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Thousands of individuals have accessed the 2012 Roxbury Crop and Harvest manual, but its production and harvest information are no longer a reliable resource. The following manuals have been rewritten by the original author reflecting current practices from a broader community of farmers while reflecting the latest research and guidelines for safe production, harvest, and post-harvest procedures.

Rewriting and editing were made possible with generous financial support by Northeast SARE, the contributions from a group of exemplary farmers in the Northeast and Midwest, as well as the support from Cornell Cooperative Extension Eastern NY Commercial Horticulture Program.

Participating growers provided parameters on:

- Seed, plant, row, and bed spacing, and tools utilized in production
- Weed, disease, and insect issues and possible controls used
- Yield, unit sizes and harvest tools
- Prices received

We are grateful for the contributions from:

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◊ Hans Bishop of PrariErth Farm in Atlanta, IL
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◊ Ryan Voiland of Red Fire Farm in Montague MA
◊ Martin Stosiek of Markristo Farm in Hillsdale NY
◊ Simon Ziegler of Sun Sprout Farm in Chester NY
◊ Tyler Dennis of Alewife Farm in Kingston NY
◊ Jack Algiere of Stone Barns Center in Tarrytown NY
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Arugula

Eruca sativa (Brassicaceae or cabbage family)

Soil Preparation and Rotation

- Arugula should not follow other crops in the Brassica family for three years.
- Arugula requires a fine and firm seedbed. When deep tillage is required prepare the land a few weeks in advance to allow the soil to settle. This provides also the opportunity for some initial weed control by means of shallow cultivation or flaming.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	20-160	0-200	6.2-6.5

Varieties

- Astro (for bunching), Sylvetta (for machine harvest), Roquette, Surrey, Wild

Direct Seeding Information in 5- or 6-foot beds

For full grown arugula plant 6 to 9 inches apart; for baby arugula broadcast or use close row sapcings

	Rows	Seeds/foot	Seed plate #	Depth	Sprocket setting	Notes
Planet Jr.	5	30	3 or 4	Depth 2		Use spreader shoe
Sutton Jr.	9-17	20-40	6	¼ inch		Drive 1 mph
Jang	5	24	YYJ-24 or YX24	¼ Inch	Rear 9/ Front 14	

Soil temperature and days to germinate

Soil temperature	40	50	60	70	85
Days to germinate	23	5	3	2	1

Seeding time and successions

- Depending on location, generally 3 in the spring, and several in the fall starting in August through September.
- Start planting as soon as the ground can be worked in the spring. Arugula won't germinate below 40°F. Optimum germination is 85°F.
- Do not plant another succession until cotyledons are fully emerged. It takes arugula approximately 5 days to germinate when soil temperature is at 50°F, 3 days at 60°F and only 1 day once soil temperatures are in the 70's.
- Unfortunately, arugula bolts due to longer days and high temperatures and therefore avoid late spring plantings for summer harvest.
- Resume planting of arugula again once flea beetle pressure subsides (in the Hudson Valley around Aug 15, earlier further north, and later further south). Weekly successions are possible until 3 to 4 weeks before first frost.
- Greenhouse or High tunnel growers plant arugula every four days for continued harvest.

Cultivation Procedures

- Problem weeds that were identified included fast-growing annuals, especially red rooted amaranth, galinsoga, purslane, lambsquarters, as well as crabgrass.
- Techniques to prevent weeds are stale seed-bedding, crop rotation, cover cropping and mowing, preventing seed rain, as well as tarping and solarization.
- Sutton Jr. or Planet Jr. Planters in combination with fine seeded crops like arugula do not perform well with plant matter on soil surface. Spring arugula does well after a winter cover crop of peas (September seeding) or when no cover crop was planted the previous fall.
- Prepare seedbed one to two weeks in advance. Cover soil with black plastic, flameweed, or shallowly cultivate seedbed before planting to eradicate weeds. Do not disturb soil too deep as new weed seeds will be brought up.
- Multi row culture; basketweed after emergence, or as soon as possible without burying the young plants.
- Hand weeding should not be necessary if arugula is planted at the correct population and row distance.

Disease and Insect Protection

- Cover with floating row covers before emergence to avoid flea beetle damage (for earliest plantings). Keep covered until harvest.
- Fall planted arugula hardly ever needs protection as seeding time occurs at the tail end of the second generation of flea beetles. Most plantings after Sept 1 used to be free from hole damage but this calendar date is becoming obscured due to climate change.

- Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.

Other Cultural Practices

- Arugula is a short season crop that allows for a wide variety of cover crops to follow if planted for spring or late summer harvest. Early arugula can be followed with another cash crop like lettuce or spinach and has some bio-fumigant effect to reduce soil borne disease.
- Arugula as a second or at times third cash crop is harvested too late to allow for the establishment of a cover crop. Working up soil at this point in the fall can cause erosion due to the poorly established cover crop. Late season Arugula serves poorly as a cover crop but is preferred to bare ground. Alternatively, Rye can be over seeded right after harvesting. This needs to be done before the end of October.

Basil

Ocimum basilicum (Lamiaceae or Mint family)

Soil Preparation and Rotation

- Basil is very sensitive to frost and cold weather. Do not plant in cold soil and expose to cold night temperatures.
- Basil does better when planted on raised beds. It likes warm well drained soil.
- Basil does better on clean ground and thrives under good natural fertility.
- Basil should not follow basil or many of the cut flowers.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	**0-160**	**0-160**	**6.0-6.4**

Varieties

- Genovese, Italian Large Leaf, Sweet Thai. Some newer varieties like Prospera show some resistance to downy mildew

Transplanting in 5- or 6-foot beds

- For first two plantings, then direct seed or continue with transplants

Greenhouse Guidelines

- **EZ Seeder** seeding plate **# 9**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75	75	Withhold water	3-4 seeds to a cell. Take plants outside 1 week before planting in field

Seeding time and successions

- Seed in greenhouse 6 weeks before last frost
- Plant between 5 to 12 successions for continued harvest with last planting or seeding in July

Transplant readiness indicators

- Soil temperature should be at least 60F.
- Plants should pull from trays easily. Plants should generally not be older than four weeks. If they get too bushy, transplanting gets more difficult as they can get stuck inside the tube of the carousal planter. This is not an issue with a waterwheel planter
- Harden plants off, plants that are lush do not adapt well in the field.

Transplanting on beds with 5- or 6-foot centers

Rows	In-Row	Planting Depth	Notes
3	9 in.	Normal to deep when plants are tall	Needs fertile conditions Basil is an aggressive neighboring plant; not suitable for companion planting unless pulled up when plants are 6-12 inches tall.

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Sprocket	Depth	Notes
Planet Jr.	**3**	50	**6**		¼ inch	Will require thinning
MaterMacc	**3**	12-20	192 H 0.8	17-18	¼ inch	
Jang	**3**	6-12	YYJ-24	Rear 14/ Rear 9	¼ inch	

Cultivation Procedures

- Stale seedbed for direct seeding. Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basket weeding 7 days after transplanting.
- Hand hoeing in between plants.
- Use the fingerweeder or alternatively spring hoes if very slight hilling is desired after 2 – 3 weeks.

Frost, Disease and Insect Protection

- Very cold sensitive. Plant when temperatures are mild with no cold nights in the forecast and harvest before first frost.
- Black spots on basil are becoming more and more common and is caused by downy mildew. Some farmers now grow their basil exclusively in high tunnels to prevent this disease. Downy mildew is windborne so cannot be controlled through rotation
- For earlier basil, plant through plastic mulch and cover with hoops and floating row cover.

Cover Cropping / Under-Seeding Procedures

- Earlier crops are usually followed with oats and peas and later crops by rye and hairy vetch
- Interplanting of basil is not recommended as it can function as a weed competing for nutrients with its neighboring crop.

Beans, Snap

Phaseolus vulgaris (Fabaceae or legume family)

Soil Preparation and General Information

- Beans should not be followed after other legumes, lettuce, carrots, nightshades, brassicas, or a lush green manure.
- Rotate after cereals (grains like corn and rye) to avoid soil borne diseases. Beans do quite well when planted through a rolled and crimped rye cover crop. Lower incidences are observed of white mold (sclerotinia).
- Total Nutrient uptake can be up to 170 lbs of N (Mostly from N fixing bacteria), 16 Lbs of P, and 80 lbs of K. but do not fertilize more than 60 lbs of N in form of compost or other organic fertilizer. Beans will get floppy and fall over
- Beans follow well after winter cover crop of oats or when no cover crop was planted that winter. Late planted beans can be planted after rye and vetch that was harvested for straw or rolled and crimped. In the latter case planting through rye only performs best.
- Direct seed, mixing yellow and green varieties in hopper if beans are to be used for U-Pick. Keep purple beans separate as they mature at a different rate.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables):

Nitrogen	Phosphorus	Potassium	pH
40	**0-100**	**0-80**	**6.2-6.4**

Varieties

- Maxibel, Jade, Isar, Royal Burgundy are favorites for hand picking. Caprice for machine picking. Machine picked beans contain more fiber to avoid bruising and breaking. Caprice is still tender when harvested a few days late.

Direct Seeding Information in 30- or 36-inch rows (60- or 72-inch wheel spacing tractor)

- Plant beans when soil temperature is above 60F
- Inoculate beans with *Rhizobium leguminosariim bv. Phaseoli* to enhance N fixation.
- Most rows are 30 to 36 inches apart allowing for good air drainage. Some growers add T 22 or Rootshield (*Trichoderma harziana*) in planter box to avoid damping off.

	Rows	Seeds/ft	Seed plate	Depth	Sprocket	Notes
Planet Jr.	2	24	Hole # 32	½ inch to 1 inch		Will need thinning as optimum spacing is 2 inches
MaterMacc	2	12	24 H 4.5	½ to 1 inch	22-17	High population is used to facilitate narrow harvest window for machine picking
Jang	2	6	N-6	½ to 1 Inch	Rear11/ Front 10	Difficult to get the correct plant spacing with this seeder

Seeding time and successions

- Plant seed when ground is warm and no frost in the forecast.
- Plant up to 8-9 succession plantings starting in May and ending in July.
- Plant each succession when cotyledons are up; generally, 10 days between the first and second succession closing to 5 to 7 intervals.

Cultivation Procedures

- Two weeks in advance prepare seedbed, then again before planting. For machine picking do not make a raised bed as machine harvester needs a flat field.
- Apply no more than 600 lbs./acre of dried granular composted poultry manure (5-4-3). Do not overfeed with N as beans might flop over.
- Use Fingerweeder with torsions or Hak hiller 7-10 days after emergence or as soon as possible without damaging the plants. Do not hill when machine picked to avoid picking up soil.
- For last cultivation you can use Lilliston Rolling Cultivators when picked by hand.
- Set hillers less aggressive to only slightly hill the plants. Bean picker will pick up soil when plants are ridged and only use the Finger weeders or side knives to cultivate.

Frost, Disease and Insect Protection

- Very cold sensitive. Harvest before first frost.
- Common issues are: Phytophthora Blight, Ozone Injury and Sclerotinia (White Mold)
- For leafhoppers use Mycotrol ESO (Beauveria Bassiana) at nymph stage. Adding molasses and milk as feeding/attractant stimulant will increase efficacy of product.
- For high infestations use PyGaNic EC 5.0II at nymph stage; repeat for three 5-day applications for best results.
- For white mold (sclerotinia) control: plant beans in areas with good air drainage, use broad rotations (three years) and incorporate the biological control Contans (Coniothyrium minitans) pre-planting.
- Organic Production and IPM Guide for Snap Beans

Cover Cropping / Under-Seeding Procedures:

- Early beans can be followed with oats and peas mixture, later plantings with rye and hairy vetch

Beets

Beta vulgaris (Chenopodiaceae or goosefoot family)

Soil Preparation

- Beets should not be followed after other members of the chenopod family, potatoes, brussels sprouts, sweet clover, or corn
- Total Nutrient uptake is 140 lbs of N, 14 Lbs of P, and 140 lbs of K
- Compost is incorporated and beets are planted on raised beds.
- Test for Boron. Boron can be added with other fertilizer to optimize Boron distribution. If no other fertilizer is needed, distribute Solubor through a water solution with a sprayer at a minimum of 50 GPA. When pre-planting is not an option apply as foliar spray but do not apply more than 1 lb. of actual Boron per acre to avoid leaf burn.
- Spread gypsum if soil test indicates low Calcium levels combined with correct or high pH.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
175	0-200	50-400	6.2-6.5

Varieties:

- Beet Variety trial Red Ace is a strong performer, other varieties popular amongst organic farmers are Eagle, Boldor, Bohan, Guardsmark, and Chioggia.

Direct Seeding Information for 5- or 6-foot raised beds

	Rows	sds/Ft	Plate #	Sprocket	Depth	Notes
Planet Jr.	**3**	50	**20**		¼-½ inch	
MaterMacc	**3**	24	144 H 2.5	17-19	¼-½ inch	Use lower seeding rate for storage beets
Jang	**3**	12	MJ 12 (large seed) or LJ 12 (small seed)	10 Front - 11 Rear	¼ - ½ inch	Use higher sprocket setting for bunching beets

Time of seeding and number of successions

- Plant beets when soil temperature is at least 45F
- For weekly availability seed bunching beets from April through July. First succession can be successfully transplanted sowing two seeds per cell in a 128 tray. As roots tend to be more fibrous this creates an issue with cleaning off dirt at the wash and pack station
- Storage beets are direct seeded not before July for an October November harvest

Cultivation Procedures

- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up. Alternatively, flame-weed right before seeding to avoid disturbing the seedbed.
- Basketweed or use shallow sweeps 7 to 10 days after planting.
- Hand-weed in between plants.
- For second cultivation only use sweeps with torsion weeders. Do not use aggressive in-row cultivation tools to avoid leaf damage.

Other Cultural Practices

- Calcium and Boron are important nutrients for beets and chard. Under most east coast conditions: apply 18 lbs of Solubor to the acre before planting. Spray colloidal Calcium on plants when Calcium levels are below optimum (varies per soil type).
- Beets are planted over a wide range of the season. Early bunching beets are one of the first crops to be planted while the storage beets should not be planted until July to avoid oversized beets. For this reason, a variety of cover crops can be used either prior or after a crop of beets.
- Cercospora leaf spot is best controlled by practicing broad rotations that do not include any member of the Chenopod family which includes weeds like lambsquarters. Other plants like sweet clover can be a host of this pathogen. Applying a mixture of Cueva and Double Nickel (bacillus amyloliquefaciens) has been observed to be effective. Other controls listed by growers are LifeGard (Bacillus mycoides J), or Actinovate and Serenade ASO (bacillus subtilis) or Regalia as a preventative schedule.
- Leaf miner can be a serious issue for bunching beets. Cover crops with row covers to prevent the adult fly from laying its eggs. Look on the underside of the leaves any eggs in late May, Late June and mid-August. Once they hatched or when you see first damage apply a Spinosyn based product every 5 –7 days not to exceed three sprays. Read label carefully.

Broccoli Rabe

Brassica rapa (Brassicaceae or cabbage family)

Soil Preparation

- Broccoli rabe should not be followed after other cole crops.
- Compost is incorporated and Broccoli Rabe is planted on raised beds.
- If additional fertilizer needs to be applied, this will need to be done with the first cultivation as Broccoli Rabe albeit a slow germinator, is once established a fast-developing crop.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	**20-160**	**0-200**	**6.2-6.5**

Varieties:

- Sessantina Grossa, Spring Rabe

Direct Seeding Information for 5 or 6 foot raised beds:

	Rows	Plate #	Seeds/Ft	Sprocket	Depth	Notes
Planet Jr.	**3**	2-3	30		¼ - ½"	Plants should be thinned to about 4 inches apart for best product
MaterMacc	**3**	192 H 1.0	12	12-17	¼ - ½"	
Jang	**3**	YYJ 12	12	14 Front -10 Rear	¼ - ½"	

Seeding Time and Number of successions

- In spring plant up to 3 successions starting in April ending in May. When planted in very cold soil, plants bolt too early. Similar with transplants if they experienced any transplant shock.
- Fall 3-4 successions starting August 15 ending in September

Cultivation Procedures

- Broccoli rabe follows well after winter cover crop of oats and peas or when no cover crop was planted that winter. Planet Jr. planters and fine seeded crops like broccoli rabe do not deal well with plant debris on soil surface. Planters with a double disc opener (slicing the debris in front of the furrow) allow for a variety of surface conditions.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basket 7-10 days after emergence as soon as possible.
- Second cultivation use sweeps with torsion weeders followed by finger weeders.
- If third cultivation is possible use sweeps with Hak hillers or spring hoes to slightly hill up the plants.

Frost, Disease and Insect Protection

- Cover with floating row covers before emergence. Keep covered if possible until harvest. Fall rabe hardly ever needs protection as seeding falls at the tail end of the second generation.
- Beneficial nematodes to control flea beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.

Other Cultural Practices

- Early broccoli rabe can be followed by fall transplanted lettuce or cover crop. Mow after last harvest with flail mower and spade the harvest leftovers in the ground. This ground is not suitable for direct seeded crops due to crop residue from fibrous stems of the rabe plants.
- Spring planted broccoli rabe follows well after winter cover crop of oats and peas or when no cover crop was planted the previous fall.
- Fall planted rabe does well after hairy vetch or clovers without any application of additional N.

Broccoli (main crop)

Brassica oleracea var. italica (Brassicaceae or cabbage family)

Soil Preparation and Rotation

- Broccoli should not be followed after other members of the brassica family for three years.
- Total nutrient uptake is 165 lbs of N, 10 Lbs of P, and 210 lbs of K
- Compost is incorporated and Broccoli is planted on raised beds or flat ground.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.
- Fall Broccoli does well when followed after a spring seeding of forage peas bell beans mix which can supply all of its N needs.
- Broccoli does best in cooler climates or during spring and fall in warmer climates. Cooler night-time temperatures are crucial during head formation and to a much lesser degree in its vegetative stage. Warm nights cause uneven sized flower buds, making it unmarketable.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Popular Varieties

- 2019 Broccoli Variety trial Varieties popular with organic growers are Arcadia, Gypsy, Marathon, Green Magic, Blue Wind, and the winner of the trial: Imperial

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75-85	60	Less water	Take plants outside 1 week before planting in field

Seeding time and Number of successions

- Plant in greenhouse 5 weeks before setting in the field
- Spring 3-4 successions 10 to 14 days apart
- Fall successions starting the end of May through June
- Broccoli needs cool nights during maturation so succession planting during summer is greatly dependent on location

Signs to watch for & what to do

- Purpling leaves indicate phosphorous deficiency in potting soil, feed with foliar spray. Purpling in field often indicates cold soil. Phosphorus is less available in cold soil conditions.
- During late spring watch plants for getting leggy from too much warmth, put outside to harden off.
- Stocky plants result in higher survival rate in the field.

Transplant readiness indicators

- 4 true leaves, plants pull easily from tray. Plants should generally not be older than four to five weeks

Transplanting on 5 or 6 foot raised beds

Rows	In-Row	Planting Depth	Notes
2-3	8 inches for bunching 12-14 inches for central head.	Long plants bury as deep as possible without covering true leaves	Even when plants slightly wilt, they always come back.

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use Sweeps (with torsions if possible) followed by Fingerweeders 7-10 days after emergence or as soon as possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary, use Lilliston Rolling Cultivators and hill aggressively without burying the plants.

Insect and Disease Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Cover with floating row covers or insect netting before emergence to avoid flea beetle damage (for earliest plantings).
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Look for eggs of cabbageworm/cabbage looper or diamond back moth, at the underside of leaves. When small worm population is over 2 per plant spray Bt or Spinosad (Entrust) every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with Spinosad to avoid buildup of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications)
- Bacterial soft rot is best controlled by selecting resistant varieties
- Choose tolerant and well-domed varieties to avoid brown bead (which is a physiological disease).
- Plant closer in the row to avoid hollow stem which happens when N and K are readily available
- Plant far away or upwind from earlier planted cole crops and avoid overhead irrigation during sprout formation to avoid Alternaria leaf spot. Serenade (bacillus subtilus) as well as JMS Stylet Oil has shown some control by a few growers. Always read the label before use. Do not mix Stylet Oil with any adjuvants as this will cause leaf burn. Regular sprays with Regalia appear to reduce Alternaria as well.
- Swede Midge has shown to become a problem for many growers over the past few years. As it is an invasive species it has no native enemies, and only exclusion (through row covers and rotation more than ½ mile away from last year's crop) was reported to be effective.
- Organic Production and IPM Guide for Cole Crops

Other Cultural Practices

- Earlier planted broccoli can be followed by cover crop. Mow plants down as low as possible with flail mower. Incorporate crop residue with disc to avoid wintering over of insects and diseases.
- Later plantings can be over seeded with a mixture of crimson, red or sweet clover at a rate of 20 lbs per acre. This is done right before the last cultivation. Alternatively, cereal rye can be planted up until a few weeks before harvesting. This needs to be done before the end of October. Great care should be taken to avoid seed getting caught in the plants.

Broccoli (early crop)

Brassica oleracea var. italica (Brassicaceae or cabbage family)

Soil Preparation

- Cultural practices are similar to main crop broccoli except that early cabbage is planted on Plastic mulch.
- Avoid too much plant debris from previous cash or cover crop as plastic will be laid as early as possible in the growing season.
- Use dried granular composted chicken manure at the rate of 1500-2000 lbs. per acre before laying plastic.

Varieties

- Belstar, Blue wind

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	12-inch	As deep as possible	Use 12-inch wheel and add kelp to water as ½% solution

Cultivation Procedures early broccoli

- Cover plants with floating row cover
- Cultivate with Hillside cultivator in between plastic
- If desired, plant cover crop like oats and peas in between plastic or use weed fabric
- After harvest work in cover crop and plant debris to allow for bare fallow
- Follow with rye and vetch

Brussels Sprouts

Brassica oleracea (gemmifera group) (Brassicaceae or cabbage family)

Soil Preparation

- Brussels Sprouts should not be followed after other members of the brassica family
- Average nutrient uptake is 236 lbs of N, 29 Lbs of P, and 235 lbs of K
- Compost is incorporated and Brussels Sprouts are planted on either raised beds or flat ground.
- Soil test will determine if additional K is needed. Brussels Sprouts needs high amounts of K. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Varieties

- Diablo, Oliver. Variety trial information is found here.

Transplant:

- Brussels Sprouts can be followed after oats and peas or hairy vetch, which is preferred.
- Plant far away or upwind from earlier planted cole crops to avoid wind infestation of Alternaria leaf spot.

Greenhouse Guidelines:

- **EZ seeder** seeding Plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75 - 90	65	Withhold water.	Take plants outside 1 week before planting in field

Transplant readiness indicators:

- Harden plants off outside, plants that are lush do not perform well in the field.
- When plants pull easily from cell. Plants should generally not be older than five weeks

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	18-24 in.	Cell is buried by soil	Use 18-inch sprocket or 18-inch water wheel; when not available plant every other hole with a 12-inch wheel

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use Sweeps (with torsions If possible) followed by Fingerweeder 7-10 days after emergence or as soon as possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary, use Lilliston Rolling Cultivators and hill aggressively without burying the plants.

Insect and Disease Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Look for eggs of cabbageworm/cabbage looper or diamond back moth, at the underside of leaves. When small worm population is over 2 per plant spray Bt using 1 to 2 pints to the acre or spinosad (Entrust) every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with spinosad to avoid buildup of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications)

- Plant far away or upwind from earlier planted cole crops and avoid overhead irrigation during sprout formation to avoid Alternaria leaf spot. Serenade (bacillus subtilus) as well as JMS Stylet Oil has shown some control by a few growers. Always read the label before use. Regular sprays with Regalia appear to reduce Alternaria as well.
- Swede Midge has shown to become a problem for many growers over the past few years. As it is an invasive species it has no native enemies, and only exclusion (through row covers and rotation more than ½ mile away from last year's crop) was reported to be effective.
- Organic Production and IPM Guide for Cole Crops

Other Cultural Practices

- Brussels Sprouts can be followed after oats and peas or rye with hairy vetch, with a preference on the latter.
- Plants should be topped (by removing or pinching the growing point) in September or when the lower sprouts are about ½ to ¾ inch to induce greater yield and uniformity of sprouts. Yellow leaves are to be removed from lower parts of plants to keep sprouts healthy. Green leaves can also be harvested as collards. Do not remove too many leaves from one plant as this affects final yield.
- Plants can be over seeded with a mixture of red and sweet clover at a rate of 20 lbs per acre. This is done right after the last cultivation, although Brussels sprouts tend to create too much shade to create a successful stand of clover. Alternatively, Rye can be overseeded a few weeks before harvesting. This needs to be done before the end of October. Great care should be taken to avoid seed getting caught in the plants

Cabbage (Chinese)

Brassica rapa (pekinensis group) (Brassicaceae or cabbage family)

Soil Preparation

- Chinese cabbage should not be followed after other members of the brassica family
- Average Nutrient uptake is 165 lbs of N, 10 Lbs of P, and 208 lbs of K
- Compost is incorporated and Chinese Cabbage is planted on raised beds or flat ground.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.
- Chinese cabbage does exceedingly well when followed after a spring seeding of bell beans and forage peas.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Varieties

- Rubicon, Minuet, Bilko

Transplanting on 5 or 6 foot raised bed

- Harden plants off outside, plants that are lush do not perform well in the field.
- Early Chinese cabbage after overwintered oats and peas and summer planted Chinese cabbage after spring cover crop of forage peas and bell beans.

Greenhouse Guidelines

- **EZ Seeder** seeding plate **# 16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75 - 90	65 - 75	Reduce water.	Take plants outside 1 week before planting in field

Signs to watch for & what to do

- Harden plants off outside, plants that are lush do not perform well in the field.

Transplant readiness indicators

- When plants come easily out of cell. Plants should generally not be older than five weeks

Number of successions

- Spring: one to two successions
- Fall: one or two successions

Transplanting in 5- or 6-foot beds

Rows	In-Row	Planting Depth	Notes
2	12 in.	Do not bury the cell, top of cell even with soil level.	Use 12-inch sprocket. Irrigate after planting, and watch for flea beetles

Cultivation Procedures:

- For direct seeding: prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basketweed 7-10 days after transplanting or after seeding when plant has developed true leaves.
- Hand hoe in between plants. Thin when necessary, if direct seeded
- Second cultivation use only sweeps and do not hill. Slight hilling or aggressive cultivation can be detrimental for Chinese cabbage.

Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Look for eggs of cabbageworm/cabbage looper or diamond back moth, at the underside of leaves. When small worm population is over 2 per plant spray Bt using 1 to 2 pints to the acre or spinosad (Entrust) every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with spinosad to avoid buildup of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications)
- To control cabbage leaf miners in high tunnel you can release a beneficial wasp (Diglyphus isaea), but in the field only row covers or the use of a Spinosyn based product has proven to be effective.
- Basal stem rot (Erwinia carotovora) (not to be confused with Rhizoctonia) is caused by insects eating at the basal stem but also damage by cultivation can help bring this disease in the plant. Aggressive cultivation is not advised in Chinese cabbage production.
- Rhizoctonia or Bottom rot can be an issue with Chinese Cabbage and Bok Choy. Avoid lower parts of plants to be in contact with the soil and apply broad rotation with other members of the brassica family.

Other Cultural Practices

- Early Chinese cabbage can be followed by fall lettuce or cover crop. Mow plants down as low as possible with flail mower. Incorporate crop residue with disc or spader. Late planted Chinese cabbage creates too much shade to develop a cover crop while cabbage is growing.
- Early Chinese cabbage after oats and peas and summer planted Chinese cabbage after rye and hairy vetch.

Cabbage (Green & Red)
Brassica oleracea (capitata group) (Brassicaceae or cabbage family)

Soil Preparation

- Cabbage should not be followed after other members in the brassica family. Maintain a minimum rotation of three years.
- Total Nutrient uptake is 165 lbs of N, 10 Lbs of P, and 208 lbs of K
- Spring planted oats and peas are incorporated in and cabbage is planted on raised beds or flat ground. Alternatively, cabbage can be planted through a rolled and crimped cover crop like rye or triticale with vetch. To ensure good weed control plant cover crop in early September at a rate of 100 lbs. of rye and 20 lbs. of vetch. Take soil test in preceding year and fertilize to provide nutrients for both the rye and the vegetable crop. To properly kill vetch, utilize a no till planter (without seed in the box) and slice the cover crop with the coulters of the drill.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.
- Storage cabbage does exceptionally well when followed after a spring seeding of bell beans, barley and oats without any application of additional N.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Varieties

- NOVIC 2016 trial
- Green main: Storage #4, Rivera, many of the BEJO varieties
- Red main: Integro
- Savoy: Alcosa

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	77-95	>60	Reduce water	Take plants outside 1 week before planting in field

Number of successions

- Spring 1 (mini cabbage and early red) 5 weeks before setting out in field
- Fall 1 (selection of varieties will allow for even harvest), with seeding time between the end of April through May

Signs to watch for & what to do

- Harden plants off outside, plants that are lush do not perform well in the field.

Transplant readiness indicators

- When plants come easily out of cell. Plants should generally not be older than five weeks

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	18 in.	As deep as possible	Use 18-inch sprocket
2	14 in	As deep as possible	Use 14-inch sprocket

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use belly mounted Sweeps (with torsions if possible) followed by rear mounted fingerweeders 7-10 days after transplanting or when possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary (in two row planted cabbage only) use Lilliston cultivators and hill aggressively without burying the plants.

Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully
- Look for eggs of cabbageworm/cabbage looper or diamond back moth, at the underside of leaves. When small worm population is over 2 per plant spray Bt using 1 to 2 pints to the acre or spinosad (Entrust) every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with spinosad to avoid buildup of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications)
- Plant far away or upwind from earlier planted cole crops and avoid overhead irrigation during sprout formation to avoid Alternaria leaf spot. Serenade (bacillus subtilus) as well as JMS Stylet Oil has shown some control by a few growers. Always read the label before use. Regular sprays with Regalia appear to reduce Alternaria as well.

- Swede Midge has shown to become a problem for many growers over the past few years. As it is an invasive species it has no native enemies, and only exclusion (through row covers and rotation more than ½ mile away from last year's crop) was reported to be effective.
- Organic Production and IPM Guide for Cole Crops

Other Cultural Practices
- Early cabbage after oats and peas and summer planted cabbage after hairy vetch or bell beans.
- Early cabbage can be followed by fall lettuce if transplanted. Mow plants down as low as possible. Incorporate crop residue.
- Close plantings of fall cabbage allow for smaller head development. Storage #4 can be spaced at 12 by 36 to allow for a larger head that keeps better in storage. Generally speaking, customers prefer a 3 lbs. size head.

Cabbage (Mini)

Brassica oleracea (capitata group) (Brassicaceae or cabbage family)

Soil Preparation
- Cultural practices are similar to regular cabbage except that early cabbage is often planted through a plastic mulch and covered to increase earliness. Plant at least 7 days after laying plastic to allow weeds under mulch to germinate. When planted right after laying plastic expect to hand weed the planting holes.
- Avoid too much plant debris from previous cash or cover crop as plastic will be laid as early as possible in the growing season.

Varieties
- Early Green: Arrowhead, Farao
- Early red: Red Express

Waterwheel Planter

Rows	In-Row	Planting Depth	Notes
3	12.	As deep as possible	Use 12-inch wheel and add kelp to water as ½% solution

Cultivation Procedures mini-Cabbage
- Cover plants with floating row cover
- Cultivate with Hillside cultivator
- If desired plant cover crop like oats and peas in between plastic
- After harvest work in cover crop and plant debris to allow for bare fallow
- Follow with garlic or rye and vetch

Other Cultural Practices
- To avoid splitting ensure regular soil moisture.

Carrots (fall and storage)

Daucus carota var. sativus (Apiaceae or carrot family)

Soil Preparation
- Carrots should not follow other member of the umbellifer family, and avoid following potatoes, cereals and cucurbits due to weed and possibly structural problems.
- Late carrots follow well after early lettuce or early greens.
- Total nutrient uptake is 145 lbs. of N, 25 Lbs. of P, and 150 lbs. of K greatly depending on yield.
- Subsoiling before planting can improve root quality
- Compost is worked in and carrots are planted on raised beds or ridges.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
90	0-160	0-200	6.0-6.4

Varieties

- **2015 Carrot Variety Trial,**
- **2016 Carrot Variety Trial**
- Other varieties popular with organic growers are Bolero, Purple Elite, Rainbow, Dulcinea, Sugarsnax, and Yaya
- 2011 NOVIC Carrot variety trial
- 2019 NOVIC non orange carrot trial

Direct Seeding Information

	12-18 inch Rows	Sds/Ft	Plate #	Depth	Sprocket	Notes
Planet Jr.	**3**	25-50	Plate 5	¼ - ½"		Irrigate before seeding
MaterMacc	**3**	20	192 H 0.8	¼ - ½"	22-17	
Jang	**3**	30	XY-24 or X24 Palleted carrots MJ-24	¼ - ½"		14 Front by 10 Rear sprocket

Seeding time and Number of successions

- Do not plant in recently tilled soil. Allow soil to settle, flame weed and plant immediately after
- Spread plantings out over 2-4 seedings, starting in June and ending by mid-July for best storage quality

Cultivation Procedures

- Carrots follow well after winter cover crop of oats and peas or when no cover crop was planted the previous fall. Raw organic matter causes forking of carrots.
- Subsoil before primary cultivation to disrupt possible plow-pan.
- Prepare seedbed two to three weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up. If this is not possible, use a flame weeder for final seedbed prep.
- Irrigate before seeding, not after as any crusting of the soil will prevent emergence.
- Irrigate with Meganet or Wobbler sprinklers as needed to aid emergence. It is important to ensure that germinating seeds do not dry out as this causes desiccation.
- Flame weed 5 days after seeding or right before they emerge. Use a glass plate over a small area. Flame weed when seedlings under glass emerge.
- Basketweed 7 to 10 days after plants have emerged. Some people will Basketweed before seeds have emerged (bind cultivation) this can be done when planter has left a clear mark in the soil.
- Handweed meticulously to avoid having to pull large weeds as this will uproot tender carrot seedlings
- Second cultivation use torsion weeders with rear mounted side knives.
- Handweed again.
- Last cultivation: use sweeps with Spring hoes or Hak hillers

Disease Protection

- To prevent Alternaria (leaf blight that also affects the roots by forming black spots on the surface) use tolerant varieties and expose seed to hot water treatment. Good short season varieties (like some of the Chantenay types) that can be seeded late are another remedy. Timing irrigation (only water during the day) helps in minimizing the spores to incubate.
- Organic production and IPM guide for carrots

Other Cultural Practices

- Storage carrots are generally not over seeded or followed by a cover crop unless they are harvested before the end of September. Interseeding with rye or vetch is not successful as digging up the carrots disturbs the root system of the cover crop.

Carrot (baby or bunching)

Daucus carota var. sativus (Apiaceae or carrot family)

Varieties:

- Nelson, Mokum for baby, Naval for longer carrots

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Depth	Sprocket.	Speed	Notes
Planet Jr.	5	25-50	5	¼ - ½"			Irrigate before and after seeding
Sutton Jr.	5	32	8	¼ - ½"		0.8 mph	
Jang	5	32	X-24	¼ - ½ "	9 Rear-14 Front		

Number of successions

- Plant as early as soil is warmed up Spring 3 to 5 starting in April until June

Cultivation Procedures

- Only choose your cleanest ground for early seeding of baby carrots.
- Subsoil before primary cultivation to disrupt plow-pan.
- Ideally prepare seedbed two to four weeks in advance, then cultivate with stale seedbed maker when weeds emerge and right before planting.
- Flame weed 5 days after seeding or right before they emerge
- Basket 7-10 days after emergence as soon as possible w/out burying.
- Summer harvested baby carrots can be followed with oats and peas or rye and vetch.

Other Cultural Practices

- Early carrots can be followed with a bare fallow and late summer planted cover crop like oats and peas or a fall seeding of salad mix or greens.

Cauliflower

Brassica oleracea (botrytis group) (Brassicaceae or cabbage family)

Soil Preparation

- Do not follow Cauliflower after other cole crops.
- Total Nutrient uptake is 165 lbs. of N, 10 Lbs. of P, and 208 lbs. of K
- Early cauliflower is planted after a cover crop of oats and peas. Summer planted cauliflower is planted after broad (bell) beans and forage peas are incorporated. No nitrogen needs to be applied in this rotation as peas and beans can fix up to 200 lbs of N. Cauliflower does not perform well after rye and vetch are harvested for straw as opposed to being incorporated. In the latter the rye should be mowed regularly to avoid N tie up.
- Compost, or oats and peas cover crop is incorporated and cauliflower is planted on raised beds or flat ground.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs. of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Varieties

- 2019 Cauliflower Variety Trial Varieties popular with organic growers are Panther, Quasar, Cassius and Skywalker

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75-90	>60	Reduce water	Take plants outside 1 week before planting in field

Signs to watch for & what to do

- Watch that they don't start to get leggy from too much warmth, put outside.

Transplant readiness indicators

- Harden plants off outside, plants that are lush do not perform well in the field.
- When plants come easily out cell not older than five weeks. Stunted plants do not form large heads. Plant cauliflower no later than 5 weeks in cell-pack to avoid being root bound which increases the risk of transplant shock
- Plant as deep as the plant allows without burying any leaves.

Seeding time and Number of successions

- Spring harvest: seed cauliflower in greenhouse 5 weeks before you can transplant in the field
- Fall Harvest: Select one planting date for your region by spreading the harvest through the selection of different lead-time between varieties.

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	24 in.	As deep as possible	Use 24 inch sprocket or waterwheel. Water after planting

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use Sweeps (with torsions If possible) followed by Fingerweeder 7-10 days after emergence or as soon as possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary, use Lilliston Rolling Cultivators and hill aggressively without burying the plants.

Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Look for eggs of cabbageworm/cabbage looper or diamond back moth, at the underside of leaves. When small worm population is over 2 per plant spray Bt using 1 to 2 pints to the acre or spinosad (Entrust) every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with spinosad to avoid buildup of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications)
- Plant far away or upwind from earlier planted cole crops and avoid overhead irrigation during sprout formation to avoid Alternaria leaf spot. Serenade (bacillus subtilus) as well as JMS Stylet Oil has shown some control by a few growers. Always read the label before use. Do not spray when heads are visible as the spray will cause damage. Regular sprays with Regalia appear to reduce Alternaria as well.
- Swede Midge has shown to become a problem for many growers over the past few years. As it is an invasive species it has no native enemies, and only exclusion (through row covers and rotation more than ½ mile away from last year's crop) was reported to be effective.
- Organic Production and IPM Guide for Cole Crops

Other Cultural Practices

- Early Cauliflower after oats and peas and summer planted Cauliflower after rye and hairy vetch or broad beans.
- When cauliflower matures, cover white part up with outer leaves to avoid yellowing of curds. Inspect the crop three times a week and cover the emerging heads (the moment when small white heads are just visible through leaves) by cracking a few leaves and bend them over, so heads are no longer exposed to direct sun light. By the time that the leaves wither, the head should be at full size. Another method is to bunch the outer leaves together with a large rubber band. Use a different color rubber band for each inspection day allowing harvesters to know how long a plant has been covered.
- If possible: Mow plants down as low as possible with flail mower. Incorporate crop residue with disc. Follow with rye and hairy vetch.
- Late planted cauliflower is not incorporated and followed with a cover crop. Alternatively, Rye can be overseeded a few weeks before harvesting. This needs to be done before the end of October. Great care should be taken to avoid seed getting caught in the plants. Never seed down rye when curds have started to develop.

Celeriac

Apium graveleolens (Apiaceae or carrot family)

Soil Preparation

- Celeriac should not be followed after other umbellifers, and not after potatoes, cereals and cucurbits due to weed and possibly structural problems.
- Total Nutrient uptake is 105 lbs of N, 16 Lbs of P, and 160 lbs of K
- Compost is incorporated and Celeriac is planted on raised beds.
- Soil test will determine if additional K is needed. Celeriac is known to need high amounts of K. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs. of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
180	0-200	60-300	6.0-6.4

Varieties

- Diamant, Brilliant

Seeding Time and number of successions

- One planting only 10 to 12 weeks before setting plant in the field
- Makes sure celeriac is not exposed to cold temperatures (45F) for more than 10 days to avoid bolting. Keep greenhouse at 55F

Transplant:

- Harden plants off outside, plants that are lush do not perform well in the field.
- As Celeriac tends to get weedy and has high need for moisture, it can be transplanted in plastic mulch for greater results

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#13**

Tray	Germ. @	Grow @	Hardening Off	Notes
288	70-75	60-70	Reduce water NO low temps	Keep greenhouse at a minimum of 55 F nighttime temp

Transplant readiness indicators

- When the plants have at least 2 true leaves, transplant to Tray 72, 98 or 128's

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	12 in.	Make sure crown is not buried since that will stop the plant from growing	Use 12-inch sprocket or waterwheel. Plant on your best ground

Cultivation Procedures:

- Basket 7-10 days after transplanting
- Use fingerweeder or spring hoes for later cultivation. Celeriac is a finicky crop. Side-dress with dried granular composted chicken manure to help increase size of crop
- Celeriac needs clean land and keep the crop clean by frequently hand hoeing in between plants.
- Irrigate generously

Cover Cropping / Under-Seeding Procedures:

- None as Celeriac is harvested in November

Celery

Apium graveleolens (Apiaceae or carrot family)

Soil Preparation

- Celery should not follow other members of the umbellifer family.
- Total Nutrient uptake is 195 lbs. of N, 50 Lbs. of P, and up to 435 lbs. of K
- Compost is incorporated in and Celery is planted on raised beds.
- Soil test will determine if additional K is needed. Celery is known to need high amounts of K. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs. of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
180	0-200	60-300	6.0-6.4

Varieties

- Ventura, Kelvin, Tango

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#13**

Tray	Germ. @	Grow @	Hardening Off	Notes
288	70-75	60-70	Reduce water No low temps	Exposure below 55 for 10 days or more causes bolting

Transplant readiness indicators:

- Harden plants off outside, plants that are lush do not perform well in the field.
- When there are 2 true leaves transplant to Tray **50**'s

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	6-8 in.	Can be planted deep	Plant on your best ground

Cultivation Procedures

- Basketweed 7-10 days after transplanting
- Use fingerweeder or Springhoes for later cultivation. Side-dress if needed
- Hand hoe in between plants.

Other Cultural Practices

- Main problem reported is lack of Nitrogen, Calcium and Boron. Spray colloidal Calcium on plants if necessary.
- Celery like Celeriac needs fertile ground with plenty moisture and organic matter to do well.
- Blanching can be achieved by hilling (resulting in more difficult harvest and cleaning) or by using a paper collar
- Summer harvested celery can be followed by oats and peas and fall harvested celery by rye and vetch.

Chard, Swiss

Beta vulgaris var. cicla (Chenopodiaceae or goosefoot family)

Soil Preparation

- Swiss chard should not be followed after spinach, beets, but later plantings do very well after early peas.
- Total Nutrient uptake is 105 lbs of N, 16 Lbs of P, and 160 lbs of K
- Compost is incorporated and Chard is planted on raised beds.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs. of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-200	6.2-6.5

Varieties:

- Golden Sunrise, Magenta Sunset, Fordhook Giant, Bright Lights, Rhubarb Supreme, Oriole

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Shoe Depth	Notes
Planet Jr.	3 or 5	50	22	Depth 2-3	
Sutton Jr.	5-9	35	24	¼ to ½ inch	0.8 mph or 1.3 km (only for braising mix)
Jang	3 or 5	6-24	LJ 12	¼ to ½ inch	Sprocket setting depending on how you cut it

Greenhouse Guidelines: **EZ Seeder** seeding plate **#9**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75 - 90	65 - 75	Reduce water.	2-3 seeds per cell. Take plants outside 1 week before planting in field

Signs to watch for & what to do:

- Watch that they don't start to get leggy from too much warmth and lack of light
- Harden plants off outside, plants that are lush do not perform well in the field.

Number of successions

- Summer 3
- Fall 3

Transplant readiness indicators:

- When plants come easily out of cell. Plants should generally not be older than four weeks

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	5 in.	Do not bury the cell, top of cell even with soil level.	Tends to have transplant shock, plant in late afternoon to avoid burning plants

Cultivation Procedures

- Basketweed 7 to 10 days after planting. For three row cultivation cover row 2 and 4 with chisels mounted on Basketweeder or use side knives mounted on rear toolbar.
- Hand hoe in between plants
- For second cultivation in three row cultivation, use fingerweeder or spring hoes with rear mounted S-tines in wheel tracks and side knives in between rows.

Frost Disease and Insect protection:

- Calcium and Boron are important nutrients for beets and chard. If necessary, spray colloidal Calcium on plants.
- Protect against leaf miner. When it cannot be controlled work under the crop. Neemix has shown some control but with heavy infestation use Entrust. If the latter is used spray only in the evening when pollinators are no longer around as entrust is a broad insecticide.

Other Cultural Practices

- To renovate Swiss chard after harvesting, use Bezzerides Spidergangs and hill vigorously. Side dress for renewed growth.
- Early chard is not followed with a cash crop as the roots will re-grow and act as a weed. After working the ground with a disc and harrow a cover crop can be established.
- Late planted chard is not incorporated to be followed with a cover crop. Alternatively, Rye can be overseeded a few weeks before harvesting. This needs to be done before the middle of October. Great care should be taken to avoid seed getting caught in the heart of the plants

Cilantro

Eryngium foedum (Apiaceae or carrot family)

Soil Preparation

- Cilantro should not be followed after other umbellifers, and not after crops that caused seed-rain.
- Late Cilantro does well after early lettuce, greens or peas.
- Compost is incorporated and Cilantro is planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
90	0-160	0-200	6.0-6.4

Varieties:

- Santo, Jantar

Direct Seeding Information:

	Rows	Seeds/Ft	Plate #	Shoe Depth	Notes
Planet Jr.	5	50	22	Depth 3	
Sutton Jr.	9	50	24	½ inch	0.7 mph or 1.3 kmph
Jang	5	12-24	MJ 24	½ inch	Sprocket setting 10 rear 14 Front

Number of successions

- Spring 3
- Summer 8
- Fall 3

Cultivation Procedures

- Cilantro follows well after winter cover crop of oats and peas or when no cover crop was planted that winter. Sutton or Planet Jr. seeders in combination with fine seeded crops like cilantro do not perform well with plant debris on soil surface.
- Three weeks in advance stale seedbed, then again at 10 days and again before planting.
- Basket 7-10 days after emergence, or as soon as possible without burying.

Cover Cropping / Under-Seeding Procedures

- Cilantro can follow many crops in the field, or it can be followed since it only takes 30 to 40 days until ready to harvest.

Corn, Sweet

Zea mays (Poaceae or grass family)

Soil Preparation

- Corn should not be followed after corn, other grains or cucurbits (corn rootworm, which should not be an issue with transplanted corn).
- Corn does well after a leguminous green manure like sweet clover. Early plantings will not be able to depend on the N out of clover.
- Compost is incorporated and corn is planted on raised beds or flat ground. Alternatively, later plantings of sweet corn can be planted through a rolled and crimped cover crop like vetch. To ensure good weed control plant vetch in early September at a rate of 40 lbs. per acre. Take soil test in preceding year and fertilize to provide nutrients for both the vetch and the sweet corn. To properly kill vetch, utilize a no till planter (without seed in the box) and slice the cover crop with the coulters of the drill. No additional N for corn is needed when you use this system.
- Total Nutrient uptake is 155 lbs of N, 20 Lbs of P, and 105 lbs of K but much of the K it is left on the soil as debris.
- PSNT (Pre-Side Dress Test) will determine amount of N to be applied with side dressing. Soil test will determine if additional K is needed.
- Corn is both direct seeded and transplanted. For greater weed control and earlier corn, it is started in the greenhouse and set in the field after two weeks.
- Later corn can be direct seeded but if the stand is poor, it is difficult to get adequate yield. Given the amount of pest control small acreage of sweet corn requires, it is imperative to get an optimum stand.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
140	0-160	0-160	6.2-6.5

Varieties:

- 2016 NOVIC Variety Trial
- You need to select sweet corn varieties that are listed as Normal, Sugary (su), Sugary Enhanced (se+) or synergystic (syn). Amongst the latter, varieties with good corn flavor are Mirai 308 BC or Mirai 301 BC and XtraTender 2171. Unfortunately, the birds love these too. There are many good organic corn varieties on the market including Double Standard, Allure and Enchanted.
- Popcorn: Robust

Direct Seeding Information

	Rows	Sds/F.	Plate	Shoe Depth	sprocket setting.	Notes
MaterMacc	2	3	24 H 4.5	1 inch	22 - 17	Soil temperature should be at least 55-60F
Jang	2	6	A6 AA6, or N6		Rear 10 Front 13	

Greenhouse Guidelines:

Use specific sweet-corn seeder or seed by hand.

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	70-95	65	Withhold water	Seed two seeds per cell Move outside 3 days before planting

Number of successions

- 10

Signs to watch for & what to do

- Harden plants off outside, plants that are lush do not perform well in the field.
- Air pruning of roots in transplants is extremely important with corn as the strong development of corn roots can cause difficulties with transplanting.
- Make sure plants don't get too tall before planting.
- Transplant as soon as plugs pull well and stay together. If roots are tangled to the bottom of tray they will need to be cut or pulled out straight, so they don't interfere with planting.

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	15 in.	As deep as possible	Works only well when you have a carrousel transplanter as the waterwheel planter is too slow

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use Sweeps (with torsions If possible) followed by fingerweeder 7-10 days after emergence or as soon as possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary, use Lilliston Rolling Cultivators and hill aggressively without burying the plants.

Frost, Insect, and Nuisance Animal Protection

- Super sweet corn varieties need to be isolated from non-super sweet varieties by at least 300 feet or the other variety should have a day-to-maturity difference or planting date of at least 12 days difference
- Grow corn in general in blocks of at least four rows to ensure good pollination
- Early corn is covered with floating row covers to protect against frost damage and for rapid development.
- European corn borer (ECB) can be controlled with Entrust or with a Bt Kurstaki product. Spray in whorl stage when you find more than 10 moths a day in the pheromone trap. Spray 3-5 days later to ensure covering all emerging tassels. Use high pressure (150

psi) to provide good penetration. Entrust (Spinosad) will also kill beneficial insects and bees. Spray only very early in the morning or later at night to avoid killing bees.

- Alternatively, for ECB control use releases of Trichogramma Ostrinnea starting when the corn is knee high. Release 30,000 eggs per acre every week until full pollination.
- For corn earworm use Gemstar LC at recommended dose per acre at 120 psi. Alternatively apply individual ears with Zealater applicator with Gemstar or Bt Kurstakis Adding some feeding/attractant stimulant like molasses and milk will increase effect.
- Gemstar provides some control for fall army worm but in case of an outbreak apply Bt Kurstaki or entrust.
- Put up a deer fence if they eat the silk. Bait deer fence with peanut butter. Make sure that fence is up, baited, and hot within one day. The surprise effect is what matters most with deer control.
- For Raccoon control, use a separate electric fence when corn has visible ears. Fence is woven grid and 18 inches tall. Only use high voltage fence charger (Inteli-shock 284) suitable for nylon woven wire to get effective control.
- For bird control you can use BirdGuard™ which is an electronic sound box that produces distress calls of certain birds and watch calls by predators. In extreme cases you can utilize a propane fired bird cannon that produces a blast at set intervals. Neither one is effective long term as birds get used to the sound. Balloons are effective but need to be taken down each time you use the boom sprayer. Some people have effectively used lasers which has become more cost competitive over the years.

Other Cultural Practices

- Corn needs to be mowed and incorporated after harvest to reduce future ECB infestations.
- Early corn is followed with an oats and peas if corn is to be followed by spring planted crops or plasticulture. Early seeded oats and peas should be mowed in December to break up long stalks as they will possibly clog up the mulch layer.
- Corn is followed by rye and vetch for later plantings.
- Over seeding with clover or rye is not recommended as this does not allow for proper incorporation of the stalks to avoid ECB to survive.

Cucumbers

Cucumis sativus (Cucurbitaceae or cucumber family)

Soil Preparation

- Cucumbers should not be followed after other cucurbits, nightshades, but follow well after cole crops, and some leguminous green manure or sweet corn.
- Compost is incorporated and cucumbers are planted on high raised beds covered with plastic mulch. IRT plastic mulch can help raise sol temperature for earliest plantings
- Soil test will determine if additional K is needed. Apply all additional N and K needed through hopper on mulch layer.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-160	6.0-6.4

Varieties

- Select varieties with broad disease resistance. I you want to maintain an insect cover until harvest select a parthenocarpic variety which means that the flower will set fruit without pollination. Monoecious varieties produce both male and female flowers while gynoecious varieties produces only female flowers. If a variety is not parthenocarpic but gynoecious you will depend on cross pollination from another variety.
- Open pollinated and organic favorites: Marketmore 76, 86 and the downy mildew resistant 97 or 420 (if available).
- Parthenocarpic varieties: Corinto (also gynoecious)
- High disease resistance Bristol (gynoecious)
- Pickling: Eureka, H-19

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#5**

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	80-95	>70day >60 n	Withhold water	Space cucumbers flats like checkers when plants get too leggy

Direct Seeding Information

- After the soil has sufficiently warmed up seeding directly in bare soil or through plastic mulch works very well. It is important to protect young seedlings against striped cucumber beetle with row covers or insect netting.

Transplant readiness indicators

- Harden plants off outside, plants that are lush do not perform well in the field.
- Transplant from Tray **50**'s when plant formed two true leaves
- Transplant in the field when plants have enough of a root-ball to hold the pot together. When they don't, they will be damaged and have a high fatality rate. Plants that are lush do not perform well in the field.
- Lay plastic mulch a week before planting to allow for germination of weed seeds and warming of soil.
- Avoid transplanting during the heat of a hot summer day on plastic mulch. The heat of the plastic can cause damage to the young seedlings. To avoid burning the young plants, transplant in the evening and use stocky transplants
- Dissolve Actinovate® SP or Regalia with Surround (Kaolin Clay) in plenty water and drench complete tray in solution before transplanting to help resist cucumber beetle damage.

Seeding time and Number of successions

- Plant 3 to 4 weeks before being ready to set out in field or high tunnel
- Plant every two to three weeks for continued harvest until July

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
1	12-18 in.	Cover the complete rootball	Take great care to maintain root ball to stay attached to plant, as cucumbers do not like to be transplanted. Keep a walking break in the plantings. Skip two plants every 100 feet to allow for walking path to facilitate harvest.

Cultivation Procedures

- Cucumbers are commonly planted in plastic mulch. When laying the plastic add granular fertilizer as needed to the soil at the recommended rate.
- Cultivate twice in between plastic with hillside cultivators before laying straw mulch. Maintaining a cover of straw in between the plastic mulch allows for better weed control and keeps the fruit clean to avoid having to wash the produce.

Frost, Disease and Insect Protection

- Plant early plantings downwind from later varieties as powdery and downy mildew are both windborne.
- Lay IRT plastic for earliest planting. Use floating row covers against frost and to protect against striped cucumber beetle. Remove at flowering for varieties that require pollination. Use 10-gauge wire to support row cover since abrasion will damage plants. If first protection is not necessary, you can use the longer lasting insect covers.
- Powdery can be (somewhat) controlled with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate) at a rate of 2 Qt of Cease and 1 lbs of Milstop per acre. Melons are sensitive to Sulfur (phytotoxicity) so great care should be taken if Sulfur (in whatever form) is applied to control PM. The use of tolerant or resistant varieties is useful. A full list of OMRI listed control products on powdery mildew is available from CALS
- Downy mildew can be somewhat controlled with Zonix. The use of tolerant or resistant varieties is useful. (Marketmore 97or 420 and Bristol are the preferred variety for later plantings as they are downy mildew tolerant). A full list of OMRI listed control products is available from CALS
- For another interesting article on Downy mildew please click here: eOrganic
- Organic Production and IPM Guide for Cucumbers and Squash

Other Cultural Practices

- Remove plastic soon after harvest and incorporate plants to avoid build-up of squash bugs. Establish a cover crop soon after disking in the remainders of the straw and plants.

Cucumbers High Tunnel

Cucumis sativus (Cucurbitaceae or cucumber family)

Soil Preparation

- Compost is incorporated and cucumbers are planted on high raised beds covered 5 feet apart.
- Early crops need to be planted in warm soil. You can accomplish this by either preparing a hotbed or as one grower reported to lay IRT plastic a few weeks before planting and closing the greenhouse up to trap the heat. This seems to be a sufficient measure.
- Soil test will determine if additional K is needed. Apply all additional N and K needed through drip line.

Varieties

- 2014 NOVIC Variety trial
- Select varieties with broad disease resistance and suitability for greenhouse production. Most greenhouse varieties are parthenocarpic and gynoecious and do not require any pollination also leading to having a seedless product.

- Katrina is a favorite to many growers for hot summer conditions
- Poniente and Socrates are good organic varieties

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#5**

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	80-95	>70day >60 n	Withhold water	Space cucumbers flats like checkers when plants get too leggy

Transplant readiness indicators

- No grower reported having grafted cucumbers but this is a common practice for organic greenhouse producers in Holland.
- Transplant from Tray **50**'s when plant formed two true leaves
- Transplant in the field when plants have enough of a root-ball to hold the pot together. When they don't, they will be damaged and have a high fatality rate. Plants that are lush do not perform well in the field.
- Avoid transplanting during the heat of a hot summer day on plastic mulch. The heat of the plastic can cause damage to the young seedlings. To avoid burning the plants, transplant in the evening

Number of successions

- 1 generally by hand

Disease and Insect Protection

- Powdery can be (somewhat) controlled with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate) at a rate of 2 Qt of Cease and 1 lbs of Milstop per acre. The use of tolerant or resistant varieties is useful.
- Good sanitation is important to slow the spread. Remove the first occurrences from the house and harvest infected areas of the house last.
- Scout weekly for spider mites. Control can be achieved with beneficial insects by starting the season off with potted green bean trap crops around the interior perimeters. When these show spider mites release the beneficials. Also intercrop with nectar & refuge plants (Alyssum, marigolds, others) at row ends and a few other spots in the house to support the predators.
- Scout weekly for Thrips. According to Amy Ivy of CCE ENYCHP an organic option to thrips is Spinosyn (Entrust) approved for tunnel application. Bio-control options exist but must be introduced early and repeatedly to keep the thrips population in check. They are not effective once the pest population is well established. Both western flower thrips and onion thrips can infest and significantly damage cucumbers.

Other Cultural Practices

- Greenhouse cucumbers need trellising since they are a vine crop, and most growers select either the single or double leader method whereby the stem is trellised on twine up a suspended wire and then allowed to drape down over the wire and grow toward the ground.

- Greenhouse cucumbers also require some pruning and training. Additional shoots that grow out of the leaf axils are removed to maintain a single, primary stem until the plant reaches the suspended wire. This is a desired method to avoid more than one fruit to develop at each leaf axil. Not removing the additional cucumber might lead to lower quality fruit. Some growers remove all fruit until the leader (or double leader) reaches the top of the wire to allow for vegetative growth.

Daikon

Raphanus sativus (Brassicaceae or cabbage family)

Soil Preparation

- Compost is incorporated and daikon is planted on raised beds.
- If soil test determines deficiency, Boron can be added with any additional fertilizer to optimize Boron distribution.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
50	0-125	0-200	6.0-6.4

Varieties

- Summer Cross no. 3, Miyashige

Direct Seeding Information:

	Rows	Sds/Ft	Plate #	Shoe Depth	Sprocket Setting
MaterMacc	**2**	3	**24 H 2.5**	½ inch	22 - 17
Jang	**2**	3	**X12**		Rear 14 Front 10

Cultivation Procedures:

- Basket weed after emergence and when large enough. As second cultivation use Finger weeder or spring hoes with rear mounted side knives.

Frost, Disease and Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- If seeded before August 15, cover with floating row covers before emergence to avoid flea beetle damage. Keep covered until harvest. Another alternative is to spray Entrust. Spray every 5-7 days up to three times per season. Read directions for use on Entrust on label.
- Beneficial nematodes can be sprayed on infected land or in hedgerows (where they over winter) to avoid future generations.

Dandelion

Cichoricum intybus (Asteraceae or Compositae family)

Soil Preparation

- Compost is incorporated and dandelion is planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-160	6.0-6.4

Varieties

- Catalogna Special, Red Rib

Greenhouse Guidelines

- **EZ Seeder** Seeding Plate **#9**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	56-85	75-60	Withhold water	Take out of greenhouse 5 days before planting. 3 seeds to a cell

Carousel Transplanter

Rows	In-Row	Planting Depth	Notes
3 Row	5 in.	Normal, do not bury plant.	

Direct Seeding Information

	Rows	sds/Ft	Plate #	Depth	Sprocket	Notes
MaterMacc	3	12-15	96 H 0.8	¼ - ½ inch	22-17	For bunching
Sutton Jr.	9	50	8	¼ - ½ inch		1 mph or 1.6 km for salad or braising greens
Jang	3	12	F 24	¼ - ½ inch	14 F 10 R	

Cultivation Procedures

- When direct seeding create seedbed 3 weeks before planting and cultivate after weeds emerge. Cultivate right before planting.
- Basket weed after emergence or 7 days after transplanting
- Hand weed or hoe in between plants.

Cover Cropping / Under-Seeding Procedures

- Dandelion can be harvested twice if crop is kept very clean from weeds.

Eggplant

Solana melongena (Solanaceae or nightshade family)

Soil Preparation

- Compost is incorporated and eggplant is planted on high raised beds covered with plastic mulch. IRT mulch will help avoid cold soil with earliest plantings
- Soil test will determine if additional K is needed. Apply all additional N and K needed through hopper on mulch layer.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
130	0-200	0-200	6.0-6.4

Varieties

- Galine, Dancer, Irene (has some Verticilium wilt tolerance)

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
288	80-90	70-80 d 65-70 n	Transplant into **50**'s after first true leaves are developed	Start seeds in germination chamber. Rotate flats like in an oven for even temperatures.

Signs to watch for & what to do:

- If plants get too leggy space trays as in checkers.

Transplant readiness indicators

- Biofumigation has shown some effectiveness to reduce incidences of Verticilium wilt, and phytophthora blight
- Harden plants off outside, plants that are lush do not perform well in the field.
- Transplant into Tray **50**'s when plant formed two true leaves
- Transplant in the field when plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the field.
- Irrigate with Actinovate or Regalia to help reduce soil borne and foliar diseases through dripline. Alternatively this can be sprayed on.

Number of successions

- 2

Waterwheel Transplanter

Rows	In-Row	Planting Depth	Notes
2	18 in.	As deep as possible through plastic	Add kelp to water as ½% solution in the water wheel planter. Keep a walking break in the plantings. Skip two plants every 100 feet to allow for a path.

Cultivation Procedures:

- Since eggplant is a tropical fruit IRT plastic mulch is the preferred material to help warm the soil for early planted crops.
- If phytophthora blight or verticilium wilt are an issue Caliente mustard is worked under in late May causing planting dates to be delayed. Flail mow mustard in full bloom after sunset to avoid killing pollinators. lay plastic mulch after mustard is fully broken down to avoid clogging up the mulch layer or plant directly in bare soil. Downside of this method is that you will only harvest a late crop due to the delayed planting time. Alternatively use this method in the fall or plant the year after cole crops like broccoli was grown
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator and cover wheel tracks with rye straw at a rate of 3lb per foot. (One 600 lbs. round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release K fertilizer later in the season and creates a very healthy environment by sanitary conditions and release of Silica in the soil.

Frost, Disease and Insect Protection

- Use floating row covers against frost for early plantings, consider keeping it on to protect against potato flea beetle. Support row cover with 10-gauge wire to prevent damage by abrasion. Remove at flowering for pollination.
- For Colorado potato beetle move eggplant far away from last year's potatoes and eggplant. Use Novodor for killing CPD in larvae stage; rate depending on size of larvae. Entrust can be used to kill adult but only spot spray where there is a presence and avoid spraying during the day to avoid killing pollinators.
- Anthracnose can be prevented by hot water treatment of seeds, rotation, and by using plastic mulch in combination with straw or weed barrier.
- Verticilium wilt has many hosts in the field and it is very difficult to use rotation only to eliminate this disease. Using somewhat resistant varieties like Irene is a good solution
- Similarly, phytophthora blight remains in the soil for a long time and bio-fumigation has shown some effectiveness. For more information on Phytophthora Capsici click her: P-Cap

Escarole
Cichoricum endivia (Asteraceae or Compositae family)

Soil Preparation
- Compost is incorporated and Escarole is planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-200	6.2-6.5

Varieties
- Natasha, Leonida, Benefine

Greenhouse Guidelines
- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	56-85	75-60	Withhold water	Take out of greenhouse 5 days before planting.

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	5 in.	Normal, do not bury plant.	For full heads plant at 9 inches

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Depth	Sprocket	Notes
MaterMacc	**3**	12-15	96 H 0.8	¼ - ½ inch	22-17	
Sutton Jr.	**9-17**	50	8	¼ - ½ inch		1 mph or 1.6 kmph
Jang	**3**	12	XY 12	¼ - ½ inch	10 Rear -14 Front	

Cultivation Procedures
- When direct seeding create seedbed 3 weeks before planting and shallowly cultivate after weeds emerge. Cultivate right before planting.
- Basket weed after emergence or 7 days after transplanting
- Hand weed or hoe in between plants.

Other Cultural Practices
- For leafhoppers and whitefly use Mycotrol ESO at 1 pint to the acre at nymph stage; repeat for three 5-day applications for best results. When pressure is high use PyGanic EC 5.0II at 6 to12 Oz to the acre. Make sure water is neutral as both low and high pH makes PyGaNic ineffective. Spray in the evening to reduce UV breakdown.
- Escarole as salad mix can be harvested twice if crop is kept very clean from weeds.
- Lends itself for double cropping after peas or before fall arugula or other greens. Avoid lettuce.

Fennel

Foeniculum vulgare (Apiaceae or carrot family)

Soil Preparation

- Fennel should not be followed after other umbellifers, and not after potatoes, cereals and cucurbits due to possible weed problems.
- Fennel does well after early lettuce and greens
- Compost is incorporated and Fennel is planted on raised beds.
- Soil test will determine if additional K is needed.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
90	0-160	0-200	6.0-6.4

Varieties

- Preludio, Zefa Fino

Direct Seed or Transplant:

- Transplant early, direct seed later if soil conditions allow.
- Fennel requires warm and relatively weed-free soil

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
128	70-85	75-65	Withhold water	Seed two seeds per cell and remove one after emergence. Add more vermiculite to the mix to increase drainage. Keep warm since low temperatures can cause bolting.

Signs to watch for & what to do

- When plants are too small and don't develop well consider a warmer location. Do not overwater as Fennel in its earlier stages does not require much. Later this changes and additional fertilization might be required.
- Harden plants off outside, plants that are lush do not perform well in the field.

Transplant tips

- Plants that lose some of their root system when replanted have a higher incidence of bolting.
- Consider direct seeding for later plantings.

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	9 in.	As deep as the plant can tolerate without growing point getting buried	Irrigate after planting

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Shoe Depth	Sprocket setting
MaterMacc	**2**	6	**96 H 1.0**	¼ - ½ inch	22-17
Jang	**2**	6	**YX6**		Rear 10 Front 14

Cultivation Procedures

- Prepare seedbed one to two weeks in advance, shallowly work seedbed before planting to eradicate weeds. Do not disturb soil too deep as new weed seeds will be brought up.
- Basketweed after planting or emergence.
- Use torsion gangs or fingerweeder for second cultivation with rear mounted S-tines for cultivation of wheel tracks and between rows. Do not hill Fennel as this makes harvest more difficult.
- Thin and weed at 9 inches apart for large bulb production.

Other Cultural Practices

- Fennel needs fertile conditions and is best grown on soils with high organic matter.
- Lends itself for double cropping as fall crop after peas or lettuce.
- Prevent cercospora leaf blight (cercosporidium punctum) through hot water treatment of seeds, and rotation

Garlic

Allium sativum var. ophioscorodon (hardneck) (Alliaceae or onion family)

Soil Preparation

- Land is bare fallowed the summer before planting usually after two years of red clover.
- Compost is worked in with buckwheat in August. Raised beds are formed two weeks later.
- Soil test will determine if additional K is needed.
- Garlic does well when followed after a spring seeding of oats and peas followed with a bare fallow to eradicate weeds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
40-120	0-150	0-150	6.0-6.4

Varieties

- Porcelain Hardneck: German White, Music, Bogatyr,
- Rocambole: Spanish Roja, Killarney Red, Chesnok Red
- Softneck: Inchelium

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	5 in.	Plant garlic right side up as deep as the length of the garlic cloves	Mulch with clean straw or hay at a rate of 3 lbs of material per foot (a 40 lbs square bale covers about 12 ½ feet). Apply before first deep freeze

Other Cultural Practices

- A crop rotation of 100 lbs of oats and 100 lbs of peas followed by 80 lbs of buckwheat serve as a good foundation for a successful garlic crop. Spread compost as needed before planting or right before buckwheat is incorporated.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Crack hardneck garlic by hand to avoid bruising of the cloves. Machine cracking can result in greater incidence of disease especially fusarium basal rot. Sort cloves carefully for mites, garlic bloat nematode, and fusarium. Here is a good article on the effects of growing techniques on yield, grade and fusarium infestation levels in garlic.
- Plant garlic as deep as the garlic is tall with the growing point facing up in an 8 by 8 grid or in rows 15 inches apart with 5 inches apart in the row.
- Mulch directly after planting with straw or weed-seed free hay. Depending on the maturity of the hay, this might break down more quickly than straw so apply generously.
- Additional Nitrogen can be applied in early spring right but is generally not advised unless excessive rain washed out the N reserves. Garlic at a yield of 4,000 to 5,000 lbs. only takes up approximately 40 lbs. of N. High N applications are associated with lower quality bulbs and greater incidence of disease.
- Mulch is not removed and has not led to yield losses in our experience as moisture preservation compensates for cooler soils
- Garlic needs to be weeded on a regular basis the season after planting.
- Check for Allium Leaf Miner. In Southern regions use exclusion netting to avoid infestation. In northern regions the flight is generally too late to do damage.
- Scapes are harvested in June and early July.
- Check garlic for possible infestation of white rot, dry rot, and fusarium basal rot. Pull plants when they look different to inspect and if diseased remove from field.
- Garlic is cut with a sickle bar mower with about 6 inches of stem left, then lifted and pulled. Treat all garlic like apples to avoid bruising.
- For further specific instruction on harvest and storage procedures see the harvest manual.

Bok Choy/Joi Choi/Mei Ching Choi

Brassica rapa (chinensis group) (Brassicaceae or cabbage family)

Soil Preparation

- Total Nutrient uptake is 165 lbs of N, 10 Lbs of P, and 208 lbs of K
- Compost is incorporated and Bok Choy is planted on raised beds.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Varieties

- Joi Choi, Red Choi, Fujo Chomi, Mei Ching Choi, Win-Win Choi

Greenhouse Guidelines: EZ Seeder seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	65-85	cool	Withhold water	Take plants outside 1 week before planting in field

Transplant readiness indicators

- Plants should easily come out of their cell. Plants should generally not be older than five weeks
- Harden plants off outside, plants that are lush do not perform well in the field.

Number of successions

- Spring 2
- Fall 2

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	12 in.	Do not plant too deep to avoid bottom rot	Bok-Choi does not like to be transplanted, so take great care of plants and plant in the afternoon

Cultivation Procedures:

- Basket weed 7-10 days after transplanting.
- Hand hoe in between plants if basket weeder is used.

Second cultivation use the fingerweeder or spring hoes with knives in the back.

Frost, Disease and Insect Protection

- Control flea beetles with Entrust every 5 –7 days not to exceed three sprays. Read label on Entrust. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- If cabbage looper / worm population is over 2 worms per plant, spray Dipel DF or Javelin using at 1–2 pints to the acre or Entrust at 1-2 oz to the acre (total amount per season per acre not to exceed 9 oz). Adding some feeding/attractant stimulant like molasses and milk will increase effect (1 lbs per acre).
- Rhizoctonia or Bottom rot can be an issue with Chinese Cabbage and Bok Choy. Avoid lower parts of plants to be in contact with the soil and apply broad rotation with other members of the brassica family.
- Basal stem rot (Erwinia carotovora) (not to be confused with Rhizoctonia) is caused by insects eating at the basal stem but also damage by cultivation can help bring this disease in the plant. Aggressive cultivation is not advised in Bok Choy production.

Kale, main crop

Brassica oleracea (Brassicaceae or cabbage family)

Soil Preparation

- Kale should not be followed after other cole crops.
- Compost is incorporated and Kale is planted on raised beds or flat ground.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.
- Kale does exceedingly well when followed after a spring seeding of bell beans, barley and oats without any application of additional N.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	20-160	0-200	6.2-6.5

Varieties

- Darkibor, Winterbor, Redbor, Lacinata, Black Magic, Red Ursa

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	65-85	cool	Withhold water	Take plants outside 1 week before planting in field

Transplant readiness indicators:

- Plants should easily come out of their cell. Plants should generally not be older than five weeks
- Harden plants off outside, plants that are lush do not perform well in the field.

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	12-18 in.	As deep as the plant can tolerate	Kale is a tough plant but can be decimated by flea beetles when not looked after

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use Sweeps (with torsions If possible) followed by fingerweeder 7-10 days after emergence or as soon as possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary, use Lilliston Rolling Cultivators and hill aggressively without burying the plants.

Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Plant far away or upwind from earlier planted cole crops and avoid overhead irrigation to avoid Alternaria leaf spot. Serenade (bacillus subtilus) as well as JMS Stylet Oil has shown some control by a few growers. Always read the label before use.
- Look for eggs of cabbageworm/cabbage looper or diamond back moth, at the underside of leaves. When small worm population is over 2 per plant spray Bt using 1 to 2 pints to the acre or spinosad (Entrust) every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with spinosad to avoid buildup of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications)

Other Cultural Practices

- Late planted Kale grows healthy and robust after hairy vetch or bell beans. No additional fertilizer (with the exception of Boron) needs to be applied when using this method.

Kale, early crop

Brassica oleracea (Brassicaceae or cabbage family)

Soil Preparation

- Cultural practices are similar to main crop kale except that early kale is planted on either plastic mulch or bare ground.
- Avoid too much plant debris from previous cash or cover crop when planted through plastic

Varieties

- Winterbor, Redbor, Toscana

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2-3	12.	As deep as possible	Cover raised beds with floating row cover right after planting

Cultivation Procedures early kale

- Cover plants with floating row cover to protect against flea beetles and increase earliness.
- Cultivate with Hillside cultivator
- If desired plant cover crop like oats and peas in between plastic
- After harvest work in cover crop and plant debris to allow for bare fallow
- Early Kale can be followed by fall cover crop. Mow plants down as low as possible with flail mower. Incorporate crop residue with chisel plow or disk.

Kale, Russian

Brassica napus pabularia (Brassicaceae or cabbage family)

Varieties

- Red Russian

Direct Seeding Information

	Rows	Seeds/Ft	Plate #	Shoe Depth	Notes
Planet Jr.	**5**	50	**2** or **3**	Depth 2	Use spreader shoe
Sutton Jr.	**9-17**	30	**6**	¼ inch	1 mph (or 1.6 kmph)
Jang	**5**	12	**YYJ 12 or 24**	¼ inch	

- Use as braising green

Kohlrabi

Brassica oleracea (gongylodes group) (Brassicaceae family)

Soil Preparation

- Kohlrabi should not be followed after other cole crops.
- Compost is incorporated and Kohlrabi is planted on raised beds.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	20-160	0-200	6.2-6.5

Varieties

- Winner, Kolibri, and Kossak for winter storage

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening off	Notes
Tray **72-98-128**	65-85	cool	Withhold water	Take plants outside 1 week before planting in field

Signs to watch for & what to do

- Kohlrabi plants tend to get leggy. Provide enough light
- Harden plants off outside, plants that are lush do not perform well in the field.

Transplant readiness indicators

- Plants should easily come out of their cell. Plants should generally not be older than five weeks

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	5 in.	Normal depth level with top of the cell	Given the close spacing, a carousel planter works well

Cultivation Procedures

- Basketweed 7 to 10 days after planting. Cover row 2 and 4 with chisels mounted on Basketweeder or side knives mounted on rear toolbar.
- Hand hoeing in between plants
- Use fingerweeder or Springhoes for second cultivation with rear mounted S-tines in wheel track and side knives in between rows.

Insect Protection

- Cover with floating row covers or insect netting before emergence to avoid flea beetle damage (for earliest plantings).
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Look for eggs of cabbageworm/cabbage looper at the underside of leaves. When small worm population is over 2 per plant spray Bt (Dipel DF) using 1 to 2 pints to the acre or spinosad (Entrust) at 1-3 Oz per acre every week until population is under control.

Other Cultural Practices

- Early Kohlrabi can be followed by fall cover crop or second cash crop. Mow plants down as low as possible with flail mower. Incorporate crop residue.
- Late planted Kohlrabi grows healthy and robust after incorporation of hairy vetch.

Leeks

Allium porrum (Alliaceae or onion family)

Soil Preparation

- Compost is incorporated and Leeks are planted on raised beds.
- Soil test will determine application rates.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-200	0-200	6.0-6.4

Varieties

- Variety trial report of 2020 showed that Lancia and Skater are good performers. Chinook, Defender, and Tadorna were good performers in the late fall. Generally, there was more discrepancy between the early than the later varieties and while Megaton appears to be a standard it was a middle of the road variety

Greenhouse Guidelines

- Start leeks in strip trays at a rate of 200-300 seeds per tray. Repot them when the leeks have a few leaves into a 1020 tray well filled with a compost based potting soil mix at a rate of 150 plants per tray.

Signs to watch for & what to do

- Yellowing; feed with fish fertilizer.
- Poor growth; don't over water. Leeks stay in the greenhouse longer than they might like to. Algae might form over time if the plants are kept too wet, and potassium and nitrogen leach out

Transplant readiness indicators

- Pencil thickness is desired but unattainable in a 128 tray. Transplant before the end of May.
- To increase disease resistance, drench plants in Actinovate® SF Regalia to help reduce plant diseases before transplanting

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
2	5-9 in.	Plant deep, just 1-2" of leaves above soil	When leeks are pencil thickness, planting is usually done by hand. Punch a 1 inch hole 6 inches deep and place the leek in the hole and ensure that roots are not bend upwards

Cultivation Procedures

- Mechanical transplanters need to be adjusted so there is good soil to plug or root-ball contact. Make sure that plants are properly rooted before cultivation.
- Use Sweeps (with torsions If possible) followed by fingerweeder 7-10 days after emergence or as soon as possible without damaging the plants. Alternatively use a tine weeder but this works better when you use bare root transplants. Tine weeders tend to uproot plugs.
- Hand hoe in between plants as necessary.
- Second cultivation use sweeps with torsions followed by Hak Hillers or Bezzerides spring hoes for slight hilling.
- If third cultivation is necessary, use Lilliston Rolling Cultivators and hill without damaging the plants.

Frost, Disease and Insect Protection

- Leeks are very sensitive for "wear", and this implies that damage can easily occur through aggressive cultivation. Take great care when leeks are cultivated to avoid damage to leaves.
- Watch for thrips, and control with Entrust at a rate of 2-3 oz or 1 lb of Mycotrol ESO to the acre with 1 lb of JMS Stylet oil and Nu-Film P as adjuvant/spreader sticker. Repeat every 5 – 7 days not to exceed 9 oz per acre per season. Use TX 12 hollow cone nozzle @ 120 psi for greatest effect. Only spray at night as thrips are nocturnal. Adding molasses and milk as feeding attractant stimulant will increase efficacy of Mycotrol ESO or Entrust.
    - Check for Allium Leaf Miner. Use exclusion netting to avoid infestation.

Lettuce, heads, main crop

Lactuca sativa (Asteraceae or Compositae family)

Soil Preparation

- Compost is incorporated and Lettuce is planted on raised beds.
- Total Nutrient uptake is 95 lbs of N, 12 Lbs of P, and 170 lbs of K

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-200	6.2-6.5

Varieties

- 2018 Lettuce Variety Trial
- 2019 Romaine Lettuce Variety Trial (summary) 2019 Romaine Lettuce Variety Trial (narrative)

Greenhouse Guidelines

- **EZ Seeder** seeding plate **# 9**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	Below 80	75-60	Withhold water	Take out of greenhouse 5 days before planting. 1 seeds to a cell. Plants should be finished within 23 days from seeding

Transplant readiness indicators and tips

- Plants should easily come out of their cell. Plants should generally not be older than 3-4 weeks
- If weather is too hot keep flats in a cool location until seeds germinate.

Number of successions

- Summer 10
- Fall 5

Transplanting on 5 or 6 foot raised bed

Rows	In-Row	Planting Depth	Notes
3	6-12 inches.	Do not bury plant. Leave the top of the cell a little above ground to avoid bottom rot.	Adjust the spacing based on variety as many Romaine types need 12 inches while many small types can be planted as close as 6-7 inches. Many butterheads, basic red and greenleafs are spaced at 9 inches

Cultivation Procedures

- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basket weed 7 days after transplanting.
- Hand weed or hoe in between plants.

Frost, Disease and Insect Protection

- Organic Production and IPM Guide for Lettuce
- To prevent bottom-rot (Rhizoctonia), provide drainage, weed control and plant cells ¼ inch above soil surface
- To prevent Downy Mildwew (Bremia Luctucae), use resistant varieties
- To prevent lettuce Drop (Sclerotinia or white mold) plant lettuce in areas with good air drainage, use broad rotations away from snap beans, carrots and celery and incorporate the biological control Contans (Coniothyrium minitans) pre-planting
- To prevent Botrytis (grey mold) avoid using overhead irrigation.
- To prevent viruses, use certified disease-free seed, and reduce cross contamination by controlling whitefly and aphids
- Watch for aphids and whitefly; control with Mycotrol ESO. Repeat every 5 – 7 days. Alternatively, insecticidal soap (just against aphids) can be used but when infestation is heavy PyGanic is more effective.

Cover Cropping / Under-Seeding Procedures

- Suitable for double cropping. Reserve this ground for later direct seeded crops since crop residue is low.

Lettuce, heads, early production

Lactuca sativa (Asteraceae or Compositae family)

Soil Preparation

- Lettuce does well after cole crops (tillage radish) and cereal cover crops and poorly after potato, beans or peas.
- Cultural practices are similar to main crop except that early lettuce is planted on Plastic mulch.
- Avoid too much plant debris from previous cash or cover crop as plastic will be laid as early as possible in the growing season.

Number of successions

- 2-3

Waterwheel Planter

Rows	In-Row	Planting Depth	Notes
2-3	6-12 inches	Top of cell should be above soil line to avoid bottom rot	Add kelp to water as ½% solution in the water wheel planter.

Cultivation Procedures early kale

- Cover plants with floating row cover
- Cultivate with Hillside cultivator
- If weeds in between are an issue cover with weed fabric
- After harvest work in cover crop and plant debris to allow for bare fallow

Lettuce, Salad mix

Lactuca sativa (Asteraceae or Compositae family)

Direct Seeding Information

	Rows	Seeds/Ft	Plate #	Shoe Depth	Notes
Planet Jr.	**5**	60	**7**	Depth 2	
Sutton Jr.	**9-17**	50	**8**	¼ to ½ inch	1 mph or 1.6 kmph
Jang	**5**	24	**X24 or XY24**		14 Front by 9 or 10 Rear sprocket

Number of successions

- Spring 5
- Summer 10
- Fall 5

Varieties

- When downy mildew is an issue select only resistant varieties. Favorites amongst growers are Salanova, Red Salad Bowl, Outredgeous, Green salad bowl and Defender.

Cultivation Procedures

- Salad mix follows well after winter cover crop of oats and peas or when no cover crop was planted that winter. Planet Jr. seeders and fine seeded crops like salad mix does not deal well with plant debris on soil surface.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basket weed after plants are two inches tall. When 9 to 17 rows are planted you can't use any mechanical weed control.
- Hand weed in between plants but make sure you do not pull any soil up. 17 row salad mix generally is very clean and is free from soil.

Cover Cropping / Under-Seeding Procedures:

- Salad can be harvested twice if crop is kept very clean from weeds and if the weather tolerates it.
- Any small green or lettuce leaves land that is very suitable for double cropping. Reserve this ground for direct seeded crops since crop residue is low and easily incorporated.

Muskmelon/Cantaloupe

Cucumis melo (Cucurbitaceae or cucumber family)

Soil Preparation

- Melons should not be followed after other cucurbits, nightshades, but follow well after cole crops, and leguminous green manure or sweet corn.
- Compost is incorporated and melons are planted on high raised beds covered with plastic mulch. Use IRT mulch for earliest plantings
- Total Nutrient uptake is 158 lbs of N, 27 Lbs of P, and 155 lbs of K.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-160	6.0-6.4

Varieties

- Athena

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#5**

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	80-90	75	Less water and temp for 1 week	Plants mature within 4 weeks

Transplant readiness indicators

- Transplant when plant has formed two true leaves or a little beyond this stage. Much beyond this stage, plants do not adapt well.
- They need enough of a root-ball to hold the pot together. When they don't, they will be damaged and have a high fatality rate.
- Harden plants off outside, plants that are lush do not perform well in the field.
- Dissolve Actinovate® SP or Regalia with Surround (Kaolin Clay) in plenty water and drench complete tray in solution before transplanting to help resist cucumber beetle damage.

Number of successions

- At least 3 seedings to allow for a 5- 6-week supply from the middle of July till end of August depending on variety. If later seedings are put in the ground, there is a risk of downy mildew.

Waterwheel Transplanter

Rows	In-Row	Planting Depth	Notes
1	12 in.	normal	Add kelp to water as ½% solution in the water wheel planter

Cultivation Procedures

- When plasti-culture is used plant at least a week after plastic mulch is laid to allow weeds to germinate under the plastic. Use IRT plastic to help soil warm up.
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator and cover wheel tracks with rye straw at a rate of one 3lb round bale per foot. (One 600 lb round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release fertilizer later in the season.

Frost, Disease and Insect Protection

- Use floating row covers against frost for early plantings, consider keeping it on to protect against cucumber beetle. Support row cover with 10-gauge wire to prevent damage by abrasion. Use insect netting for later plantings. Remove at flowering. When row covers are not used, drench plants in a mixture of Surround® WP and water before transplanting.
- Powdery mildew can be proactively reduced with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate). Melons are sensitive to sulfur (phytotoxicity) so great care should be taken if sulfur (in whatever form) is applied to control PM. Use the same mixture to control downy mildew
- When phytophtora (phytophtora capsici) is an issue, rotate away from this land if possible. Biofumigation has shown some effectiveness to reduce incidences.

Other Cultural Practices

- When melons have sized up, hold back on irrigation to avoid splitting.

Onions

Allium cepa (Alliaceae or onion family)

Soil Preparation

- Compost is incorporated and Onions are planted on high raised beds either covered with plastic mulch or in bare ground
- Total Nutrient uptake is 145 lbs of N, 25 Lbs of P, and 155 lbs of K

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-200	0-200	6.0-6.4

Varieties

- Ailsa Craig, Gunnison, Red Bull, Redwing

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	60 -85	60-65 d 55-60 n	Withhold water	3-4 Seeds per cell. Take plants outside 1 week before planting in field
Tray **128**	60-85	60-65 day 55-60 Night	Withhold water	1 seed per cell, take plants outside 1 week before planting in field

Signs to watch for & what to do

- Yellowing; feed with fish fertilizer.
- Poor growth; don't over water. Onions stay in the greenhouse longer than they might like to. Algae might form over time if the plants are kept too wet, and potassium and nitrogen leach out
- Clip tops off tall onion leaves to avoid falling over. Onions are transplanted after a good "haircut".

Transplant readiness indicators

- Transplant in the field when plants have enough of a root-ball to hold the pot together.
- Mix Actinovate® SP or Regalia in water to create solution and drench complete tray before transplanting.

Waterwheel Transplanter

Rows	In-Row	Planting Depth	Notes
3-5	4 inches for individual plants and 9 inches for clumps	Not too deep. Same level as potting medium and a little below	Add kelp to water as ½% solution in the water wheel planter.

Cultivation Procedures

- Planting in plastic mulch can increase onion yield:
    - Higher soil temperature before the longest day results in bigger onions
    - better soil moisture due to drip irrigation and lower evapotranspiration due to covered soil.
    - Additionally, a silver strip can be applied to the plastic to repels the thrips away from the onions.
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator and cover wheel tracks with rye straw at a rate of 4lb of straw per foot. (One 800 lbs round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release fertilizer later in the season.

Frost, Disease and Insect Protection

- Onion's main insect pest is thrips, which is controlled with Entrust. Alternatively, garlic oil or Stylet JMS oil (without adding an adjuvant) can be used as it smothers the nymph. Spray late in the evening when the thrips emerges from the bottom of the plants as feeding takes place at night. Irrigation with larger droplets (at night) works also very well to wash the thrips off. During years of heavy rain, thrips are less of a problem.
- Having said this, Allium Leaf Miner is becoming more and more a serious issue. Entrust will provide some control but covering with insect netting is considered to have the best control
- Botrytis Leaf Blight (fungus) and Xanthanomas Leaf Blight. (bacterial) are common problems that can be avoided with good rotations, certified disease-free seed and good water management
- Purple Blotch
- Downy Mildew

- Botrytis (neckrot) is a problem that is caused by cultural practices like giving too much space to the onions. Use certified disease-free seed and follow the same guidelines to avoid all other bacterial bulb diseases. Varieties like Candy and Ailsa Craig should be used for green onions as they are very sensitive to botrytis.
- Many bacterial bulb diseases are developed between pre-harvest and storage. These diseases can be controlled by
    - Avoiding damaging onions during harvest (for example by topping the onions in the field,
    - Late applications of nitrogen fertilizers (given that most organic fertilizer are slow release, this can be a serious issue for organic growers so care should be taken to not overfertilize with composted poultry manure).
    - Excessive moisture combined with high temperatures. (Avoid the use of overhead irrigation late in the season).

Other Cultural Practices

- Onions are usually followed by oats and peas as they are harvested by September.

Onions overwintering in High Tunnels

Allium cepa (Alliaceae or onion family)

Soil Preparation

- Compost is worked in or left on surface of soil and onion sets are planted on raised beds
- Total Nutrient uptake is 145 lbs of N, 25 Lbs of P, and 155 lbs of K
- Soil test will determine if additional K is needed.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-200	0-200	6.0-6.4

Varieties

- Stuttgarter Reisen, Sturon, Bridger

Planting information

- Plant sets around September in an 8 by 8 grid

Rows	Distance	Planting instructions	
5-6	8 in.	Plant sets just below the surface like garlic heads up	Cover onions with compost and add sufficient moisture to the soil to get onions through the winter.

Frost, Disease and Insect Protection

- As these onions are grown in a high tunnel over the winter you do not have any pest issues aside from any pest already living in the tunnel. Apply good hygiene in the tunnel by removing old plant material

Other Cultural Practices

- Onions are ready to harvest starting in June

Parsley

Petroselinum crispum (Asteraceae or carrot family)

Soil Preparation

- Compost is incorporated and Parsley is planted on raised beds.
- Side dress N as needed after first cut

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-200	6.0-6.5

Varieties

- Darki (curly leaf) and Italian Dark Green (flat leaf)

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#9**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75	65	Withhold water	Place 3-5 seeds per cell. Take plants outside 1 week before planting in field

Signs to watch for & what to do

- Yellowing; use a dressing of Vermont Compost's Forte Plus.
- Poor growth; don't over water. Parsley stays in the greenhouse longer than it might like to. Algae might form over time if the plants are kept to wet, and potassium and nitrogen leaches out

Transplant readiness indicators

- Harden plants off outside, plants that are lush do not perform well in the field.
- Plants should easily out of cell but in the case of parsley they might become rootbound when left too long in the greenhouse

Number of successions

- 3

Transplanter

Rows	In-Row	Planting Depth	Notes
3	12 in	Same level as potting medium	Use 12-inch sprocket or 12-inch wheel

Cultivation Procedures

- If transplanted on bare ground, use basketweeder for cultivation followed by hand hoeing. Crawling many times through the crop to keep it weed free is a common procedure with this crop as you can cut it over three times per season. It is important to feed it with a granular fertilizer to keep it productive at a rate of 500 lbs per acre (17 lbs per 500 feet in between each row).
- When planted through plastic mulch plant it at three rows 12 inches apart and fertigate after each cutting.

Frost, Disease and Insect Protection

- Main pest is cutworm that takes out the whole plant. No remedy except replanting

Parsnip

Pastinaca sativa (Asteraceae or carrot family)

Soil Preparation

- Parsnips should not be followed after other umbellifers, and not after potatoes, cereals and cucurbits due to weed and possibly structural problems.
- Compost is incorporated and Parsnip is planted on raised beds or ridges.
- Soil test will determine if additional K is needed.
- Side dress N as needed.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
150	0-160	0-200	6.0-6.4

Varieties

- Javelin

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Sprocket	Depth	Notes
Planet Jr.	**3**	15 -25	**15**		½ inch	Takes 3 wks to germinate
MaterMacc	**3**	20	**192 H 2.0**	**22-19**	½ inch	
Jang	**3**	20	**MM 12 or M12**			Will not singulate

Cultivation Procedures

- Parsnips follow well after winter cover crop of oats and peas or when no cover crop was planted that winter.
- Subsoil before planting to break up any possible plowpan.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Use only a precision seeder to avoid using too much seed.
- Cultivate when weeds emerge and right before planting
- Flame weed before parsnips come up. Look for sprouted seeds under plate of glass. Basket weed with soil busters in front of the baskets since soil will be hard at this point.
- Use a variety of tools after this. Initially the fingerweeder or springhoes, followed by the rear mounted Bezzerides Spiders proved to work very well (the latter as hiller, as long as you are careful).
- When hand weeding, avoid working in full sun and when temperatures are high as many develop an allergic reaction (skin rash) from exposure to the leaves. Provide workers with full protection of the skin by providing gloves, and requiring them work only with long sleeves and pants.

Peas

Pisum sativum (Fabaceae or legume family)

Soil Preparation

- Compost is incorporated and Peas are planted on raised beds.
- Total Nutrient uptake is 170 lbs of N, 22 Lbs of P, and 80 lbs of K

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
50	0-120	0-160	6.2-6.5

Varieties

[See variety trial 2020]

- Sugarsnap
- Snow Pea
- Shell peas

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Depth	Notes
Planet Jr.	**2**	25	**36**	½-1" Depth 4 or deeper. Only use regular shoe	Mix with Inoculants and T22. Important to bury completely!
Earthway	**2**	10	**Peas disc**	½ - 1 inch	Skips easily
Jang	**2**	12	**B or C12**	½ - 1 inch	Rear 10 Front 14
MaterMacc	**1**	12	**144 H 4.5**	½ - 1 inch	12 seeds per row when 2 rows are planted. Use Sprocket **17-19**

- Seed two rows of peas by traveling twice with the one row planter on the same bed. Drive carefully so each row is 4 inches apart from the other.

Cultivation Procedures

- Peas follows well after winter cover crop of oats or when no cover crop was planted that winter. Planet Jr. seeders do not deal well with plant debris on soil surface.
- Because of the peculiar way this crop is seeded, basket weeders and spring hoes are useless. In order to keep the crop clean use rear mounted side knives and cultivate as close as possible near the germinated peas.

Other Cultural Practices

- Trellis like you would trellis tomatoes (see tomatoes for description)
- Organic Production and IPM Guide for Peas

Cover Cropping / Under-Seeding Procedures

- Peas can be followed by another vegetable crop. Take great care to spade the residue in right after the first harvest before the vines lose their nitrogen content and weeds go to seed.

Peppers

Capsicum annuum (Solanaceae or nightshade family)

Soil Preparation

- Total Nutrient uptake is 140 lbs of N, 12 Lbs of P, and 140 lbs of K
- Compost is spaded in and peppers are planted on high raised beds covered with plastic mulch.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
150	0-200	0-200	6.0-6.4

Varieties

- 2019 Bell Pepper trial
- Popular with Growers:
  - Bell peppers: Alliance
  - Italian Peppers: Carmen, Banana Bill
  - Hot Peppers: Tiburon, Sahuaro, El Jefe, Red Rocket

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
288	80-90	70 day 60 night	Withhold water	Consider cold treatment of 55 after 3rd true leaf appears for 4 wks, then back to 70

Signs to watch for & what to do

- Repot into Winstrip 50's, 38 pro-trays or in 4-inch pots when true leaves are developed.
- Yellowing: make sure the temperatures are high enough during the day. When temperatures drop too low premature flowers form that need to be picked off.
- If necessary, side dress with Vermont Compost Forte plus to keep plants healthy.

Transplant readiness indicators

- Transplant in the field when plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the field.

Number of successions

- Usually, one main planting.

Waterwheel Transplanter

Rows	In-Row	Planting Depth	Notes
1-2	12 in.	As deep as the plant allows	Add kelp to water as ½% solution in the water wheel planter. Plant with abundant water mixed with kelp. Keep a walking break in the plantings. Skip two plants every 100 feet to allow for path.

Cultivation Procedures:

- In the rotation plastic mulch culture follows after a winter cover of oats.
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator and cover wheel tracks with rye straw at a rate of one 3-4lb round bale per foot. (One 600 lb round bale covers 150-200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release fertilizer later in the season. Both hay and straw releases K and Silica in the soil acting suppress disease and adding nutrients to plants later in the season.

Frost, Disease and Insect Protection

- Use floating row covers against frost for early plantings but remove as soon as the danger of frost has passed. Support row cover with 10-gauge wire hoops to prevent damage by abrasion. Peppers need abundant water and nitrogen during the season.
- Actinovate or Regalia application through the drip tape provides anecdotal prevention of soil borne diseases.

- CEW is a problem in peppers when they fly in from the sweet corn during the second generation (usually around the third week in July). Control with frequent release of Trichogramma Ostrinae as soon as the second generation has hatched. Release at high numbers to be effective. Entrust is not very effective as it is more difficult to get direct contact with the larvae. Eggs are often hatched on the fruit with the hatched larvae creating an opening that causes the fruit to prematurely ripen and subsequently rot.
- Pepper Maggot is a new issue, and often undetected until the customer opens the fruit. Damage is best visible on glossy varieties like hot cherry peppers. Start spraying with Neemix when first damage is spotted (usually around mid-July) every 7 days.

Potato

Solanum tuberosum (Solanaceae or nightshade family)

Soil Preparation

- Total Nutrient uptake is 180 lbs of N, 26 Lbs of P, and 225 lbs of K
- Compost and SulPoMag (if soil test calls for it) is incorporated, and potatoes are planted with a potato planter.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
150	0-240	50-350	See guidelines

Varieties

- Yellow: Keuka Gold, Natasha, Satina, Nicola
- White: Kennebec, Green Mountain, Lehigh,
- Red: Red Maria, Adirondack Red, Chieftain
- Russet: Amey Russet, Gold Rush,
- Purple: Adirondack Blue, Magic Molly
- Fingerling: Yellow Finn

Planting in the Field with Potato Planter

Rows	In-Row	Planting Depth	Notes
2	7" -9" for regular potatoes, 12 inches for Russet's	As deep as the planter allows the seed to be dropped in the furrow (not deeper than 2-3 inches	100 lbs seed can cover approximately 600 row feet. Any potatoes larger than B size need to be cut in smaller pieces. Make sure that each piece has at least one eye.

Cultivation Procedures:

- Lely tine weeder or rolling cultivator at ground crack (when potatoes are showing their first leaves). Make sure plants are well rooted at that point.
- Use a ridger to slowly hill the potatoes without burying them. This can take several passes allowing emerging weeds to be covered after each pass. As potatoes are aggressive plants, shading by the leaves will control weeds until they are ready for harvest.
- If control of leaf hoppers is not adequate, exposed soil allows for conditions of germination of new weed seeds. leaves will perish before potatoes have developed a skin resistant to damage from handling especially machine harvesting. There is no good way of controlling weeds in this stage as additional ridging will either expose the tubers to sunlight or damage them.

Frost, Disease, and Insect Protection

- Plant potatoes when soil temp is over 50F.
- Check soil for wireworms as yield can be declined at high populations.
- Many potato varieties are resistant to scab. When soil pH is below 5.5 scab is not an issue.
- For Colorado potato beetle move potatoes far away from last year's plot. Use Novodor for killing CPD in larvae stage.
- Potatoes can host a great variety of beneficials and avoid spraying the whole field. Use Entrust only to kill adults and use backpack sprayer for spot spraying.
- For leafhoppers use Mycotrol ESO (Beauveria bassiana) when leafhoppers are in the nymph stage. When infestations are high use PyGanic EC 5.0II at 6 to12 Oz with 1 pint of Nu-Film P as adjuvant/spreader sticker to the acre; repeat for three weeks for best results. Make sure water is neutral as both low or high pH makes PyGanic ineffective. Spray in the evening to reduce early UV breakdown of Pyrethrum.
- Late blight can be controlled with a weekly spray of Zonix. or a OMRI listed copper mixed with JMS Stylet Oil and Regalia (Reynoutria sachalinensis). Do not mix in a spreader sticker with the mixture if Stylet oil is used. Please be informed if the

particular strain that is airborne will affect both the foliage and the tuber. In 2009 we lost the foliage but the tubers were fine as we waited with harvesting until all foliage was decomposed (phytophtora can only survive on living tissue).
- When potatoes flowers, ensure there is abundant moisture available as this is a critical stage in their development.
- Mow down any weeds after foliage have died down (usually caused by leafhoppers) to avoid weeds from taking over. Use the flail chopper as this will suck up any weeds or foliage that has died down.
- Organic Production and IPM Guide for Potatoes

Cover Cropping / Under-Seeding Procedures
- Potatoes are followed by rye and vetch.

Pumpkin
Cucurbita pepo (Cucurbitaceae or cucumber family)

Soil Preparation
- Pumpkins should not be followed after other cucurbits, nightshades (phytophtora capsici), but follow well after cole crops, and leguminous green manure or sweet corn.
- Pumpkin and Squash Fertility Management
- Compost is incorporated and Pumpkins are planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-160	6.0-6.4

Varieties
- Baby Pam, Baby Bear

Greenhouse Guidelines
- **EZ Seeder** seeding plate **#5** or seeded by hand

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	75	75	Withhold water	Take outside 1 week before planting in field

Signs to watch for & what to do
- Pumpkins grow fast. Make sure they can go in the field without becoming leggy.

Transplant readiness indicators
- When plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the field.
- Cover plants with Surround® WP (Kaolin clay) before planting by diluting 8 lbs of clay in 3 gallons of water. Dunk plants in mixture or spray on with backpack sprayer. Do not add spreader sticker to solution.

Water wheel Planter

Rows	In-Row	Planting Depth	Notes
1 Row	12 in.	Same level as potting medium	Add kelp to water as ½ % solution in the water wheel planter.

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Shoe Depth	sprocket setting
MaterMacc	**1**	1	**9 H 4.5**	½ inch	**22 - 18**

Cultivation Procedures:
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator.
- Cover wheel tracks with rye straw at a rate of 3lb per foot. (one 600 lb round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow release fertilizer later in the season.

Frost, Disease and Insect Protection

- Choose less susceptible varieties to powdery and downy mildew varieties.
- Powdery and downy mildew (somewhat) is controlled with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate) at a rate of 2 Qt of Cease and 1 lbs of Milstop per acre. Melons are sensitive to Sulfur (phytotoxicity) so great care should be taken if Sulfur (in whatever form) is applied to control PM.
- Cucumber beetle is difficult to control. Spraying them every 5-7 days with PyGanic EC 5.0II mixed with Nu-Film P as adjuvant/spreader sticker to the acre has some effect. Check pH of water which has to be neutral. Spray only in the evening as PyGanic breaks down under UV.

Radish

Raphanus sativus (Brassicaceae or cabbage family)

Soil Preparation

- Radishes should not be followed after other cole crops.
- Compost is incorporated and radishes are planted on raised beds.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
50	0-125	0-200	6.0-6.4

Varieties

- Crunchy Royale, Sora, French Breakfast, and Read Meat (for watermelon radishes)

Direct Seeding Information

	Rows	Seeds/Ft	Plate #	Depth	Notes
Planet Jr.	**5**	15	8	2-4	Use row-covers after planting for flea beetle control
Sutton Jr.	**5**	20	16	¼ -½ inch	1 mph or 1.6 kmph
Jang	**5**	12	X12 or X24		

Number of successions

- Spring 2-3
- Fall: several successions starting Aug 1 until September 21.
- Watermelon radishes for storage are planted in mid to late August.

Cultivation Procedures

- Radish follows well after winter cover crop of oats and peas or when no cover crop was planted that winter. Planet Jr. seeders and fine seeded crops like radish do not deal well with plant debris on soil surface.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basket weed once

Frost, Disease and Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Cover with floating row covers or insect netting before emergence to avoid flea beetle damage (for earliest plantings).
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.

Other Cultural Practices

- Early crops can be followed by fall lettuce or spinach.

Rutabaga

Brassica napus (Brassicaceae or cabbage family)

Soil Preparation

- Rutabaga should not be followed after other cole crops.
- Total Nutrient uptake is 165 lbs of N, 10 Lbs of P, and 200 lbs of K.
- Compost and SulPoMag is incorporated and rutabaga is planted on raised beds.
- Soil test will determine if additional K is needed. Boron can be added with the SulPoMag to optimize Boron distribution. If SulPoMag is not needed, distribute boron through a water solution with a sprayer at 50 GPA whereby 18 lbs of Solubor is diluted per 50 gallons of water.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
60	0-125	0-200	6.0-6.4

Varieties

- Laurentian

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
Tray **72-98-128**	75	65-75	Withhold water	Take plants outside 1 week before planting in field

Signs to watch for & what to do:

- Yellowing and purpling. Rutabaga doesn't make a strong transplant. Needs pampering. Feed with fish when plant shows distress.

Transplant readiness indicators:

Plants should easily come out of their cell. Plants should generally not be older than five weeks

Transplanter

Rows	In-Row	Planting Depth	Notes
3	9 in.	Same level as medium	Use 9-inch sprocket

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Depth	Notes
Planet Jr.	**3**	25	**1-2**	Depth 2	Only use regular shoe!
MaterMacc	**3**	3	**24 H 1.0**	¼ -½ inch	Sprocket **22-17**
Jang	**3**	12	**Y 12**		10 rear 14 Front

Cultivation Procedures:

- Lely or basket weed 7-10 days after transplanting.
- Hand hoe in between plants if basket weeder is used.
- Second cultivation use the Bezzerides spring hoes with knives in the back.
- Third cultivation use them in combination with the spider gangs and hill without burying the plants or alternatively use the Lilliston Cultivators without allowing them to bury the crop.

Frost, Disease and Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.

- Cover with floating row covers or insect netting before emergence to avoid flea beetle damage.
- Control flea beetles with Spinosyn based product at 1.25-2.5 Oz per acre every 5 –7 days not to exceed three sprays. Read label carefully. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- If cabbage looper/worm population is over 2 worms per plant, spray Dipel, or Entrust at (total amount per season per acre not to exceed 9 Oz).

Cover Cropping / Under-Seeding Procedures:
- Rutabaga is harvested too late to be followed with a cover crop.

Scallions

Allium cepa (Alliaceae or onion family)

Soil Preparation
- Compost is incorporated and scallions are planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-200	0-200	6.0-6.4

Varieties
- Ishikura, Nabechan

Greenhouse Guidelines: EZ Seeder seeding plate #16

Tray	Germ. @	Grow @	Hardening Off	Notes
128	60 -85	60-65 d 55-60 n	Withhold water	7-9 Seeds per cell. Take plants outside 1 week before planting in field

Signs to watch for & what to do:
- Yellowing; broadcast Vermont Compost's Forte Plus on cells.
- Poor growth; don't over water. Scallions stay in the greenhouse longer than they might like to. Algae might form over time if the plants are kept too wet, and potassium and nitrogen leach out

Transplant readiness indicators:
- Plants come easily out of cell without soil falling off.

Number of successions
- All season long starting early spring going into the fall starting off on a 14-day interval, followed by 12 days, 10 days, 9 days, 8 days and after that weekly seedings. Last seeding is generally in August.

Transplanter

Rows	In-Row	Planting Depth	Notes
3	5 in.	Not too deep. Same level as potting medium and a little below	Use 5-inch sprocket

Cultivation Procedures
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basketweed 7 to 10 days after planting. Cover row 2 and 4 with chisels mounted on Basketweeder or side knives mounted on rear toolbar.
- Hand hoeing in between plants
- Use finger weeders or Springhoes for second cultivation with rear mounted S-tines in wheel track and side knives in between rows.

Frost, Disease and Insect Protection

- Scallion's insect pest is thrips, which is controlled with Entrust. Alternatively, garlic oil or Stylet JMS oil (without adding an adjuvant) can be used as it smothers the nymph. Spray late in the evening when the thrips emerges from the bottom of the plants as feeding takes place at night. Irrigation with larger droplets (at night) works also very well to wash the thrips off. During years of heavy rain, thrips are less of a problem.

Other Cultural Practices

- Scallions are followed by another cash crop or a cover crop like oats and peas. Scallions provide good conditions for a second crop to be seeded, since very little crop residue is left after harvest. Spade after harvest.

Spinach

Spinacia oleracea (Chenopodiaceae or goosefoot family)

Soil Preparation

- Total Nutrient uptake is 100 lbs of N, 12 Lbs of P, and 100 lbs of K
- Compost is incorporated and spinach is planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
125	0-170	0-200	6.5-6.7

Varieties

- Space, Equinox (OP), Kolibri, Gazelle (for winter production), reflect (heat resistant) Add T 22 (Trichoderma harziana) to planter box to avoid damping off

Direct Seeding Information

	Rows	Seeds/Ft	Plate #	Depth	Notes
Planet Jr.	**5**	50	**20**	2-4	Mix with T22 to avoid damping off
Sutton Jr.	**9**	25	**18**	¼ -½ inch	0.8 mph or 1.3 km
Jang	**5**	25	**F24**		14 Front and 9 Rear sprocket

Number of successions

- Spring 3
- Fall 5

Cultivation Procedures:

- Spinach follows well after winter cover crop of oats and peas or when no cover crop was planted that winter. Planet Jr. seeders and fine seeded crops like spinach does not deal well with plant debris on soil surface.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- After emergence basket weed once if seeded on 5 rows.

Frost, Disease and Insect Protection

- Choose white rust resistant or tolerant varieties. Make sure high fertility is available before planting.
- Organic Production and IPM Guide for Spinach

Cover Cropping / Under-Seeding Procedures:

- Spinach either follows or precedes other vegetables like lettuce, mustard. Etc.

Summer Squash/ Zucchini

Cucurbita pepo (Cucurbiticeae or cucumber family)

Soil Preparation

- Squash should not be followed after other cucurbits, nightshades (phytophtora), but follow well after cole crops, and leguminous green manure or sweet corn.
- Compost is incorporated and squash is planted on high raised beds covered with plastic mulch.
- Soil test will determine if additional K is needed. Apply all additional N and K needed through hopper on mulch layer.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-160	6.0-6.4

Varieties

- Green: Dunja, Raven, Desert
- Yellow: Slickpick, Sunray, Sunburst

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#5**

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	75	75	Withhold water	Take outside 1 week before planting in field

Signs to watch for & what to do

- Squash grows fast. Make sure they can go in the field without becoming leggy. Leggy plants suffer and can perish in the summer heat

Transplant readiness indicators

- When plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the field.

Number of successions

- 3

Water wheel planter

Rows	In-Row	Planting Depth	Notes
1	12 in.	Same level as potting medium	Plant with abundant water mixed with kelp @ ½ gallon per 100 gallons of water. Keep a walking break in the plantings. Skip two plants every 100 feet to allow for path.

Cultivation Procedures:

- In the rotation plastic mulch culture ideally follows any crop that will not leave much plant matter especially stalks like cabbage or corn. Early established oats and peas will require mowing before the winter to avoid clogging up of mulch layer.
- IRT plastic is the preferred plastic to help warm the soil for first planting then use black mulch followed by bare ground.
- After transplanting, cultivate once or twice in between plastic and cover wheel tracks with rye straw at a rate of 3lb per foot or alternatively use weed fabric secured by sandbags. (One 600 lbs. round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release fertilizer later in the season.

Frost, Disease and Insect Protection

- Use floating row covers against frost for early plantings, consider keeping it on to protect against cucumber beetle. Support row cover every 4 feet with 10-gauge wire to prevent damage by abrasion. Remove at flowering, for varieties that require pollination. Some varieties (like Partenon) are parthenocarpic and will not require pollination.
- Watch for cucumber beetle and squash bugs with later plantings. When row covers are not used, cover plants with Surround® WP before transplanting. Use motorized backpack sprayer to apply mixture (read label). Cucumber beetle is difficult to control. Spraying them every 5-7 days with PyGanic EC 5.0II at 6 to12 Oz with 1 pint of Nu-Film P as adjuvant/spreader sticker to the acre has some effect. Add some feeding/attractant stimulant like molasses and milk for greater effect (1 lb per acre).

- As soon as squash bug larvae infest one planting disc in the crop or remove plants from field. High density should take care of possible losses but the main loss in this crop is secondary which is viral. Select virus resistant varieties.
- Also select less susceptible varieties to powdery and downy mildew varieties.
- Powdery and downy mildew (somewhat) is controlled with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate) at a rate of 2 Qt of Cease and 1 lbs of Milstop per acre. Melons are sensitive to Sulfur (phytotoxicity) so great care should be taken if Sulfur (in whatever form) is applied to control PM.

Other Cultural Practices

- Remove plastic soon after harvest to avoid buildup of squash bugs. Establish a cover crop soon after disking in the remainders of the straw and plants.

Squash, Winter

Cucurbita pepo (Acorn, Spaghetti, Delicata) Cucurbita maxima (Kabocha, Hubbard) Cucurbita moschata (Butternut) All belonging to the Cucurbiticeae family

Soil Preparation

- Winter squash should not be followed after other cucurbits, nightshades (phytophtora capsici), but follow well after cole crops, and leguminous green manure or sweet corn.
- Pumpkin and Squash Fertility Management
- Compost is incorporated and squash is planted on raised beds or flat ground either covered with plastic mulch or without.
- Alternatively, squash can be planted through a rolled and crimped cover crop like rye or triticale with vetch. To ensure good weed control plant cover crop in early September at a rate of 100 lbs. of rye and 20 lbs. of vetch. Take soil test in preceding year and fertilize to provide nutrients for both the rye and the vegetable crop. To properly kill vetch, utilize a no till planter (without seed in the box) and slice the cover crop with the coulters of the drill.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-160	6.0-6.4

Varieties

- 2018 Variety Trial
- Delicata, Bon Bon, Carnival, Chieftain Butternut, Royal Ace, Sunshine.

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#5** or seeded by hand

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	75	75	Withhold water	Take outside 1 week before planting in field

Signs to watch for & what to do

- Winter Squash grow fast. Make sure they can go in the field without becoming leggy.

Transplant readiness indicators

- When plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the field
- Cover plants in Surround® WP (Kaolin clay) before transplanting to protect against cucumber beetle. Dunk complete trays in mixture or apply with backpack sprayer. Do not use a spreader sticker. The irritation of the clay makes the SCB look for different habitat.

Water wheel Planter

Rows	In-Row	Planting Depth	Notes
1	12 in.	Same level as potting medium	Add kelp to water as ½% solution in the water wheel planter.

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Shoe Depth	sprocket setting
MaterMacc	**1**	1	**9 H 4.5**	½ inch	**22 - 18**

Cultivation Procedures

When not set in plastic:

- Torsion gangs as primary tool with the help of knives mounted behind the tractor.
- Make several passes and hoe the remainder out by hand
- If squash bugs is not a problem over-seed with a 50/50 mixture of red and sweet clover of 20 lbs to the acre after final pass.

When set in plastic:

- Cultivate twice in between plastic with Hillside Cultivators and cover wheel tracks with rye straw at a rate of one bale per 35 feet of wheel track.

Disease, insect Protection and other cultural practices.

- Watch for cucumber beetle. High density should take care of possible losses. Avoid buttercup varieties.
- Cover plants with Surround® WP before transplanting to protect against cucumber beetle. Use motorized backpack sprayer to apply mixture (read label)
- Watch cucumber beetle and squash bugs with later plantings. Cover plants with Surround® WP before transplanting. Striped cucumber beetle is difficult to control. Spraying them every 5-7 days with PyGanic EC 5.0II at 6 to12 Oz with 1 pint of Nu-Film P as adjuvant/spreader sticker to the acre has some effect. Add some feeding/attractant stimulant like molasses and milk for greater effect (1 lb per acre).
- As soon as squash bug larvae infest one planting disc in the crop or remove plants from field. High density should take care of possible losses but the main loss in this crop is secondary which is viral. Select virus resistant varieties.
- Also select less susceptible varieties to powdery and downy mildew varieties.
- Powdery and downy mildew (somewhat) is controlled with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate) at a rate of 2 Qt of Cease and 1 lbs of Milstop per acre. Melons are sensitive to Sulfur (phytotoxicity) so great care should be taken if Sulfur (in whatever form) is applied to control PM.
- Organic Production and IPM Guide for Cucumbers and Squash

Sweet Potato

Ipomoea batatas (Convolvulaceae or Morning glory family)

Soil Preparation

- Considerations when planting sweet potatoes
- How to grow sweet potatoes
- Total Nutrient uptake is 140 lbs of N, 20 Lbs of P, and 200 lbs of K
- Compost and a source for potassium like SulPoMag or sulphated potash is incorporated, and sweet potatoes are planted on high raised beds covered with plastic mulch or on ridges. Many soil tests on commercial vegetable operations have excess phosphorus levels.
- Sweet potatoes do not well when nitrogen is applied before planting. Using a slow-release compost like feather-meal is advisable

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
75	0-300	0-350	5.0-6.8

Varieties

Plants are bought in as slips (bare root)

- Covington is the standard orange variety. Beauregard and Georgia Jet are old standards. Mirasaku is a purple variety with white flesh and resistant to wire worms. Averre is a new promising high yielding variety but not as disease resistant as Covington

Transplanter

Rows	In-Row	Planting Depth	Notes
2	12 in.	Plant deep for highest yield! All roots should be firmly underground without burying the growing point.	Plant slips right away after receiving order; do not store them in cooler or set them in water! Irrigate after planting

Cultivation Procedures

When not set in plastic:

- Basket weed for first cultivation.
- Use the torsion weeders for all other cultivation with the aid of knives in the back. No hilling.
- Make several passes and hoe the remainder out by hand

When set in plastic:

- Add feathermeal or other slow-release N source to the soil at a rate of 500 lbs per acre when laying plastic.
- Cultivate twice in between plastic with**.** but do not cover wheel tracks with rye straw as mice will cause too much damage on the roots (they love the cover of the rye mulch).

Frost, Disease and Insect Protection

- Check soil for wireworms as yield can be declined at high populations.
- Sweet potatoes perform better at close spacing (maximum 12 inches in the row)
- Protect the crop from deer damage by putting up a temporary fence. Bait with peanut butter and complete project in one day, as the element of surprise is the only thing that makes this tool effective.
- Mow foliage and harvest tubers before soil temperature dips below 60˚ F
- Cure tubers at 85˚ F in greenhouse for one week
- Store tubers at 55˚ F. If tubers are stored below 55˚ F the develop hard spots, don't taste as sweet, and will not keep well.
- Post-harvest handling of sweet potatoes

Cover Cropping / Under-Seeding Procedures

- Sweet potatoes are usually followed by rye and hairy vetch.

Tatsoi

Brassica rapa (narinosa group) (Brassicaceae or cabbage family)

Soil Preparation

- Tatsoi should not be followed after other cole crops.
- 10 ton of compost is sufficient for P but is usually insufficient in nutrients for N and K.
- Compost and is spaded in tatsoi is planted on a raised bed.
- Soil test will determine if additional K is needed.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
120	0-160	0-200	6.2-6.5

Greenhouse Guidelines: EZ Seeder seeding plate #16

Tray	Germ. @	Grow @	Hardening Off	Notes
128	65-75	65-75	Withhold water	Take plants outside 1 week before planting in field

Transplant readiness indicators:

- Plants should easily come out of their cell. Plants should generally not be older than five weeks

Lännen Transplanter

Rows	In-Row Planting Depth	Notes
3	5 inches	Normal Soil level even with potting medium

Direct Seeding Information

	Rows	Seeds/Ft	Plate #	Shoe Depth	Notes
Planet Jr.	**3-5**	22	**2**	Depth 2	Spreader shoe
Sutton Jr.	**9**	30	**6**	¼ inch	1 mph or 1.6 km
Jang	**3-5**	12	**YYJ 12 or YX12**		14 Front by 10 Rear

Number of successions

- **5**

Cultivation Procedures for five rows

- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basketweed 7 to 10 days after planting. Cover row 2 and 4 with chisels mounted on Basketweeder or side knives mounted on rear toolbar.
- Hand hoeing in between plants
- Use Springhoes for second cultivation with rear mounted S-tines in wheel track and side knives in between rows.

Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Control flea beetles with Entrust at 3 oz per acre every 5 –7 days not to exceed three sprays. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.
- Look for eggs of cabbageworm/cabbage looper at the underside of leaves. When small worm population is over 2 per plant spray Bt using 1 to 2 pints to the acre or spinosad (Entrust) at 1-3 Oz per acre every week until population is under control. Alternate spraying schedule by using Bt aizawi or Bt kurstaki in conjunction with spinosad at 1-3 Oz to the acre to avoid build up of resistance. (Total amount of Entrust per season per acre should not exceed more than three applications with a total of 9 Oz.).

Other Cultural Practices

- Early crops can be followed by fall lettuce or spinach. Mow plants down as low as possible with flail mower. Incorporate crop residue with spader when followed with other cash crop.
- Late crops can be harvested into November and are not incorporated before the winter.
- When machine harvested cut tatsoi before it gets tall as the lower leaves turn yellow in a matter of days after the crop reaches prime condition.

Tomato

Solanum lycopersicum (Solanaceae or nightshade family)

Soil Preparation

- Total Nutrient uptake is 180 lbs of N, 21 Lbs of P, and 280 lbs of K
- Compost is incorporated and tomato is planted on high raised beds covered with plastic mulch.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-200	0-240	6.0-6.4

Varieties

- Tomato variety trial 2020
- Tomato taste trial 2009
- Popular with growers:
    - Early Red: Polbig, Early Cascade (Alternaria tolerant), Early Girl, New Girl.
    - Midseason Red: Celebrity (sweet and good tolerance for diseases), Tastilee
    - Late Red: Mountain Fresh Plus, Mountain Merit (Alternaria resistant)
    - Small plum: Juliet (high disease resistance and great flavor), Golden Rave, and large cherry: Mountain Magic
    - Heirloom: Valencia, Nepal, Brandywine
    - Plum: Plum Regal, San Marzano

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
288	75-90	60-70	Withhold water	Take plants outside 1 week before planting in field

Signs to watch for & what to do:

- Repot into Winstrip 50's, 38 pro-trays or in 4-inch pots when true leaves are developed.
- Brush plants with broom to get stocky seedlings once a week.
- Don't over water and keep them lean with nutrients. Don't let them turn yellow.
- Space 50's trays as in checkers to get more light on the plants.

Transplant readiness indicators

- When plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the field so increase light (by moving them outside) and reduce watering.

Number of successions

- 3

Water wheel planter

Rows	In-Row	Planting Depth	Notes
1	24 in.	As deep as possible	Add kelp to water as ½% solution in the water wheel planter. Keep a walking break in the plantings. Skip two plants every 100 feet to allow for path.

- Make sure to paint four feet "walking break" on the plastic mulch every hundred feet to allow for later easy removal of tomatoes. Do not plant anything in the "break". Absence of this break will make picking of tomatoes a very arduous task as buckets or trays have to be handed over the trellis.

Cultivation Procedures

- In the rotation plastic mulch culture follows after a cover crop of oats
- First planting in IRT plastic, second and third on black plastic or bare ground
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator and cover wheel tracks with rye straw at a rate of one 3lb round bale per foot. (One 600 lb round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release fertilizer later in the season.

Staking

- For staking use 6 feet stakes and T posts for indeterminate varieties (Juliet, Golden Rave, Mountain Magic), 5 feet posts for semi-indeterminate (Mountain Spring) and 4 feet stakes and T posts for determinate (Defiance, Regal Plum). Use a post pounder to pound in the stakes and T posts every other plant (4 feet apart) and avoid puncturing the drip tape.
- The first string should be about 10 inches above the soil and should be strung when the plants are 12 to 15 inches high. A "stringing tool" is used to pass the string along one side of the row, looping the string around each stake. Use the end of a broom handle with a eye round on the top to aid in trellising. Use twine that is in cardboard box attached to your belt and thread it through the eye round. Hold the twine steady by sliding it between your hand and the stick.
- It is important to keep the twine tight. Proceed to the end of the break and return on the opposite side passing the string along the other side of the plants, again looping each stake. It is helpful at the first stringing to cross the string between plants. Subsequent strings should be put up as the plants grow in order to maintain a well-trained system. 4 to 6 stringing's are needed (depending on length of stake), each about 6 to 10 inches higher than the preceding one.

Frost, Disease and Insect Protection

- Staking greatly improves plant health but the thick mulch of rye straw also reduces plant diseases. While it will not prevent a late blight outbreak, the practice of tolerant or resistant varieties in combination with plastic mulch and heavy rye straw mulch greatly reduces disease pressure. Some of this is due to release of both K and Silica out of the mulch into the plants at the time they need it most.
- Don't remove any suckers on determinate plants. Plant the three plantings in different parts of the field to avoid contamination and plant each planting away from the prevailing wind (west).
- When late blight (phytophtora), early blight (Alternaria), grey mold (Claudosporium), Leaf spot (Septoria), or bacterial speck are a problem control this with a weekly spray Nordox 75 (CuO), or NuCop50 (CuOH) mixed with JMS Stylet Oil Regalia (Reynoutria sachalinensis). Apply with 32" drops on the boom to achieve better penetration of foliage. Drops have two nozzles that spray to one side. Each row is covered by two nozzles on the boom and four nozzles coming from each side from a drop. Do not spray when winds are over 2 mph to avoid drift.

Other Cultural Practices

- Remove stakes out of the field and store in the greenhouse
- Late Tomatoes are generally harvested until October and do not provide good conditions for a successful cover crop establishment.
- Early tomatoes are followed with oats and peas after removal of plastic and plant remnant incorporated with disc.

Tomato, High Tunnel Production

Solanum lycopersicum (Solanaceae or nightshade family)

Soil Preparation

- Total Nutrient uptake is 180 lbs of N, 21 Lbs of P, and 280 lbs of K
- Compost and fertilizer is incorporated and tomato is planted on raised beds
- After tissue analysis, determine if plants need additional fertilizer is needed. Low Nitrogen levels can be adjusted by injecting dissolved AllGanic (15-0-2) through a drip line.
- Low Potassium levels can be adjusted by injecting dissolved AllGanic (0-0-52-18)

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-200	0-240	6.0-6.4

Varieties

- Tomato variety trial high tunnels
- Caurulina
- Red: Caurulina, Geronimo, Polbig
- Yellow/orange: Beorange
- Purple: Marnero
- Striped: GinFizz

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#16**

Tray	Germ. @	Grow @	Hardening Off	Notes
288 or strip trays	75-90	60-70	Withhold water	Hard plants off in tunnel 1 week before planting

Signs to watch for & what to do:

- Repot into Winstrip 50's, 38 pro-trays or in 4-inch pots when true leaves are developed.
- Brush plants with broom to get stocky seedlings once a week.
- Don't over water and keep them lean with nutrients. Don't let them turn yellow.
- Space 50's trays as in checkers to get more light on the plants.
- Many high tunnel producers graft their plant on rootstock to improve plant health

Transplant readiness indicators

- When plants have enough of a root-ball to hold the pot together. Plants that are lush do not perform well in the tunnel so reduce heat (by moving them in the unheated tunnel) and reduce watering.

Number of successions

- Only one

Hand planting: rows are generally 4 -5 feet apart

Rows	In-Row	Planting Depth	Notes
1	12-24 in.	As deep as possible	Plants have one or two leaders. When plant have two leaders plants are set at 24 inches giving the leaders 12 inches

Trellising

- Determinate varieties can still be grown with the traditional Florida weave system.
- Indeterminate varieties are trained to 1-2 leaders on a string trellising system.
- Diligent pruning to a strong Y on determinates and removal of all suckers indeterminates is essential to keeping plants manageable.

Frost, Disease and Insect Protection

- Growing tomatoes in a tunnel greatly improves plant health. While it might prevent late blight other diseases like Powdery mildew, but also Leaf Molds (Fulvia), and Septoria leaf spot, as well as Sclerotinia (timber rot) and Botrytis can become an issue. The practice of tolerant or resistant varieties in combination with good sanitary practices greatly reduces disease pressure.

- Pruning and air circulation are the primary defenses against tomato foliar problems. Leaf molds can be controlled with resistant and immune cultivars. Powdery mildew is partially controlled through genetics, but weekly foliar sprays of Milstop has proven to be effective,
- Tomato hornworm can be an issue in high tunnel production. They can be either handpicked or sprayed with Bt
- Two spotted spider mites and aphids

Turnip

Brassica rapa (Brassicaceae or cabbage family)

Soil Preparation

- Turnips should not be followed after other cole crops.
- Compost is incorporated and turnips are planted on raised beds.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
60	0-125	0-200	6.0-6.4

Varieties

- Hakurei for bunching
- Purple Top White Globe for winter storage

Direct Seeding Information

	Rows	Sds/Ft	Plate #	Depth	Notes
Planet Jr.	**3**	35	**1-2**	Depth 2	Only use regular shoe!
MaterMacc	**3**	12	**96 H 1.0**	¼ -½ inch	Sprocket **22-17** for storage turnips
Jang	**3**		**YX 24 or YYJ 24**		14 Front by 10 Rear for bunching turnips, 13 Rear 10 Front for storage turnips

Number of successions

- Spring 2-3
- Fall 1-2

Cultivation Procedures

- Turnip follows well after winter cover crop of oats and peas or when no cover crop was planted that winter.
- Prepare seedbed one to two weeks in advance, shallowly stale seedbed before planting to eradicate weeds if possible. Do not disturb soil too deep as new weed seeds will be brought up.
- Basketweed 7 to 10 days after planting. Cover row 2 and 4 with chisels mounted on Basketweeder or side knives mounted on rear toolbar.
- Use Springhoes for second cultivation with rear mounted S-tines in wheel track and side knives in between rows.
- Hand weeding is not necessary as turnips develop quickly to shade out in row weeds.

Insect Protection

- Blackrot (Xanthamonas) is controlled by purchasing clean seeds, keeping the greenhouse clean and by exposing seed to hot water treatment. Many organic seed suppliers are treating their seeds these days, so please check as double treatment can affect the germination.
- Consider the use of floating row covers against flea beetle until harvest, especially in hot dry weather. Otherwise control flea beetles with Entrust at 3 oz per acre every 5 –7 days not to exceed three sprays. Beneficial nematodes to control flea-beetle grubs can be sprayed on heavily infected land to avoid future generations. Flea beetles tend to overwinter in nearby hedgerows and grass strips.

Other Cultural Practices

- Turnips can be grown before or after another vegetable or does very well after vetch or can be followed with a variety of cover-crops in the spring.

Watermelon

Cirullus lanatas var. lanatus (Cucurbitaceae or cucumber family)

Soil Preparation

- Melons should not be followed after other cucurbits, nightshades but follow well after cole crops, and leguminous green manure or sweet corn.
- Compost is spaded in and melons are planted on high raised beds covered with plastic mulch.

Common Recommended fertilizer rates in New York (2019 Nutrient Guidelines for Vegetables)

Nitrogen	Phosphorus	Potassium	pH
100	0-160	0-160	6.0-6.4

Varieties

- Sugar Baby, New Orchid

Greenhouse Guidelines

- **EZ Seeder** seeding plate **#5**

Tray	Germ. @	Grow @	Hardening Off	Notes
38 or 50	80-90	85	Less water and temp for 1 week	Start seeds when greenhouse can be kept warm day and night. Germination is poor at lower temperatures.

Signs to watch for & what to do

- Poor growth; keep the greenhouse warmer.

Transplant readiness indicators

- Transplant out of Tray **50**'s when plant formed two true leaves
- Transplant in the field when plants have enough of a root-ball to hold the pot together. When they don't, they will be damaged and have a high fatality rate. Plants that are lush do not perform well in the field.
- Dissolve Actinovate® SP or Regalia with Surround (Kaolin Clay) in plenty water and drench complete tray in solution before transplanting to help resist cucumber beetle damage.

Number of successions

- 3

Waterwheel Transplanter

Rows	In-Row	Planting Depth	Notes
1	12 in.	normal	Add kelp to water as ½% solution in the water wheel planter.

Cultivation Procedures

- In the rotation, plastic mulch culture follows after sweet-corn and a cover crop of oats and peas. After spading plastic is laid. As melons are a tropical fruit, IRT plastic is the preferred plastic to help warm the soil. When laying the plastic add dried granular composted chicken manure to the soil at a rate of 500 lbs per acre.
- After transplanting, cultivate once or twice in between plastic with Hillside cultivator and cover wheel tracks with rye straw at a rate of one 3lb round bale per foot. (One 600 lb round bale covers 200 feet of wheel track). When an early cutting of orchard grass is used, increase that amount as hay breaks down much faster than straw. Hay can act as slow-release fertilizer later in the season.

Frost, Disease and Insect Protection

- Use floating row covers against frost for early plantings, consider keeping it on to protect against cucumber beetle. Support row cover with 10-gauge wire to prevent damage by abrasion. Remove at flowering, as watermelon requires pollination. When row covers are not used, cover plants with Surround® WP before transplanting. Use motorized backpack sprayer to apply mixture (read label). A 3-gallon sprayer takes about 4 -6 lbs of Surround. apply twice to get good coverage.
- Powdery and downy mildew (somewhat) is controlled with a mixture of Cease (bacillus Subtilis) and Milstop (Potassium Bicarbonate) at a rate of 2 Qt of Cease and 1 lbs of Milstop per acre.
- Melons are sensitive to Sulfur (phytotoxicity) so great care should be taken if Sulfur (in whatever form) is applied to control PM.