store for early December shares if possible.
Farmers Market	\$4/lb	
Direct to Grocery	\$2.75/lb	\$37 / 18# case, looking to raise this price for 2022
Direct to Restaurant	\$2.75/lb	
Wholesale to Distributor		\$30 / 18# case, looking to raise this price for 2022