The Northeast Harvest Manual

A Crop-by-Crop Guide to Harvest and Post-Harvest Handling for Small- and Mid-Size Growers

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Mention of Certified Organic Products

Check with your certifier or the Organic Materials Review Institute (OMRI) that any products mentioned in these manuals are included in the OMRI list of approved products, as the list of approved products changes annually. Also, follow all label instructions carefully when using any product.

Available Online

Both this guide and its companion, the *Northeast Crop Production Manual,* are available online at www.sare.org/resources/northeast-crop-production-harvest-manual. Not available in print.

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Letter from the Author

In the 1990s, when Roxbury Farm (now known as Roxbury Farm CSA) was in its pioneering phase, apprentices were a key part of our workforce. One of our apprentices, Katie Smith (currently the co-owner of the Farm at Miller's Crossing in Hudson, N.Y.), complained, correctly, that it was difficult to learn how to farm through on-the-job instruction alone. Her sentiment reflected a broad dissatisfaction among apprentices with the lack of intentional training within apprenticeship programs. During my own farmer training in the Netherlands, our apprenticeships were guided by our schools and were supported by a strong theoretical foundation, so I knew we could do much better. In response, David Inglis of Mahaiwe Harvest CSA and I called together 13 other farmers in the Hudson and Pioneer Valleys for a meeting to reflect on what should be offered to an apprentice working on our farms. As our collective knowledge proved greater than what we could offer individually on our farms, the Collaborative Regional Alliance for Farmer Training (CRAFT) was born.

To provide our apprentices with better guidance, I decided to write down all the daily instructions for growing and harvesting our crops. This process spanned several years, and resulted in the first edition of the Roxbury Farm Crop and Harvest Manuals, published in 2001. Because I wrote them for our apprentices and employees, they referenced tools and methods specific to our farm. At the end of their employment, apprentices kept their own copies, which helped them during their own pioneering phase in building a new farm.

Over time, word got out about the manuals, and when apprentices from the other farms came for a CRAFT visit, many requested a copy. To offset printing costs and make them easier to share, I made the manuals available through our website. At conferences, people would often stop me and thank me for having made the manuals available, telling me it was one of the most important tools available to them in the early phase of their farming career.

The manuals went through several editions and continued to be written exclusively from the Roxbury Farm perspective. Roxbury Farm grew from a 5-acre vegetable operation in 1990 to a 370-acre farm producing vegetables, beef, and lamb for 1,100 CSA shareholders in 2005. In 2014, I left Roxbury Farm–which continues to thrive today under new ownership–to start a small-scale farm from scratch in the foothills of the Adirondacks, named Philia Farm. Here, our goal is to conduct research on the optimal practices in vegetable and vegetable seed production while providing fresh produce to a small local community.

This experience gave me a renewed appreciation of how scale affects production practices, and when I reread the manuals, I realized their limitations. In response, I applied for and received a grant from Northeast SARE in 2020 to update and broaden the manuals (project FNE20-950). This involved polling 60 exemplary farmers in New England and beyond about their production and harvest practices. Vegetable specialists from Cornell Cooperative Extension helped with the questionnaire and interpretation of the results. They also reviewed the final copies to ensure compliance with the Food Safety Modernization Act. This expansion prompted me to rename them the Northeast Crop Production and Harvest Manuals.

The *Northeast Crop Production Manual* includes tips on planning rotations, preparing the soil, planting and transplanting, and managing pests. It's most useful for organic farmers in the Northeast, and also for farmers in other parts of the country with a similar four-season climate. The *Northeast Harvest Manual*

addresses the timing and methods for harvesting crops, along with post-harvest handling and storage considerations.

The information in the latest edition of the manuals is written to be relevant to both mid-size and smaller-scale operations.

While the new manuals continue to be a bit Northeast-centric, I have tried to keep farmers all over the United States in mind. New links provide in-depth knowledge on specific topics or practices. These links were carefully selected to appeal to a broad audience.

I extend my sincere gratitude to all the participating farmers, extension specialists, and SARE staff for their support and valuable contributions over the years. We hope the following information will help your operation become more successful and allow you to adopt the most sustainable practices in your operation.

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Arugula

Yield	For wild arugula, expect to harvest an average of ⅓–½ lb. per bed foot when planted at 10–17 rows per bed. For regular arugula, expect to harvest an average of ¼ bunch per row foot when planted at 5–7 rows per bed, especially when arugula is over 8 inches tall.
Standards	**Harvesting*** Hand harvest 20–25 lbs. per hour, per person, for regular arugula. Add time when bunching the arugula, but the price per lbs. makes up for the extra cost in labor. Hand harvesting of wild arugula is about 8 lbs. per person, per hour. Machine harvest up to 300 lbs. per hour of wild arugula.
	Washing and sorting Depends on crop quality and washing equipment.
Tools and supplies needed	A handheld harvester, machine harvester or harvest knives, and rubber bands or twist ties (customer preference may influence this).
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Plants are 34-inches tall for salad or 6–10 inches tall for cooking greens or bunching.
- Plants are deep green and without pungency.
- Leaves shouldn't have excessive holes due to flea-beetle damage.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Move the crop from dirty harvest boxes to new clean ones after washing.
- Walk the fields before harvesting to inspect the crop for animal damage or feces. Mark these spots with a flag so the tractor operator or harvest crew can avoid harvesting near them.
- When machine harvested**:**
    - Weed the field thoroughly before harvesting as people on the machine won't be able to keep up with sorting at the speed of harvesting.
    - During harvest, remove all yellow leaves from the belt before they fall into the crates. When using a quick-cut harvester (e.g., Farmer's Friend), you'll sort after harvesting.
- When hand harvested with a knife:
    - Hold a small bunch of leaves at the top of the plant with one hand and cut with one motion using the other hand.
    - Shake vigorously to remove any yellow leaves or stems from previous cuttings.
    - Place the crop in a box with the stems facing the same direction.
    - Leave behind 1–2 inches for regrowth. For salad mix, the leaves should be small and tender. Cut high enough that only the leaf part is harvested.
    - For braising mix, the leaves can be larger and not as tender, but leave long stems behind.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer like hydrogen peroxide and peracetic acid to the water for the first washing or in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.

- Wash arugula at least twice and preferably three times in clean, potable water when a rinse conveyor vegetable washer is not available. You can use the last dunking of the arugula to hydrocool the product by adding ice to the water or pre-cooling it. Using a bubbler to agitate the water reduces damage to the leaves.
- Don't leave greens in water for longer than 1 minute. Leaves tend to get waterlogged after a few minutes, which causes them to deteriorate faster.
- Dry arugula in a centrifuge. There are different sizes and models of commercial-grade salad spinners available through restaurant equipment suppliers.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for arugula

Packing in the field	Plastic 1 ⅓-bushel boxes
Packing for delivery	3 lb. boxes for baby arugula or 24–30 bunches in 1 ⍰-bushel boxes weighing 18 lbs. for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. A clean box of choice for CSA distribution. Line the boxes with a plastic liner to avoid having the product lose moisture.
Storage	At 32°–41° and 95–100% humidity.

Basil

Yield	The yield greatly depends on the crop's quality and number of cuttings but is generally 1 bunch per row foot.
Standards	**Harvesting*** 60 bunches per person per hour.
	Washing Basil isn't washed.
Tools and supplies needed	Scissors and rubber bands or twist ties (customer preference may influence this)
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Plants are 10–15 inches tall and deep green.
- Plants have no signs of black spots (downy mildew) or damage from Japanese beetles.
- Harvest before frost.

Harvest and cleaning procedures

- Harvest basil in the late morning after any dew has evaporated.
- Wash hands and sanitize scissors before harvesting.
- Cut individual stems with scissors.
- Don't harvest flowering stems.
- If the crop has high field quality (no Japanese beetle damage or downy mildew) leave 3–4 inches behind for regrowth.
- Don't get basil wet. Don't harvest in the rain, since the leaves will turn black in storage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for basil

Packing in the field	Plastic 1⅓ bushel boxes
Packing for delivery	Pack 24 bunches in a sealed 1⅑ bushel box bunches for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. A clean box of choice for CSA or farmers market distribution. Line the boxes with a plastic liner to avoid having the product lose moisture.
Storage	Store at 50° and 95–100% humidity with good air circulation.

Beans, Snap

Yield	Yield depends greatly on varieties grown and whether hand or mechanically harvested. Growers report ⅓–¾ lbs. per row foot
Standards	**Machine harvesting*** Up to 375–500 lbs. per hour, with 1 person driving a tractor and a second person packing boxes. **Hand harvesting** 15–20 lbs. per person, per hour for Haricot Vert beans; 30 lbs. per person, per hour for regular green beans.
	Sorting If machine harvested, sorting on a vibrating sorting table is required, at between 500–750 lbs. per hour (with 4 people running the table).
Tools and supplies needed	A tractor pulling a 1-row bean picker, and large plastic boxes or buckets when hand harvested.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- It depends on the variety, but for machine-harvested beans you want optimum yield, whereby most pods are mature without starting to form any seed.
- Immature beans lower the overall yield and easily get damaged.

Harvest and cleaning procedures

- When hand harvested, you can harvest the plants several times, increasing the overall yield.
- Keep the stem intact when harvesting by hand.
- Bring beans in regularly to the packing shed or keep them in shade to avoid field heat accumulation and wilting.
- Wash hands before handling produce and boxes.
- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- When machine harvesting, dump beans on a conveyor belt that leads to a well-lit sorting line. Remove all broken beans, pin beans, beans with defects and stems that don't fall through the sorting line.
- Don't harvest when the plants are wet.
- If necessary, wash beans in cold water. Add a sanitizer like hydrogen peroxide and peracetic acid to the water for the first washing in the washing tub, or in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.
- Allow beans to dry before placing in storage, as any *Sclerotinia* (grey mold) and cottony leak (*Pythium spp.*) will quickly spread under wet conditions in the cooler.

Additional resources

- Snap Bean Post Harvest Factsheet
- Wholesale Grading and Packing Instructions
- U.S. Standards for Grades of Snap Beans
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for snap beans

Cleaning in the field	When machine picking, adjust the blower so only pin beans and leaves blow out of the stack.
Packing in the field	One person rides on the bean picker to switch boxes and to adjust the machine and signal to the driver to speed up or slow down, depending on yield and other conditions.
Packing for delivery	Pack beans in ½ bushel or 1 -bushel boxes at either 15 or 31 lbs. for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. Use a clean box of choice for CSA or farmers market distribution.
Storage	Store at 41–45° and 95% humidity but never under wet conditions or below 40°, to avoid chilling injury. Beans are moderately sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Beets

Yield	An average of 1 lb. of marketable beets per row foot, but much higher numbers have been reported.
Standards	**Harvesting*** It depends on size, but 175–200 lbs. per person per hour isn't unusual when picked by hand.
	Washing 350 lbs. per person, per hour, using a conveyor washer.
Tools and supplies needed	When picked by hand, use boxes, buckets and possibly a tractor with bulk bins. It's possible to use a carrot harvester as well.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-Harvest and quality indicators

- Beets are 2–3 inches in width.
- Beets are round and unblemished.

Harvest procedures

- Leave beets that have any defects (e.g., black cavities due to boron deficiency) in the field.
- By hand:
    - Wash hands before harvesting.
    - Twist the leaves off beets and pack the beets into buckets.
    - Place full buckets next to the harvest lane.
    - If bulk harvesting in 20-bushel bins, drive by with the bulk bin on a tractor and carefully dump the beets into the bulk bin.
- With a carrot harvester:
    - Speeds of conveyors and components will vary a great deal with field conditions. There is no prescribed speed at which to set the flow controls. However, there is an approximate start-up setting, and the operator needs to adjust as needed for conditions.
    - Adjust the machine's belt to the speed of the tractor and set the digging chisel to just below the roots.
    - Set the cutting height of beet tops at approximately 1–2 inches.
    - Most small carrot harvesters (that can also harvest beets) don't allow for a sorting platform. Most likely you will need to do additional sorting for damaged beets in the packing shed before long-term storage.

Washing and sorting procedures

- Wash hands and rinse boots before entering the wash-and-pack shed.
- Wash in a rinse conveyor washer, or use a brusher washer or barrel washer if the beets are very dirty. When using a rinse conveyor washer, add a sanitizer like hydrogen peroxide and peracetic acid to the water circulation tank.
- Sort by size and sort out culls at a well-lit sorting table.

Packing and storage summary for beets

Packing for delivery	Pack in 25 lb. plastic bags for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. Pack in any clean box of choice for CSA distribution or the farmers market.
Storage	At 32°–41° and 95–100% humidity.

Beets, Bunching

Yield	An average of ⅓ bunch of beets per row foot with some residual harvest of storage beets.
Standards	**Harvesting*** 30–60 bunches per hour per person.
	Washing 50–100 bunches per hour, depending on the method used.
Tools and supplies needed	Rubber bands or twist ties (customer preference may influence this), boxes and a rinse conveyor washer.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Beets are 2–3 inches in width with healthy tops (e.g., unaffected by *Cercospora*).

Harvest and cleaning procedures

- Wash hands before harvesting beets.
- Harvest in the morning hours to avoid field heat accumulation.
- Select beets out of rows, clean off the dead leaves and make bunches out of 3–5 beets, weighing between 1–1 ¼ lbs. Make sure the tops of the beets are even with each other, and wrap the twist tie or rubber band around the stems just above the beets.
- Leave beets that have black cavities on the roots due to boron deficiency in the field. Remove any leaves with *Cercospora* (leaf blight) injury.
- Hold the twist tie in place and twist the bunch to tighten the twist tie. It is important to have a neat and tight bunch for washing and distribution. All bunches should be uniform in size.
- Leave bunches in the wheel-track, putting them into piles of 4 bunches each. This makes it easier to box the product based on counts of 16-, 20- or 24-bunches per box.
- Don't bunch and count at the same time, as this can lead to mistakes in counting. Somebody should periodically pick up and box the piles to avoid overharvesting.
- When bunching isn't necessary, pull beets, and clean and pack them in a 1 ⅓-bushel box.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Lay beets out on a mesh table to spray them off by hand, or run them through a rinse conveyor washer. Regarding the last option, make sure you use the appropriate pressure on the nozzles to avoid damage to the leaves. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Some growers have connected a valve operated by a foot pedal to a stationary nozzle to free up a hand, which increases efficiency.

Additional resources

- U.S. Standards for Grading of Beets
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for bunching beets

Cleaning in the field	Pull off damaged or yellow leaves.
Packing in the field	Place bunches in multiples of 4 to facilitate transfer to boxes. Place beets into boxes in rows of 4 bunches, alternating the direction of each layer.
Packing for delivery	The boxes you use for delivery may be different than for field packing. The size depends on the customer, but wholesale is usually a 12- or 24-count in a 1 ⍰- or 1 ¾-bushel box. CSA delivery is often a 16-count in a 1 ⅓-bushel box. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack with ice in closed containers for storage longer than a week.

Bok Choy and Chinese Cabbage

Yield	An average of 1 head of marketable cabbage per row foot for bok choy and joi choi, when planted at 2 rows per bed. Mei qing choi has a similar yield per row foot when planted at 3 rows per bed.
Standards	**Harvesting*** 125–175 heads per person, per hour
	Washing 175 heads per person, per hour
Tools and supplies needed	Knives and 1 ¾-bushel or 1 ⅓-bushel plastic boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Bok choy and joi choi heads are 8–12 inches tall and 2–3 lbs. each, depending on the variety.
- Mei qing choi heads are harvested at about 1 lb. each.
- Heads are free from damaged or yellow leaves.

Harvest and cleaning procedures

- Harvest in the morning to avoid field heat accumulation.
- Wash hands and sanitize knives before harvesting.
- Use different boxes in the field than the ones you use for distribution.
- Slide the knife under the head and cut it off where the root meets the stem. Be careful to leave the head intact.
- When you cut properly and straight, the bottom of the head is nice and smooth.
- If the lower leaves are damaged or yellow, cut just above the lower leaves to leave them on the ground. Re-trim if your first cut did not leave behind a nice, smooth surface on the bottom.
- It's important to cut at the correct place so that all the excess leaves fall off. Stripping off leaves after cutting is incorrect. Cut a second time if you need to remove leaves.
- One person cuts the heads and another person counts and packs them.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Wash this crop only once, preferable with a hose (use potable water). If dunking is necessary to remove field heat or dirt, use the second dunking to hydrocool the product by adding ice to the water or having it pre-cooled.
- Add a sanitizer to wash water if dunking. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to water.
- Leave the heads in water until the core of the stems are properly cooled down.
- Pack them in sealed boxes to avoid having the product lose moisture during longer storage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for bok choy

Cleaning in the field	Remove dead and yellow leaves.
Packing in the field	12 heads per 1 ¾-bushel box
Packing for delivery	20 lbs. in 1 ¾-bushel boxes (for medium-sized heads) See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers or bags for storage that lasts longer than 5 days. Chinese cabbages are sensitive to ethylene exposure. Long-term exposure will turn green leaves yellow. Allow for good air exchange and don't store with crops that release ethylene.

Broccoli

Yield	An average of ⅓ bunch of broccoli per row foot for spring harvest. Expect higher yields in the fall.
Standards	**Harvesting*** 100 heads of broccoli (not including small ones) per person, per hour, all stripped of their leaves. Bunching takes place in the washing area.
	Washing Includes counting and possibly bunching, 200 bunches per hour.
Tools and supplies needed	Use a clean, sharp knife. Use picking crates plus enclosed boxes to transport to a washing shed.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- For a full head: Florets are dark green and still tightly bunched, each about 0.1-inch in size. Heads are usually domed. Once the florets are loose, they don't store very long and may flower in a cooler.
- Hot weather (86° in the day and over 77° at night) can cause broccoli to grow a sterile or deformed crown, resulting in an unmarketable product.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Harvest twice a week and with great care for optimum product.
- Don't harvest heads with traces of head rot or brown bead.
- Separate and discard any broccoli that might have been contaminated with bird feces.
- Don't expose broccoli to warm temperatures and make regular trips to the wash and pack shed during harvest.

Washing and sorting procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Place broccoli in room temperature water with an appropriate sanitizer to wash. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to water.
- Hydrocool broccoli in a washing tub filled with iced water to remove field heat. It is advisable to slowly cool down warm broccoli before exposing it to ice water, as the florets will absorb the water. Any contaminant in the water will then enter the broccoli.
- Smaller heads are bunched together with a strong rubber band, or they can be sorted out and counted at a higher rate per box if each head in the box is about the same size and weight.

Additional resources

- Wholesale Broccoli Packing
- Post Harvest Factsheet
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for broccoli

Cleaning in the field	Remove leaves from stems.
Packing in the field	Prevent any damage by handling broccoli very carefully in picking crates.
Packing for delivery	The standard is 14-count and 18-count bunches per 1 ⍰-bushel box, weighing 21 lbs. Customers accept 10-, 12- and 16-count as well. For loose crown cut, pack 10 or 20 lbs. in waxed ½- or 1 ⍰-bushel boxes. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. Use clean boxes of choice for a CSA and farmers market.
Storage	In a cooler at 32°, packed with ice when available. Broccoli is sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Broccoli Rabe

Yield	An average of ½ bunch per row foot
Standards	**Harvesting*** 40–50 bunches per person, per hour. When harvested loose, it's 75–100 lbs. per person, per hour.
	Washing 150–200 bunches per hour, which includes re-packing. Pass-through conveyor washers will increase efficiency.
Tools and supplies needed	Knives, rubber bands or twist ties (customer preference may influence this), and enclosed boxes.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- For mature harvest, the greens are 12–18 inches tall with small broccoli heads. For young, tender leaves, the greens are 8–10 inches tall.
- Leaves are dark green without any sign of yellowing or necrosis. Stems should be pale green on the inside without any sign of a white fibrous core.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Harvested broccoli rabe should be tender with no white core. To find the best cutting height, look at the cut stem to see if there is a solid-white core in the stem. If there is, cut a little bit higher on the stem.
- Bunch size is usually a large handful. Trim the stems evenly after bunching. Weigh bunches according to the customer's needs, but a bunch is usually about 1 lb.
- When packing bunches in a box, place 4 bunches per layer, all in 1 direction. For the next layer, place the bunches in the opposite direction of the one below. This allows for an even fill and makes it easier to close and stack boxes.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer like hydrogen peroxide and peracetic acid to the water for the first washing in the wash tubs or in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much peracetic acid solution to add to water.
- Wash rabe at least twice in clean tubs. The last dunking can be used to hydrocool the product by adding ice to the water or having the water pre-cooled.
- Don't leave bunches in water for longer than 1 minute or until the cores of the stems are properly cooled down. Rabe can get waterlogged after a few minutes, which causes it to deteriorate faster.
- Pack in sealed boxes or line the boxes with a plastic liner to avoid having the product lose moisture and to allow for longer storage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for broccoli rabe

Cleaning in the field	Remove dead and yellow leaves.
Packing in the field	16–24 bunches per box. The industry standard is 20-count boxes with each bunch weighing 1 lb.
Packing for delivery	20 bunches per 1 □-box for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Broccoli rabe tends to lose its water content rapidly, so pack in closed containers for storage longer than a few days. Broccoli rabe is sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Brussels Sprouts

Yield	An average of ¼-marketable stalk per row foot. This is when planted with a wide amount of spacing to avoid *Alternaria*.
Standards	**Harvesting*** 60 stalks per person, per hour
	Washing Don't wash brussels sprouts.
Tools and supplies needed	Long-handled pruning shears (loppers) and boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Sprouts are firm, solid and round without any sign of *Alternaria* on the center leaves of the sprouts.
- Some of the outer leaves can have some black spots, but clean these off during packing.
- Harvesting brussels sprouts after the first frost increases the sweet flavor of the sprouts.

Harvest and cleaning procedures

- Wash hands and sanitize pruning shears before harvesting.
- One person snaps the leaves off the stalks and removes the diseased sprouts at the bottom of the stalk. This person also snaps off the top of the stalk.
- A second person cuts the stalks with pruning shears and places them in a box.
- When the cutter catches up with the person snapping off the leaves, they can then count the stalks and pack them at 10–12 stalks per box.
- When sprouts are sold off the stalk: Remove all yellow and loose leaves, and trim the stem, leaving it straight and clean. Sort them to an average of 1.25 inches in diameter (no smaller than 1 inch and no bigger than 1.5 inches). Sprouts larger than 1.5 inches and smaller than 2.75 inches are sold as a different grade.
- Do not wash brussels sprouts.
- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Repack in a well-lit wash-and-pack shed into clean boxes for delivery.

Additional resources

- Wholesale grading and Packing Instructions
- Postharvest Factsheet Brussels Sprouts
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for brussels sprouts

Cleaning in the field	Remove leaves and diseased sprouts from the stalk.
Packing in the field	10–12 stalks in each 1 ¾-bushel box
Packing for delivery	10–12 stalks in each 1 ¾-bushel box for both wholesale and CSA When selling loose sprouts wholesale, pack 12 sprouts in 8 oz packages. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41°, 95–100% humidity. Brussels sprouts need good air circulation; don't pack them in closed containers for long-term storage. Brussels sprouts are sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Cabbage

(Green, Red, Savoy, Arrowhead and Mini)

Yield	Green and red: An average of ¾ marketable head to the row foot at 4–5 lbs each Arrowhead and mini: 0.6 heads per row foot at 2 lbs. each
Standards	**Harvesting*** 200 heads per person, per hour
Tools and supplies needed	Very sharp knives and regular 1 ⅓-bushel boxes or 20-bushel bulk bins
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Firmness is a better indicator than size. The heads should feel firm and the top of the head must be hard and solid. The basal stem has no hollow cavity.
- A good spraying program should avoid any presence of cabbage worms or damage by other insects at this point.
- Cabbage heads infected with *Alternaria* or black rot won't store and should not be harvested. Some *Alternaria* in older wrapper leaves might not affect long-term storage.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Cut heads with a few wrapper leaves to protect the head during transportation. Use clean and sharp cabbage knives that are only used for this purpose.
- Slightly push the plant to one side, and with a smooth motion, cut the cabbage high enough to remove the damaged leaves but to allow for a few healthy wrapper leaves to remain. The cut should be straight across.
- If harvesting for 1 delivery, count heads into regular boxes.
- If harvesting for bulk storage, first place them on windrows to be picked up later and placed in a 20-bushel bulk bin.
- If cut at the right height, no additional cleaning needs to be done before delivery. Remove any damaged leaves. Cleaning cabbage in the field greatly increases distribution efficiency.

Cleaning procedures

- Wash hands and sanitize knives before cleaning cabbage.
- Cabbage is not washed. If cabbage is coming out of storage it usually needs to be re-trimmed.
- Use very sharp knives. Place clean cardboard or a cutting board on a table, and place the cabbage on the table to trim. Make sure your cut is straight across.
- Peel the leaves from the bottom of the plant instead of from the top. When you cut at the correct height, the leaves will come off without much effort.

Additional resources

- Wholesale Grading and Packing Instructions
- Postharvest Factsheet Cabbage
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for cabbage

Cleaning in the field	Remove damaged leaves.
Packing in the field	10–15 arrowhead or 6–8 red cabbages in a regular box, or 800 lbs. in a 20-bushel bulk bin
Packing for delivery	45–50 lbs. in a cabbage box (1 ¾ bushels) for wholesale Use a clean box of choice for CSA distribution or a farmers market. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Cabbage needs good air circulation; don't pack them in closed containers for long-term storage. Cabbage is moderately sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Carrots, Bunching with Tops

Yield	An average of 0.4 bunch per row foot at 0.75 lbs per bunch, with a bunch containing 6–8 carrots.
Standards	**Harvesting*** 35–60 bunches per person, per hour
	Washing 80–100 bunches per hour if using a rinse conveyor washer. Otherwise, the rate depends on the method used.
Tools and supplies needed	A tractor with a bed lifter. Twist ties and regular 1 ⅓-bushel boxes. Use a digging fork or shovel if harvesting manually.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Carrots have healthy, green tops, and carrots are typically 5–7 inches long (depending on variety), with filled tips.
- Always wait until they are sweet. Don't allow carrots to become over mature and grow fine root hairs. (This can be caused by over-fertilization or a nematode infection as well.)
- For best quality, plant several successions and harvest in a timely manner. Mature carrots suffer from *Alternaria* in the leaves, and the roots might get affected by carrot flies, which reduces flavor and quality.

Harvest procedures

- Wash hands before harvesting carrots.
- Harvest in the morning as soon as foliage is dry from any dew that collected on leaf surfaces overnight.
- Carrots are usually dug up with a bed lifter or tractor-drawn undercutter.
- If conditions don't allow for machine harvest, use digging forks or shovels to loosen the soil and pull up the carrots. Two people dig up the carrots while the rest of the crew pulls the carrots out of the ground and bunches them. Dig far enough away that you don't damage the carrots.
- Try to pull out enough carrots for 1 bunch with each pull. Remove any forked or misshapen carrots. Clean off any brown leaves.
- Put 6–8 carrots in each bunch (depending on variety), but make sure all bunches are similar in size, weigh 0.75 lbs, and that carrots are at least 5-inches long with a diameter of ½–¾ inch. Make sure the tops of the carrots are even with each other, and wrap a twist tie around the stems just above the carrots. Then twist the bunch to tighten the twist tie. It is important to have a neat and tight bunch for washing and distribution. If the bunches are loose, the carrots will break off during washing.
- When carrots are small, deviate from the standard of 6–8 carrots to ensure 0.75 lbs of carrots per bunch.
- Place bunches in piles of 6 to facilitate an even count of 12 or 24 to a box. If packing individually, orient carrots so they are parallel to each other in the container to avoid breaking carrots and to fill the container efficiently.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Clean bunching carrots by hand with a handheld nozzle and a wire mesh table. Some growers have connected a valve operated by a foot pedal to a stationary nozzle to free up a hand, which increases efficiency.

- Or run them through a rinse conveyor washer. Make sure you use the appropriate pressure on the nozzles to avoid crop damage. When carrots are very dirty remove the bottom pan at the infeed chain. Add a sanitizer like hydrogen peroxide and peracetic acid to the circulating tank.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for bunching carrots

Cleaning in the field	Remove forked or diseased carrots, and dead and yellow leaves.
Packing in the field	12 or 24 bunches in plastic crates
Packing for delivery	Pack roots with ice in ventilated containers for transport if not using a refrigerated truck. Don't allow foliage to come in contact with ice. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Carrot roots will retain more moisture if the tops are cut, leaving about 3 inches of foliage attached to the crown.

Carrots, Storage

Yield	Farmers in the Northeast reported an average of 1.2 lbs. of marketable carrots per row foot. Higher yields are possible in different regions or in soils with a deep rooting depth.
Standards	**Hand harvesting*** 100–250 lbs. per person, per hour. Three people can fill up a bulk bin in 1.5 hours at approximately 150 hours per acre. **Machine harvesting*** 500–2,000 lbs. per hour with 3 people and a one-row harvester. Numbers vary greatly due to the age of the machine and the conditions of the soil.
	Washing 300 lbs. per person, per hour.
	Bagging 50–100, 2-lbs. bags per person, per hour.
Tools and supplies needed	A tractor with a bed lifter, and either a 20-bushel bulk bin or ⅝-bushel buckets and regular boxes. When using 20 bushel bins, you also need a pallet fork to move the bins.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Carrots are full size, straight and without forks or eating damage due to carrot flies, other insects or other defects.
- When tops are not as healthy looking as bunched carrots, this might not affect hand harvesting but will greatly affect the efficiency of a mechanical harvester that depends on healthy tops. Damaged or deteriorating tops have a significant effect on the efficiency of mechanical harvesters.

Harvest procedures: hand harvesting

- Wash hands before harvesting.
- Undercut carrots with a tractor and bedlifter.
- Make sure the blade is set at a downward angle to lift the carrots and is let down deep enough to avoid cutting the carrots.
- After lifting, grab a bunch of carrots and place them in your lap to remove tops. Place a bucket in front of you so you don't have to twist your body to put them in a bucket.
- Only take straight carrots with no forks. Leave stunted, diseased, forked and split carrots in the field. A good crop rotation should prevent disease inoculum from remaining in the soil.
- Small carrots don't store well, so discard those or distribute them immediately as baby carrots.
- If harvesting for bulk and storage, empty the buckets into a 20-bushel bulk bin. When all the buckets are full, drive the tractor with the bulk bin down the driving lane and carefully dump the carrots into the bin. The buckets are laid out over the full length of the bed so the entire crop from one bed is dumped into the bin at one time.
- Leave the buckets in the same place to be filled up with carrots from the next bed. Drive the tractor with the bin in the bed next to the harvested bed to facilitate easy loading.

Harvest procedures: machine harvesting

- Speeds of conveyors and components will vary a great deal with field conditions. There is no prescribed speed at which to set the flow controls. However, there is an approximate start-up setting, and the operator needs to adjust as needed for conditions.
- Most small carrot harvesters don't allow for a sorting platform. Most likely, you'll need to do additional sorting before long-term storage. Use a conveyor sorting belt to remove any carrots that are forked or damaged by either the harvester or pests.

Washing procedures

- Don't wash carrots until you're ready to deliver them. Put them through a barrel washer to clean. This barrel washer works best if filled up with approximately 300 lbs. of carrots.
- Hose the carrots with potable water before entering the washer, so any dirt on the carrots is soft.
- Sorting is done on the receiving end. The barrel washer should have a well-lit sorting table at the end.
- Remove any damaged or diseased carrots that were previously overlooked. Sort carrots by root length into separate bins if needed.

Additional resources

- U.S. Grade for Carrots
- Postharvest Factsheet Carrots
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for storage carrots

Cleaning in the field	Remove tops; discard forked or diseased carrots
Packing in the field	45 lbs. per plastic box or 800 lbs. per 20-bushel bulk bin
Packing for delivery	25 lbs. per plastic bag. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers or bags for long-term storage. Carrots are sensitive to ethylene damage (they turn bitter), so store them away from crops that produce ethylene, such as apples, tomatoes and melons.

Cauliflower (White and Green)

Yield	An average of ⅓ marketable head per row foot
Standards	**Harvesting*** 40 heads per person, per hour
Tools and supplies needed	Knives, rubber bands or twist ties (customer preference may influence this), and 1 ¾-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Firm, white heads over 4 inches in diameter without any presence of worms.
- It's too late to harvest once heads become loose and turn yellow.
- The heads need to be kept out of direct sunlight 1 week before harvest. To do this, fold several large leaves over the small white head or tie the leaves with a large rubber band. If using rubber bands, choose 3 different colors to represent 3 different harvesting days. Tying is done at the same time as harvest. (Many varieties now are "self blanching" and don't require this step.)

Harvest and cleaning procedures

- Wash hands and sanitize knives before harvesting.
- Cut the stem just under the head, leaving some leaves attached.
- Cut off the tops of wrapper leaves surrounding the head. Do this so there is a complete circle of leaves surrounding the head. They will protect the outside of the head from bruising and will provide a nice appearance. Any bruises turn into brown spots in less than 6 hours.
- If harvested for a CSA or farmers' market, layer 6 heads in the box and use cauliflower leaves or cardboard to separate them from the next layer. All heads are face up.
- For wholesale, use an appropriate container in the field, then sort and repack heads in a packing shed. Sort by size and pack 12–24 heads per box, with a 12-count box being most common.

Additional resources

- Wholesale Grading and Packing Instructions
- Postharvest Factsheet Cauliflower
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for cauliflower

Cleaning in the field	Cut off tops of wrapper leaves.
Packing in the field	12–24 heads per box, with a 12-count being most common
Packing for delivery	9 or 12 in a single layer box. Many buyers require cauliflower to be wrapped in plastic jackets to reduce postharvest losses. For a CSA, most packing is done in the field to avoid damage from handling. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers or wrap cauliflower heads in plastic bags for storage longer than 3 days. Cauliflower is sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Celeriac

Yield	An average of 0.66 marketable root (at 1–2 lbs. each) per row foot
Standards	**Harvesting*** 100 lbs. per person, per hour
	Washing 350 lbs. per person, per hour
Tools and supplies needed	Knives, ⅝-bushel buckets and 20-bushel bulk bins
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Roots are 3–6 inches in diameter, and the timing is usually late in the fall.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- One crew cuts the celeriac out of the ground. Cut below the surface just enough to remove most of the soil and tangled roots, but not too high or the bulb will be damaged. If this is too difficult, first go through with a bed lifter to lift the celeriac out of the ground.
- The rest of the crew removes the tops and puts the roots in buckets.
- If harvesting for 1 delivery, empty buckets into boxes on a truck.
- If harvesting for bulk, move the crop from the buckets into a 20-bushel bulk bin. When buckets are full, drive a tractor with the bin down the driving lane and carefully dump the celeriac into the bin. The buckets are laid out over the full length of the bed so the entire crop from one bed is dumped into the bin at once. Leave the buckets at the same place to be used for the next bed.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Don't wash until it's time for delivery. Then, put the celeriac through a barrel washer. This washer works best if filled up with approximately 300 lbs. of product. Alternatively use a brusher washer. Hose the celeriac before entering the washer, to soften any dirt on it.
- Do the sorting on the receiving end. A barrel washer should have a well-lit sorting table at the end.
- Sort the celeriac by size into regular boxes (about 15 large or 20 medium).

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for celeriac

Cleaning in the field	Remove dead and yellow leaves.
Packing in the field	35 lbs. per regular box or 800 lbs. per bulk bin
Packing for delivery	Use 20 lb. plastic bags whereby each root has a minimum diameter of 3 inches. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–36° and 97–98% humidity. Pack in closed containers or bags for long-term storage.

Celery

Yield	An average of 1 marketable stalk (an entire head) per row foot at 1 lb. each, when planted at 9 inches
Standards	**Harvesting*** 150 stalks per person, per hour
	Washing 300 stalks per person, per hour
Tools and supplies needed	Sharp knives and 1 ¾-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Harvest when celery has fully developed, thick petioles (ribs) and is well formed.
- Harvested stalks should be free from blackheart, pithiness (spongy tissue on the inside of the leaf stalk), cracks, brown stem, soft rot doubles and damage or defects. Don't harvest seed stalks.

Harvest procedures

- Prompt pre-cooling to 32° is critical. (Hydrocooling with a chilled water spray is possible, with the appropriate equipment.)
- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- The plant is cut at the root. Hold the knife in a level position so the stalk being cut is nice and smooth at the bottom. If the immediate outside ribs are blemished, cut slightly higher so they are easily removed.
- A second person cuts off extra leaves in the field, trimming to the length of the box. The same person packs and loads on the truck.
- Properly harvested stalks are free from blemishes or soft spots when brought back to the pack shed, and only need some slight washing by spraying off the bottom part of the stalk.
- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for celery

Cleaning in the field	Remove damaged ribs and cut stalks to length of box.
Packing in the field	1 ⅓-bushel boxes, 20–24 stalks per boxes
Packing for delivery	The industry standard is a 24-, 30- or 36-count in a 1 ⍰-bushel box or celery box. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32° and 95–100% humidity. Celery is not sensitive to ethylene exposure.

Chard, Swiss

Yield	An average of 1 marketable bunch per row foot. Higher yields are possible when making multiple cuttings but the quality diminishes over time.
Standards	**Harvesting*** 60–80 bunches per person, per hour. Half the labor is needed when harvesting loose instead of in bunches.
	Washing 240 bunches per person, per hour
Tools and supplies needed	Sharp clean knives, 1 ⅓-bushel boxes and rubber bands or twist ties (customer preference may influence this).
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Plants are 15–18 inches tall, and the bottom leaves are large enough to make a bunch.
- Chard has good color and is free from yellowing leaves, old stems or damage from leaf miners.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- The harvest boxes you use in the field should be different from the boxes you pack for distribution.
- Hold onto all the leaves you will put in the bunch before cutting close to the ground.
- Inspect the bunch for dead or diseased leaves and discard them.
- Or, for better bunches and regrowth, pick chard leaves individually. One bunch will contain about 5 mature leaves.
- Place a twist tie or rubber band around the bunch and make one final straight cut to make the bunch the length of the box.
- Layer the bunches in the crate lengthwise, alternating the direction of the leaves.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much peracetic acid solution to add to water.
- Wash chard at least twice in clean tubs. You can use the last dunking to hydrocool the product by adding ice to the water or by having the water pre-cooled.
- Don't leave bunches in water for longer than 1 minute, or until the core of the stems are properly cooled down. Chard can get waterlogged after a few minutes, which causes the leaves to deteriorate faster.
- Pack in sealed boxes or line the boxes with a plastic liner to avoid having the product lose moisture during longer storage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for swiss chard

Packing in the field	Plastic 1 ⅓-bushel boxes
Packing for delivery	24 bunches or 20 lbs. per regular 1 ⍰ waxed bushel box See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. Use a clean box of choice for CSA distribution.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers for improved storage. Swiss chard is highly sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Cilantro

Yield	An average of 0.1 lb. per row foot
Standards	**Harvesting*** 3–4 boxes per person, per hour when harvested as a loose pack, or 60–90 bunches per person, per hour
	Washing 15 boxes per hour per person
Tools and supplies needed	Harvest knives and plastic 1 ⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Plants are 6–8 inches tall and have nice green leaves without any signs of yellowing.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Use different boxes in the field than the ones you use for distribution.
- Walk the fields before harvesting to inspect the crop for animal damage or feces. Mark these spots with a flag so the tractor operator or harvest crew can avoid harvesting near them.
- When machine harvested**:**
    - Weed the field thoroughly before harvesting, as people on the machine won't be able to keep up with sorting at the speed of harvesting.
    - During harvesting remove all yellow leaves from the belt before they can fall into the crates. When using a quick cut harvester, you'll sort after harvesting.
- When hand harvested with a knife:
    - Hold a small bunch of leaves at the top of the plant with one hand and cut with one motion with the other hand.
    - Shake vigorously to remove any yellow leaves or stems that are from previous cuttings.
    - If bunches are made with roots attached, pull the whole plant and form a bunch. This will make washing more time consuming.
    - Place bunches in a box with the stems facing the same direction.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.
- Wash cilantro at least twice. Using a bubbler to agitate the water reduces damage to the leaves.
- Don't leave greens in the water for longer than 1 minute. Leaves tend to get waterlogged after a few minutes, which causes them to deteriorate faster.
- Dry loose-packed cilantro in a centrifuge. When bunched, shake excess water off the bunches before packing. There are different sizes and models of commercial-grade salad spinners available through restaurant equipment suppliers.
- Pack 24–36 bunches in ½-bushel boxes. The boxes should be sealed or lined with a plastic liner to avoid

having the product lose moisture.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for cilantro

Cleaning in the field	Remove dead and yellow leaves.
Packing in the field	Pack loosely in plastic 1 ⅓-bushel boxes.
Packing for delivery	Use a ½ bushel or 1 waxed box for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. Use a clean box of choice for CSA distribution.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers or bags for storage that's longer than a day. Cilantro is moderately sensitive to ethylene exposure.

Collards

Yield	An average of 0.7 marketable bunches per row foot. Higher yields are possible by taking multiple pickings from each plant.
Standards	**Harvesting*** 40–60 bunches per person, per hour
Tools and supplies needed	Knives and large boxes and rubber bands or twist ties (customer preference may influence this) if you're making bunches.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- The leaves are 15–18 inches tall, with bottom leaves that are large enough to make a bunch out of 5–6 leaves.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Grab a bunch of the biggest leaves near the stem of the plant and snap off the leaves.
- Don't use the dark green leaves. Leave the smaller leaves at the top of the plant and remove any dead or yellow leaves on the bottom.
- If making bunches, snap off 5–6 leaves, twist the twist tie around the stems and twist the bunch to tighten the twist tie or use a rubber band.
- Put 15 bunches or 80 loose leaves in a large box.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to water.
- Wash collards at least twice in clean tubs. The last dunking can be used to hydrocool the product by adding ice to the water or having it pre-cooled.
- Leave bunches in water until the core of the stems are properly cooled down.
- Pack in sealed boxes or line the boxes with a plastic liner to avoid having the product lose moisture during longer storage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for collards

Cleaning in the field	Remove dead and yellow leaves
Packing in the field	24 bunches containing 5–6 leaves each in a 1 ¾-bushel harvest box, or 90 loose leaves for a CSA in a 1 ⅓-bushel plastic harvest box.
Packing for delivery	16 bunches in 1 □ waxed boxes or 24 bunches in 1 ¾ waxed boxes for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. For CSA delivery, use any preferred packing method.
Storage	At 32°–41°and 95–100% humidity. Pack with ice in closed containers or bags for storage that lasts longer than a day. Collards are sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Corn, Sweet

Yield	Ears are often packed in 48-count boxes. Excellent yields are up to 200 boxes per acre when management practices are optimal (e.g., planting, fertility, irrigation and weed control). Most organic farmers report a yield of 150 boxes per acre.
Standards	**Harvesting*** When using a harvest conveyor, the rate is 8–10 bins (400–500 ears) per hour per person. When harvesting by hand with a pickle barrel, time is lost unloading the pickle barrels into boxes, but time is gained by freeing up a tractor operator. Hand harvest is also harder on your workers. Using a harvest conveyor requires 6 people: 1 person on the tractor, 1 person on the wagon and 4 people harvesting.
Tools and supplies needed	Large 1 ¾-bushel boxes and either a harvest conveyor or pickle barrels
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Ears are firm and filled out to the tip with no missing kernels; husks look fresh and the silk sticking out of the ears is brown and dead but not eaten by insects or deer. When husks are pulled back, all kernels are plump and tender.
- Don't harvest overmature ears, as the sugars have converted to starch.
- Don't harvest ears with worm damage, damaged husks or missing kernels. To check for incidental worm damage in the field by harvesters:
    - The European corn borer can be detected by a pin hole in the ear and can be felt when pressing the ear in the palm of your hand. The presence of this worm is noticed by a hollow feeling underneath the leaves where it has damaged the ear.
    - The corn earworm is usually at the tip of the ear and is easier to spot. Fall production in southern states is particularly challenging due to high worm pressure.

Harvest procedures

- Wash hands before harvesting sweet corn.
- Harvest in the morning hours to avoid field heat accumulation.
- When harvesting by hand:
    - Take 2 rows and put a pickle barrel into the middle.
    - Grab the ear and pull down and out to pull the ear off the stalk.
    - Remove extra stem at this time, or do it when transferring the corn into the boxes.
    - Remove stems both to save space in the box and for its cosmetic value.
    - Count 50 ears to a barrel to allow for easier sorting at the packing shed.
- If using a harvest aid conveyor, place the ears on the belt as you pick. The person on the wagon counts the corn into boxes. For 50 ears, pick up 4 ears at a time and count to 12 and then add 2 individual ears to get to 50.

Sorting procedure

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Sort all the ears in a well-lit barn so that it's easier to identify defects such as worm damage or poor tip fill before distribution. Also, remove extra stem and flag leaves.

Additional resources

- Wholesale Grading and Packing Instruction Sweet corn
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for sweet corn

Cleaning in the field	Remove extra stem and flag leaves if possible.
Packing in the field	Pack 50 ears in a large plastic 1 ¾-bushel harvest box. Picking extra ears allows for sortout in the packing shed.
Packing for delivery	Ears are inspected, sorted, recounted into 48 ears and placed in clean delivery boxes, crates or bags for wholesale or CSA delivery. If the 50 ears per harvest box creates a surplus or deficit with this final sortout, then adjust the amount you harvest next time. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–34° and 95–98% humidity. Pack with ice in closed containers or bags for storage that lasts longer than a few days.

Cucumbers

Yield	An average of 7 cucumbers per row foot, but much higher yields have been reported.
Standards	**Harvesting*** Eight ½-bushel buckets per person, per hour
	Washing Productivity depends on how dirty the cucumbers come out of the field. Wash with a rinse conveyor washer or brusher washer only when needed, at a rate of 350–500 lbs. per person per hour. When washing by hand, avoid dumping cucumbers in a tub.
Tools and supplies needed	½-bushel buckets and/or ⅝-bushel buckets
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Cucumbers are about 6–7 inches long and are firm, dark green, straight and smooth.
- The skin is free from cucumber beetle damage or any other blemishes.

Harvest procedures

- Wash hands before harvesting cucumbers.
- Make sure you harvest the newest plantings first to prevent the spread of disease.
- One person harvests each side of a cucumber bed.
- Go down the bed and pull all harvest-ready fruits off the vine without breaking the skin off the cucumber, and place them in a bucket.
- When the bucket is full, place it in the harvest lane for pick up with a flatbed trailer.
- You won't need to wash cucumbers if the wheel tracks are mulched with straw or hay.

Washing and packing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- If washing is necessary, use a rinse conveyor washer or a brusher washer. Make sure you use the appropriate pressure on the nozzles to avoid crop damage. Don't dunk cucumbers in cold water as this can create cross-contamination of pathogens that are absorbed through the skin of the fruit. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.
- Sort fruit by size (see "Additional resources" below) in a well-lit location.
- Pack fruit for wholesale customers in waxed 1 1/9-bushel boxes.

Additional resources

- Wholesale Grading and Packing Instructions Cucumbers Select
- Wholesale Grading and Packing Instructions Cucumbers 24 Ct
- Wholesale Grading and Packing Instructions Cucumbers 36 Ct
- Wholesale Grading and Packing Instructions Cucumbers Super
- Postharvest Factsheet Cucumbers

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for cucumbers

Packing in the field	Fill buckets
Packing for delivery	The average when picked regularly for CSA distribution is 40–60 cucumbers per container, each weighing 45 lbs. Use waxed 1 ⍰-bushel boxes for wholesale. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 50°–55° and 95% humidity. Don't store below 50°. Cucumbers are highly sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene. Pack in closed containers for longer storage.

Dill

Yield	An average of 0.07 lbs. per row foot
Standards	**Harvesting*** 3–4 boxes per person, per hour
	Washing 12–15 boxes per person, per hour
Tools and supplies needed	Harvest knives and plastic 1 ⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- 7–10 inches tall, dark green
- Harvest without weeds and before the plant bolts (forms a seed head).

Harvest procedures

- Wash hands and sanitize knives before harvesting dill.
- Harvest in the morning hours to avoid field heat accumulation.
- Use different bins for harvesting in the field and for distribution.
- When hand harvested with a knife:
    - Hold a small bunch of leaves at the top of the plant with one hand and cut with one motion with the other hand.
    - If making bunches with the roots attached, pull out the whole plant and form a bunch. This will make washing more time consuming.
    - Place the bunches in a box with the stems facing the same direction.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much peracetic acid solution to add to water.
- Using a bubbler to agitate the water reduces leaf damage. Rinse the dill at least twice. For the last rinse you can use hydrocooled water.
- Shake excess water off the bunches or allow them to drain before packing.
- Pack 3 lbs. or 24–36 bunches in sealed ½-bushel boxes.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for dill

Cleaning in the field	Remove dead and yellow leaves.
Packing in the field	Pack loosely in regular boxes.
Packing for delivery	Wholesale distribution is mostly done in bunches. Pack 24–36 bunches into ½-bushel boxes and 48–72 into waxed 1 □ boxes.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers or bags for storage that's longer than a day.

Eggplants

Yield	An average of 1.75 lbs. per row foot is common, but growers using protected tunnels report much higher yields.
Standards	**Harvesting*** 5–7 buckets (20 lbs. per bucket) per person, per hour
	Washing Ideally, eggplant is not washed but is carefully sorted and counted.
Tools and supplies needed	Scissors or pruning shears and ⅝-bushel or ½-bushel buckets
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Fruits are 8–10 inches long and free of blemishes. Asian and Thai eggplant have similar requirements as the standard Italian type.
- Eggplants must be firm, filled out and heavy in relation to their size.

Harvest procedures

- Wash hands and sanitize pruning shears or scissors before harvesting.
- Each person harvests 1 bed at a time (1 row per bed). Mark the spot where you stop harvesting with a bright flag so that you can begin there the next time you harvest, because it might not be obvious when you return.
- Cut eggplants from the plant with scissors or pruning shears, leaving a small (¾ inch) stem on the fruit.
- If you grew the eggplant on plastic mulch and wheel tracks are mulched with straw or covered with weed fabric, the fruit is usually clean, making washing unnecessary.

Washing and packing procedures

- Eggplants are sensitive to sunburn. Don't leave them in the field in uncovered harvest boxes or buckets where they can be exposed to the sun on hot days.
- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- If washing is necessary, use a rinse conveyor washer or a brusher washer, or rinse off by hand when dealing with smaller quantities. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water. Make sure you use the appropriate pressure to avoid fruit damage.
- Avoid dunking eggplants in cold water, as this can create cross-contamination of foodborne pathogens that can be absorbed through the skin of the fruit.
- Make sure the eggplants have a chance to dry off before packing them into boxes.
- Sort fruit by size in a well-lit location whereby each box contains approximately 16–18 Italian eggplants, or 30–35 Asian eggplants, in waxed 1 1/9-bushel boxes. Pack small Thai eggplants in ½-bushel boxes.

Additional resources

- Wholesale Grading and Packing Instructions
- Postharvest Factsheet Eggplant
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for eggplants

Packing in the field	½-bushel or ⅝-bushel buckets
Packing for delivery	Traditionally, a count of 16–18 Italian eggplants goes into regular 1-bushel boxes (with different counts for other types), but in the end each box should contain 33 lbs. of eggplants. If you aren't able to fit 16 eggplants in a 1-bushel box, you have allowed them to grow too large for customers' preference. Pack Thai and Asian eggplants in ½-bushel boxes that weigh 15–16 lbs. each. As these types are much more variable in size, they are usually sold by weight. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 50°–54° and 90–95% humidity. Don't store below 50°. Eggplants are sensitive to ethylene exposure. Allow for good air exchange and don't store with crops that release ethylene.

Fennel

Yield	1 bulb per row foot
Standards	**Harvesting*** 50 bulbs per person, per hour
	Washing 150 bulbs per hour
Tools and supplies needed	Sharp knives and plastic boxes (1 ⅓ bushel or 1 ¾ bushel)
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Harvest when fennel has filled out to a bulb that weighs about 1 lb. and has a diameter of at least 4 inches.
- Stems should be succulent and free from any defects.

Harvest and washing procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Don't let fennel bulbs overheat. Hydrocooling is recommended, if possible.
- The plant is cut at the root. Hold the knife in a level position so the stem being cut is nice and smooth at the bottom. If the immediate outside leaves are affected by crown rot, cut slightly higher so those are easily removed.
- In the field, a second person cuts off extra leaves measured to the length of the box. The same person packs and loads boxes on the truck.

Washing and packing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Bulbs brought back to the shed are free from blemishes or soft spots, and only need light washing by spraying off the bottom part of the bulb.

Additional resources

- U.S. Standards for grades of Sweet Anise
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for fennel

Packing in the field	Plastic 1 ⅓-bushel or 1 ¾-bushel boxes, with 15 bulbs per box
Packing for delivery	The industry standard is 18, 24, 30 or 36 count in a ½-bushel or 1 ⍰-bushel box.
Storage	At 32° and 90–95% humidity

Garlic

Yield	An average of 0.2 lbs. dried and cured garlic per row foot from hardneck varieties.
Standards	**Harvesting*** 35 lbs. garlic per person, per hour. This includes lifting the garlic with a bedlifter, removing the tops and putting them into boxes.
	Cleaning 40–50 lbs. per person, per hour
Tools and supplies needed	Gloves, a utility cutter, serrated knives, regular 1 ⅓-bushel boxes or any other plastic box (like 1 ¾-bushel), and a tractor with a bedlifter, or a fork or shovel for manual harvesting
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- The best indicator for harvest readiness is how the cloves are filling the wrapper leaves. To determine this, take a couple of average-looking plants from each variety and cut them in half perpendicular to the stem, so that you are cutting through all the cloves. For the garlic to be ready to harvest, each clove should be tight in its wrapper leaves. If there is any give when you squeeze the bulb, or if the wrapper leaves seem a little loose around the cloves, the garlic is still growing, and harvest is premature. At maturity a few of the outer wrapper leaves will probably be breaking down, which is normal.
- You can also look at the shape of each clove. Cloves start out being more or less round and expand to more of a wedge shape. On hardneck varieties, the cloves will pull very slightly away from the scape as the garlic reaches full maturity.
- If you let the garlic stay in the ground too long, too many wrapper leaves will decay, and the cloves will continue to expand until the garlic splits open. At this point the garlic becomes unmarketable.
- Make sure that you check your garlic every few days as it's approaching maturity.

Harvest procedures

- When the garlic is ready, mow garlic at about 6 inches to avoid bringing a lot of wet material into the curing area. Pull garlic out of the ground with the help of a bedlifter, shovel or hand fork.
- Harvest in the morning to avoid sunscald, as it's best to field dry the garlic for a few hours before taking it into the curing area. Bring it in before temperatures hit the upper 80°s.
- Either use a sharp serrated knife to cut the roots off ½ inch below the bottom of the bulb, or shake the dirt off. Never bang the bulbs to remove dirt from the roots. Any bruises will cause decay in storage. Don't twist the roots off as damage to the basal plate of the garlic will introduce *Fusarium* basal rot.
- To prevent bruising, handle all garlic like apples by gently placing them in a crate for transport.

Washing procedures

- You can wash garlic straight after harvest, but only do this when field conditions are very muddy. Never wash garlic that is already drying, as this might cause the garlic to spoil.

Curing procedures

- After harvest, it's best to cure garlic in a high tunnel on mesh benches with lots of good air circulation. Make sure the mesh is strong enough to prevent sagging in the middle. Galvanized metal wire mesh that's 1x2 inches works well. Alternatively, use a plenum and forced air to save space.

- The high tunnel should be covered with 60% shade cloth to protect garlic from sunscald and to moderate temperature. Lay the garlic flat on greenhouse benches to allow for good aeration. Set the exhaust fan temperature to around 80°, and always keep the circulation fans on to avoid moisture buildup on the plastic.
- Curing is complete when the leaves flake off and the necks are sufficiently dried (with no evidence of moisture). This can take 2–3 weeks under optimum conditions. Do not over dry garlic, which leads to yield loss and poor storage life.

Cleaning and sorting procedures

- After curing, cut off any excess stem with pruning shears or a scissor-style utility cutter. Preferably use a utility cutter for root trimming as blades tend to get dull due to the soil particles left on the roots.
- You can remove any dirt particles by removing the outer wrapper. Do this under dry conditions so the wrappers come off easily. These conditions are favorable when the sun warms and dries the curing area (high tunnel/caterpillar tunnel).
- Check garlic for any discolorations, soft spots or other defects, and remove these bulbs from the curing area.
- After this, move the garlic to a cooler, dry area. Ideally this is a climate-controlled area like an insulated room with an AC unit keeping the temperature at around 60°. The AC unit will also maintain low moisture.
- Sort garlic for size and quality in a well-lit location when you're ready to ship it.

Additional resources

- Growing, Harvesting, Storing and Marketing Garlic in the Northeast
- U.S. Standards for grades of Garlic
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for garlic

Cleaning in the field	Cut tops, lift garlic, pull the bulbs and clean off roots.
Packing in the field	Fill in boxes for transport.
Packing for delivery	Sort to size: Small bulbs are less than 1.5 inches, medium are 1.5–2 inches and large are 2 inches and over. Pack in mesh bags or cardboard boxes at 20–40 lbs. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	Store seed garlic at 70° and 65–75% relative humidity. For long-term storage of garlic that you plan to sell, ideally store at 32°–41° and 65–70% humidity. Garlic will sprout after being removed from cold storage. Garlic doesn't produce ethylene and isn't sensitive to ethylene.

Kale

Yield	An average of 1 bunch per row foot with increased yield after successive harvests.
Standards	**Harvesting*** 60–100 bunches per person, per hour
	Washing 175 bunches per person, per hour
Tools and supplies needed	Knives, rubber bands or twist ties (customer preference may influence this), and 1 ¾-bushel plastic boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Plants are 15–18 inches tall.
- The bottom leaves are dark green and large enough to make a bunch out of 5–6 large leaves.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning to avoid field heat accumulation.
- Use different boxes in the field than the ones you use for distribution.
- Grab a bunch of the biggest leaves near the stem of the plant and snap them off.
- Leave the smaller leaves at the top of the plant and any dead or yellow leaves at the bottom.
- Each bunch uses 5–6 leaves of curly kale or about 10 leaves of lacinato kale.
- Place a twist tie around the stems and then twist the bunch to tighten the twist tie, or use rubber bands.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Kale is not always washed, but you can dunk it in ice water to remove field heat.
- Add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to the water.
- Leave bunches in the water until the cores of the stems are properly cooled down.
- Pack in sealed boxes to avoid having the product lose moisture during longer storage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for kale

Cleaning in the field	Remove dead and yellow leaves
Packing in the field	12–16 bunches per 1 ¾-bushel plastic box
Packing for delivery	12 bunches per 1 ⍰-bushel box and 24 bunches per 1 ¾-bushel box See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack with ice in closed containers or bags for storage that lasts longer than a day. Kale is sensitive to ethylene exposure. Long-term exposure will turn green leaves yellow. Allow for good air exchange and don't store with crops that release ethylene.

Leeks

Yield	An average yield is between 0.8–1 bunch per row foot (with 3 leeks per bunch), at a population of 36x7 inches.
Standards	**Harvesting*** 25 bunches per person, per hour
	Washing It depends on where the roots are cut, but when roots are almost cut off, a minimum of 100 bunches per person, per hour. Leaving a short "haircut" of roots reduces washing efficiency but increases appeal to customers.
Tools and supplies needed	Knives, regular 1 ⅓-bushel boxes, extra boxes to use as a cutting surface for excess leaves, and either hand forks or a tractor with a bedlifter
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Leeks are about 1 inch in diameter, with tall, dark green leaves that are free from blemishes and diseases.

Harvest and cleaning procedures

- Wash hands and sanitize knives before harvesting.
- Use different boxes in the field from the ones you use for distribution.
- Leeks are much easier to harvest if you use a bedlifter first. Otherwise, you need to fork the leeks loose. The crew's tasks are:
    - One person loosens the leeks, either with a bedlifter or fork.
    - A second person pulls the leeks and lays them out in rows with the roots facing the same direction.
    - A third person cuts the roots off, at the place where the roots meet the stem. Don't cut into the plant.
    - A fourth person cleans off any old, diseased or damaged leaves by peeling them from the bottom.
    - A fifth person trims off the tops by cutting across the leaves at the same height. Do the trimming with an upside down box as the cutting surface. Using a box as a cutting surface also helps to ensure that the leeks are cut the same length as the box.
- If bunching the leeks, select 2–4 leeks per bunch that combined make for a uniform bunch.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Place leeks on a wire mesh table and rinse them off with a hose, or alternatively run them through a rinse conveyor washer. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water. Make sure you use the appropriate pressure on the nozzles to avoid crop damage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for leeks

Cleaning in the field	Cut off roots and remove outer leaves.
Packing in the field	20 bunches per regular 1 ¾ plastic bushel box
Packing for delivery	11 lbs. per regular 1 □-bushel box for wholesale Bunches or by the piece for a CSA or farmers market See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack with ice in the bins for storage that lasts longer than a week. Leeks are slightly sensitive to ethylene exposure. Long-term exposure will turn green leaves yellow. Allow for good air exchange and don't store with crops that release ethylene.

Lettuce, Full Size

Yield	An average of 1 marketable head per row foot when planted at 10 inches. Numbers are higher for compact varieties that are planted at higher populations (like Salanova). Yields drop down under heavy pressure from thrips or white flies that cause viral infections during August unless you implement a good spraying program.
Standards	**Harvesting*** Approximately 100–150 heads of lettuce per person, per hour for cutting, with a second person packing the lettuce in boxes at a rate of 300 heads per hour, when packing 16–24 heads into 1 ¾-bushel boxes
	Washing 150–240 heads per person, per hour
Tools and supplies needed	Knives and 1 ¾-bushel plastic boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Heads are firm, weighing anywhere from 0.8 lb. (Boston lettuce) to 1 lb. (green leaf or romaine).
- Lettuce doesn't have the beginning of a seed head (it hasn't started to bolt). The growing point of the lettuce has not elevated from the basal plate.

Harvest procedures

- Harvest in the morning to avoid field heat accumulation.
- Use different boxes in the field from the ones you use for distribution.
- Wash hands and sanitize knives before harvesting.
- Determining the correct cutting height is important and can save time. Cut high enough to remove dead and damaged outer leaves while keeping most of the head intact.
    - Cleaning after cutting is unnecessary when heads are cut with skill.
    - One suggestion is to stay close to the place where you'll make the cut by working on your knees. This way you can easily bend over to see where the knife is entering the plant.
- Lettuce should not touch the ground after you cut it. To avoid this, do your cutting and packing in the same motion.
- Pack lettuce so the bottom of the plant doesn't touch any leafy parts. Lettuce releases a milky juice where it has been cut, and this can leave a brown stain on the leaves.
- For Boston lettuce, pack one layer face up and the other face down. For green, red and romaine lettuces, pack all the heads in one direction.

Washing and racking procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- If heads are clean in the field, you only need to rinse the bottom of the lettuce to remove the milky juice. Leaving this on will make the bottom turn brown and the head will appear old. Repack in clean boxes and put directly into a cooler.
- If lettuce is dirty, dump heads into the washing tub. Clean tubs thoroughly and add a sanitizer to wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much

hydrogen peroxide and peracetic acid solution to add to water.

- Make sure to remove dirt from the cut ends either with gloves or with a brush. Shake out any excess water or let the heads dry upside down to drain water and sanitizer out of the lettuce head.
- Make sure the lettuce is only underwater for a short amount of time so it doesn't get waterlogged.
- In the cooler, stack heads of red leaf, green leaf and romaine lettuce upside down to let the water drain. Washing Boston lettuce is problematic because it's difficult to remove all the water from it, and it will break down prematurely if it remains wet.

Additional resources

- Wholesale Packing and Grading Instructions Romaine Lettuce
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for full-size lettuce

Cleaning in the field	Leave dead yellow leaves in the field.
Packing in the field	Harvest in plastic 1 ¾-bushel bins, making sure the cut ends never touch the leaves. Use different boxes for delivery.
Packing for delivery	**Boston** 10 lbs. in 1 ⍰-bushel boxes, with 12 heads to a box 20 lbs. in lettuce boxes, with 24 heads to a box **Loose leaf** 22 lbs. in lettuce boxes, with 24 heads to a box 12 lbs. in 1 ⍰-bushel boxes, with 12 heads to a box **Romaine** 22 lbs. in lettuce boxes, with 24 heads to a box (unless you pack romaine hearts) 12 lbs. in 1 ⍰-bushel boxes with 12 heads to a box (unless you pack romaine hearts) Pack 12 heads in 1 ⅓-bushel boxes for CSA delivery. Make sure the cut end of one head doesn't touch the leaves of another. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32° and 98–100% humidity. Pack in closed containers for storage that lasts longer than a few days. Lettuce is sensitive to ethylene exposure, which will turn the ribs of leaves brown or cause them to develop brown spots. Allow for good air exchange and don't store with crops that release ethylene.

Lettuce, Salad Mix

Yield	An average of 1 lb. of salad mix per bed foot when planting lettuce at 7–14 rows per bed. When using transplanted Salanovo for salad mix expect a yield of ⅓ lbs per row foot.
Standards	**Harvesting*** 4–5 boxes per person, per hour when the crop is free of weeds and other issues (at 8 lbs. per box) Machine harvest can be up to 35–50 bins per hour (involving 3 people). The rate greatly depends on crop quality, weed infestation and other field conditions. The machine will need to be slowed down dramatically for sorting when there is a high amount of weeds or yellow leaves.
	Washing 8–12 boxes per person, per hour
Tools and supplies needed	Either a machine harvester, handheld harvester or harvest knives; and plastic 1 ⅓-bushel boxes.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Leaves are 4–8 inches tall and healthy.
- Plants are free of weeds, yellowing, necrosis or other blemishes

Harvest procedures:

- Wash hands and sanitize knives and equipment before harvesting salad mix.
- Harvest in the morning hours to avoid field heat accumulation.
- Use different bins for harvesting from those used for distribution.
- Walk the fields before harvesting to inspect the crop for animal damage or feces. Mark these spots with a flag so the tractor operator or harvest crew can avoid harvesting near them.
- When machine harvested:
    - Weed the field thoroughly before harvesting, otherwise the people on the machine won't be able to keep up with sorting at the speed of harvesting.
    - During harvesting, remove all yellow leaves off the belt before they fall into the crates. When using a hand-held harvester, you'll sort after harvesting.
- When hand harvested with a knife:
    - Hold a small bunch of leaves at the top of the plant with one hand and cut with one motion using the other hand.
    - Shake vigorously to remove any yellow leaves or stems from previous cuttings.
    - Place loosely in a box.

Washing and packing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to water.
- When a commercial salad washer isn't available, wash salad mix at least twice, preferably 3 times. Using a bubbler to agitate the water reduces damage to the leaves. You can use hydrocooled water for the last

rinse.
- Don't leave greens in water for longer than 1 minute. The leaves tend to get waterlogged after a few minutes, which causes them to deteriorate faster.
- Dry salad mix with a centrifuge. There are different sizes and models of commercial-grade salad spinners available through restaurant equipment suppliers.
- Pack in sealed, ½-bushel boxes, or line the boxes with a plastic liner to avoid having the product lose moisture.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for salad mix lettuce

Cleaning in the field	Inspect the crop for weeds, yellow leaves and contamination.
Packing in the field	8 lbs. per regular bushel box
Packing for delivery	3 lbs. per regular ½-bushel box See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32° and 98–100% humidity. Pack in plastic bags inside closed containers for longer storage. Salad mix is sensitive to ethylene exposure, which will turn the ribs of leaves brown or cause them to develop brown spots. Allow for good air exchange and don't store with crops that release ethylene.

Melons, Cantaloupes

Yield	An average of 1 marketable melon per row foot, although this depends greatly on the variety. For example, smaller types, like sugar cube, usually yield 2–3 melons per foot.
Standards	**Harvesting*** 75–100 melons per person, per hour. It takes a crew of 5 people about 45–60 minutes to harvest and sort 350 melons.
	Washing Not necessary when using mulch between plastic. Sort melons in the field to save time in the pack shed.
Tools and supplies needed	1 ¾-bushel plastic boxes or 20-bushel bins and a forklift to move the bins
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Cantaloupes are of good quality when they have developed a good netting with full yellow color on the outside, and when the flesh is orange, sweet and juicy.
- Each type of melon has its own harvest readiness indicators. Open up a few melons when they look ready, taste them and look for characteristics that indicate harvest readiness.
- Cantaloupes and melons cannot be overripe, soft or wilted and must be free of any defects.
- Good cantaloupes and melons come from a field where the foliage is still healthy and the plants are in full production.
- Cantaloupes are ready to harvest when the stem is either at the half-slip or full-slip stage. This refers to how easily a melon's stem will break off the vine, and indicates ripeness. When a cantaloupe is fully ripe, the stem will detach from the fruit with a gentle nudge, which is the full-slip stage. At the earlier half-slip stage, the stem will only partially break off. For full flavor pick at full slip, but include all the fruit that is at half-slip as well, if you don't want the fruit to over ripen. Using full- and half-slip as harvest indicators works best on cantaloupes and doesn't apply when determining the ripeness of real melons.
- Cantaloupes picked at full slip won't tolerate shipping, so you should sell them in retail settings. For shipping, harvest cantaloupes at half slip.
- Cantaloupes ripen over a period of 2 weeks, but the fruit is smaller and less netted at the last picking, which is an indication that the quality has decreased. To maintain a satisfied customer base, many growers leave those last cantaloupes in the field and move on to the next succession.

Harvest procedures

- One or 2 people stand on a harvest wagon while the others each take a row of melons.
- After a picker harvests a melon, they toss the melon underhanded to one of the people on the truck. Make sure you have eye contact with the catcher before you toss the melon.
- Move the harvest wagon down the harvest lane as you pick.

Washing procedures

- Using adequate straw mulch can keep the fruit clean and make washing unnecessary. This is preferred over washing melons.
- If washing is necessary, wash your hands before handling melons and use a rinse conveyor washer or brusher washer, or spray off the melon. Add a sanitizer like hydrogen peroxide and peracetic acid to the

water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.

- Under no circumstances should you dunk melons in cold water, as this can create cross-contamination of pathogens that are absorbed through the skin of the melon. When muskmelons are submerged in water (which almost always has a lower temperature than the melon), ensure that they are washed in an ambient sanitizing solution. Aside from tubs, even rinse conveyors are known to be challenging in making sure that the correct peracetic acid solution is present.
- Inspect the melons after washing for any defects. Any possible puncture is a food-safety issue and you'll need to cull these melons from the packing line. Any cosmetic issue will impact storage life.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for melons

Cleaning in the field	Brush off any soil or straw mulch.
Packing in the field	If possible, sort by size in the field to accommodate easier sorting in the packing shed.
Packing for delivery	Sort by size and pack anywhere from 8–12 melons per 1 ¾-bushel box or 4–6 melons per 1 ⍰-bushel box. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	Store cantaloupes at 37°–45° and 95% humidity, and honeydew melons at 45°–54°. Cantaloupes are ethylene producers but are also sensitive to ethylene exposure, which will turn them soft. Allow for good air exchange in the cooler.

Onions, With Green Tops

Yield	An average between 0.8–1 bunch per row foot
Standards	**Harvesting*** 40–60 bunches per person, per hour
	Washing 80–100 bunches per person per hour
Tools and supplies needed	1 ¾-bushel plastic box, rubber bands or twist ties (customer preference may influence this), and knives
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Harvesting onions with tops allows for CSA and farmers market growers in the Northeast and Midwest to bring onions to their customers in June. Cured storage onions are ready for market by mid-August and can also be harvested fresh (without tops) in July.
- Onions are 2–4 inches in size.
- Onion bulbs are firm and have no signs of any defects from insects, bacterial rot or other pathogens.
- Leaves are light to deep green, are not crushed or damaged, and have no signs of any defects.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- The first person pulls onions out by grabbing them as low as possible at the stem to avoid crushing the green stems. Place the onions on top of the bed all facing the same way.
- The second person cleans off the outer leaves around the bulb, which results in a clean, white bulb.
- The third person bunches 3–4 onions together with twist ties or rubber bands.
- The fourth person cuts the excess length off the leaves to allow the bunch to fit lengthwise in a box.
- The last person picks up the finished bunches, counts them and places them in the boxes.

Washing procedures

- Fresh, bunched onions look much nicer when clean. If washing is necessary, wash your hands and place green onions on a wire mesh table and rinse them off with a spray nozzle. Don't dump them into a washing tub, as submerged onions will decay quickly by absorbing water into their leaves.
- Alternatively, run green onions through a rinse conveyor washer, and make sure you use the appropriate pressure on the nozzles to avoid crop damage. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.

Additional resources

- Postharvest Factsheet Green Onions
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for onions with green tops

Packing in the field	15 bunches in a regular 1 ⅓-bushel box
Packing for delivery	24 bunches in a regular 1 ¾-bushel box or 12 bunches in a 1 -bushel box. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	32°–41° and 95–100% humidity. Pack in closed containers for storage longer than a week.

Onions, Storage

Yield	An average of 1.5 lbs. of marketable cured onions per row foot
Standards	**Harvesting*** 175 lbs. per person, per hour, or approximately 200 hours per acre. This includes pulling the onions, removing the tops and putting them into boxes.
	Curing, cleaning and sorting 250 lbs. per person, per hour
Tools and supplies needed	⅝-bushel buckets or regular 1⅑-bushel boxes, and knives
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Reduce irrigation when onions start to mature (about 3 weeks before harvest) to maintain a healthy crop. Organic farmers don't have many tools to control the N levels of their soil, as most N is released from biological sources. A high N level, high thrips feeding, low plant population (wide spacing) and excessive irrigation all contribute to bacterial bulb decay and especially bacterial internal soft rot. Reducing irrigation water reduces N uptake.
- Onions are almost ready to pull when the plants stop putting on new leaves, the necks get soft and plants start to fall over, and the roots begin to die. Generally, it's said that onions are ready when 75% of the plants have lodged, but it pays to leave them in the ground until the roots are loose as well. They continue to put on size even when the leaves have fully lodged.
- Pull on plants and see how hard it is to pull them out of the ground. If you don't feel much resistance, they're ready to harvest.
- Onions should be firm, have a good bulb size, and contain no defects from insect damage, sunscald, or bruising. Onions should also have good internal condition with no presence of bacterial bulb decay.

Harvest procedures

- To avoid sunscald, don't harvest on hot days when the temperature will soar into the high 80s or 90s. To avoid black mold, don't harvest in the rain or on days when the relative humidity is higher than 90%.
- Pull onions out of the ground, place them in windrows and orient the leaves so they protect the bulbs from direct sunlight. Ensure onions aren't injured, because this can lead to the postharvest development of pathogens.
- Conduct field curing when temperatures are at least 75° but lower than 90°. When conditions are ideal, this can take a few days to a few weeks. However, this is always a risky proposition on the East Coast, where the weather is easily changeable. Also, when you do field curing, you want to make sure that the onions are fully mature and have developed a solid outer wrapper. When onions prematurely lodge due to high thrips pressure, they have not developed enough of a wrapper to protect them against sunscald. When you feel confident about the quality of the onions and the weather forecast, follow the following procedures:
    - Windrow the onions and allow them to dry in the field.
    - Alternatively place the onions in wooden boxes that provide plenty of ventilation. Only place a small layer of onions in each box and stack the boxes on top of each other. In case it does rain you will be able to provide some protection with a tarp.
- When temperatures are high or onions have prematurely lodged, avoid long-term field curing and bring onions into a barn or high tunnel within a few hours of pulling. Expose onions to temperatures of up to

86°F and an optimum relative humidity of 75–80%. You can cut the tops of the onions, but leave approximately 4 inches of stem. Cutting the onions lower can introduce bacterial soft rot. Lay the onions out in single layers and avoid stacking them on top of each other. Ensure good air movement. (Forced air curing with a plenum allows for higher curing temperatures.)

- If stored in a plastic tunnel, cover the tunnel with 60% shade cloth to protect the onions from sunscald.
- Curing in a plastic tunnel or well-ventilated barn can take up to 2–3 weeks depending on the weather and storage conditions. When you can no longer roll any stems between your fingers and the stem tissue feels like paper, onions are cured and you can bring them into long-term storage.
- Store onions at close to 32° and 65–70% humidity for long-term storage.

Additional resources

- Postharvest Factsheet Onions
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for storage onions

Packing in the field	⅝-bushel buckets
Packing for delivery	Pack in regular 1⍰-bushel boxes or mesh bags, 40 lbs. total, sorted by size (smaller than 3 inches or larger than 3 inches). See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 65–70% humidity. Onions are moderately sensitive to ethylene exposure during long-term storage.

Parsley

Yield	An average of 1 bunch per row foot (1 bunch weighs about 2 oz.). Higher yields with multiple cuttings.
Standards	**Harvesting*** When packed loose, the rate is 4 boxes (at 3–4 lbs. per box) per person, per hour, and when bunched it's up to 75 bunches per hour per person. These rates are for a weed-free crop.
	Washing 12 boxes per hour per person
Tools and supplies needed	Knives, rubber bands or twist ties (customer preference may influence this), and regular 1⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Plants are 9–10 inches tall. They are bushy, dark green and free of yellow, diseased, or dead leaves.

Harvest and cleaning procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning to avoid field heat accumulation.
- Use different boxes for harvesting than for distribution.
- Hold the leaves with one hand and cut with one motion using the other hand. Often with parsley you are able to grab the correct amount needed to make one bunch. If this is not possible, hold the leaves and add more leaves to that same hand with a second cut.
- Remove any yellow leaves or stems and wrap the bunch with a rubber band or twist tie; place the bunch in a clean box.
- If the stems are cut high off the ground, make sure you re-cut them again, so only 2–3 inches remain on the plant. This is to avoid cutting dead stems at the next harvest. After harvest, the parsley plants will need to look evenly cut to accommodate even re-growth.
- If you work your way methodically through a bed, you should be able to do a second cutting later on, starting at the same place as your first.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to water.
- When a conveyor washer is not available, rinse parsley twice, adding peracetic acid to the first rinse water. Curly parsley can hold a lot of soil particles. Using a bubbler to agitate the water reduces leaf damage. You can use hydrocooled water for the last rinse.
- To avoid waterlogging, don't leave parsley in water for longer than a few minutes, and shake the water off each bunch before repacking it in a clean box. Set the bunches upside down to drain dry if necessary.
- Weigh the product according to your customer's needs and pack it in 24- or 48-bunch quantities (for restaurants you can pack in bulk in 1–3 lb. boxes).
- Top-ice can be used for cooling.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for parsley

Packing in the field	Plastic boxes
Packing for delivery	½-bushel waxed boxes for 24 bunches and 1-bushel boxes for 48 bunches. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops. Use a clean box of choice for CSA distribution and farmers markets.
Storage	At 32°–36° and 95–100% humidity. Pack in closed containers for storage longer than a few days. Parsley is highly sensitive to ethylene exposure; it will turn the crop yellow. Allow for good air exchange and don't store with crops that release ethylene.

Parsnips

Yield	An average of 0.83 lbs. of marketable parsnips per row foot
Standards	**Harvesting*** 175 lbs. per person, per hour
	Washing 300 lbs. per person, per hour with a barrel washer
Tools and supplies needed	⅝-bushel buckets, 20-bushel bulk bins, a tractor with a bedlifter and a tractor with a forklift. Use a harvesting fork or shovel if you don't have a bedlifter.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- The roots are 6–12 inches long with a minimum diameter of 1.5 inches.
- Harvested roots are white and straight, and are free of woodiness, cankers or cavity spots. Roots with discoloration should be evaluated for the presence of plant pathogens. Some disease-causing organisms such as *Rhizoctonia* and *Schlerotinia* are known to infect edible root crops (and many other crops), leaving symptoms of discoloration. These pathogens can reside in the soil for many years. It's best to submit samples of roots and shoots to a local lab or Extension office for evaluation. If disease is present, remove infected plant material (roots and shoots) from the field to avoid future problems with subsequent crops.

Harvest procedures

- Undercut parsnips with a bed lifter, or use either a harvesting fork or shovel to loosen them.
- Then pull out parsnips, inspect them for defects, twist off the tops and put them in buckets.
- Separate out small parsnips.
- Small parsnips don't store well, so you cannot sell them through wholesale markets. You can give them out in CSA shares as long as you distribute them soon after harvest.
- When harvesting in bulk, harvest parsnips into ⅝-bushel harvest buckets and transfer them into a 20-bushel bin. When the bed is fully harvested, avoid lugging the buckets to the headland. Instead, drive a tractor with forks along the harvested bed. People empty their buckets directly into the bin. When first loading a bin, lower the buckets to the floor of the bin before dumping them, otherwise the long drop can damage the roots. If multiple beds are harvested, leave the buckets where you emptied them. This prevents unnecessary trips in retrieving buckets. Once harvest is completed, rinse all buckets to reduce cross contamination to other crops.
- Rapid cooling to 41° immediately after harvest is essential. Keep the cooler at a high humidity.

Washing and sorting procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Barrel wash for short-term storage. For long-term storage, wait until after storage to wash.
- A barrel washer works best if filled with approximately 300 lbs. of parsnips.
- Hose the parsnips with potable water before they enter the washer, so any dirt on the parsnips is soft.
- A barrel washer should have a sorting table at its end. Sort out any parsnips with defects. Sort by size if needed.

Additional resources

- U.S. Grade 1 and 2 Standards for Parsnips
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for parsnips

Packing in the field	800 lbs. per bulk bin.
Packing for delivery	25 lbs. in plastic bags See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–34° and 98% humidity. Pack in closed containers or bags for long-term storage. Parsnips are highly sensitive to ethylene exposure, which makes them turn bitter. Allow for good air exchange and don't store with crops that release ethylene.

Peas, Sugar Snap and Snow

Yield	An average of 0.12 pints of sugar snap peas per row foot for bush types An average of 0.75 pints of sugar snap peas row foot for trellised peas Snow peas often yield approximately 30% less than sugar snaps.
Standards	**Harvesting*** For bush peas, 15 lbs. per person, per hour For trellised peas, 20 lbs. per person, per hour
Tools and supplies needed	⅝-bushel buckets or food safe 5-gallon buckets
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- For sugar snaps, the pods are plump and peas inside the pod have filled out. Snow peas are best before they become much larger than 3 ½ inches.
- Sugar snap peas are 2 ½–3 inches long, and snow peas are 3–3 ½ inches long and don't contain any large seeds.
- Don't harvest diseased, damaged, over-mature or immature pods.

Harvest procedures

- Wash hands before harvesting peas.
- If peas are trellised, only harvest the mature peas into the bucket. If the plants aren't trellised and most of the peas are mature, pull out the whole plant and pull off the peas. If using buckets with holes, double them to prevent peas from falling out of the holes, or use food-safe, 5-gallon buckets. Alternatively, use a harvest bucket that is carried around your shoulders.
- You can harvest standing up or kneeling down. Some people sit on a bucket while picking or cleaning the vines. This might not be as efficient, but pea harvest can become strenuous after a few hours.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Peas don't need to be washed, but if needed, rinse them quickly with cold water to remove field heat. If harvested on a hot day, you can soak peas in a cold water tub to remove the field heat. Add a sanitizer like hydrogen peroxide and peracetic acid to the water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for peas

Packing in the field	Every ⅝-bushel bucket weighs about 20 lbs. when filled with peas.
Packing for delivery	10 lb. cartons. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–34° and 85–95% humidity. Cover in closed containers or bags if stored for a few days. Peas are moderately sensitive to ethylene exposure. The typical shelf life is 7–10 days.

Peppers, Green and Red Bell, and Hot

Yield	An average of 2 ½ lbs. per row foot of marketable peppers, but this depends greatly on the variety
Standards	**Harvesting*** 10 buckets or 150 lbs. per person, per hour
Tools and supplies needed	⅝-bushel or ½-bushel buckets
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Peppers are firm and large. A sign of being ready is when the peppers cannot be easily squeezed between the fingers. Harvest readiness isn't measured only in size but also in the thickness of the walls. It depends on the market if you allow a pepper to turn color (for higher value) or if you pick them green. Some peppers are only picked red (like sweet Italian peppers) and some are only picked green (like Poblano).
- Only harvest peppers that are free of blemishes. Pick damaged peppers and remove them from the field to avoid disease buildup.

Harvest procedures

- Count out the number of buckets you'll need to harvest. For example, 1 bucket of green peppers yields approximately 35 peppers or 15 lbs., and 1 bucket of sweet Italian peppers yields 60 peppers. If you need 750 green peppers (or 320 lbs.), you need to lay out 21 buckets.
- Move full buckets to the harvest lane as you fill them. When all the buckets are full, pick them up with a tractor or truck.
- Two people harvest from the same bed, each taking 1 side of the row. Watch for rot, which might on the outside look like a small blemish but is usually more substantial on the inside. Most rot on organic farms is caused by the European corn borer. As the worm bores a small hole in the top of the pepper, water is able to penetrate the pepper, which causes secondary bacterial rot. Therefore, look for a small pinhole on the top of each pepper to detect possible decay.
- Mark the spot where you stop harvesting with a bright flag so that you can begin there the next time you harvest, because it might not be obvious when you return.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Planting in a plastic tunnel or in plastic mulch (with adequate mulch-like straw in the wheel tracks) will keep the peppers clean from mud, so washing may not be necessary. Sort and pack peppers in a well-lit packing shed. You can discover many blemishes during this process.
- If washing is necessary, use a rinse conveyor washer or use a brusher washer. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water. Make sure you use the appropriate pressure on the nozzles to avoid crop damage.
- Under no circumstances dunk peppers in cold water, as this can create cross-contamination of pathogens that are absorbed through the skin of the fruit.

Additional resources

- Wholesale Grading and Packing Instructions Fancy #1
- Wholesale Grading and Packing Instructions Sweet Large
- Wholesale Grading and Packing Instructions Sweet Medium
- Wholesale Grading and Packing Instructions Hungarian Hot
- Wholesale Grading and Packing Instructions Jalapeno
- Wholesale Grading and Packing Instructions Poblano
- Postharvest Factsheet Bell Pepper

Packing and storage summary for peppers

Packing in the field	Harvest in buckets and fill up in regular 1 ⅓ bushel boxes, either by count or volume.
Packing for delivery	In regular 1- or 1 ⍰-bushel boxes at 28 lbs. or in ½-bushel boxes at 14–15 lbs. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	Store peppers at 45° and 95–100% humidity. Peppers are sensitive to ethylene exposure and chilling injury. Peppers (especially the breakers, which are peppers just turning color) start to develop water loss and surface pitting when they are stored below 45° for over a week. Chilling injury is cumulative, so short exposure to colder temperatures is generally not harmful. Ripe peppers are ethylene producers and also sensitive to ethylene exposure. Allow for good air exchange.

Potatoes

Yield	An average yield of 1.3 lbs. of potatoes per row foot is common on the East Coast. Expect fingerlings to yield significantly less.
Standards	**Harvesting*** 300–400 lbs. per person, per hour (10–16 buckets) when using a mechanical harvester. Don't expect to harvest more than 50 lbs. per hour when forking potatoes out by hand.
	Washing and sorting 500 lbs. per person, per hour
Tools and supplies needed	⅝-bushel buckets, digging forks for manual harvest or a tractor with a potato digger, a tractor with a forklift, and 20-bushel bulk bins.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Potatoes are firm, free from defects and have an intact skin.
- Wait until the vines have died down before harvesting potatoes. This improves the quality of the potatoes, as the tubers start removing themselves from the stolons and the skin begins to harden up after the vines die. Also, if late blight is a problem, you might be able to protect the tubers from infection. Conventionally this is also done to control tuber size because the tubers stop growing after the vines die down. This is exactly the reason why organic growers in the Northeast have relatively small yields. Many organic potatoes don't require vine killing, as the leafhoppers tend to do this. Even a good spraying program doesn't control the whole leafhopper population. Inspect the crop for pathogens like *Rhizoctonia* and late blight before the vines die down, as they will continue to cause problems in storage. If vine kill is needed, mow 10 days to 2 weeks before harvest.
- Periods of heavy rain after vine kill can result in a pathogen infection of the tubers, so growers may have to dig earlier than expected to avoid heavy rainfall.
- Before digging, check that potatoes have developed a good skin set, which means that the skin won't easily rub off during handling. Dig up a few plants to determine if the tubers are ready to handle your harvest equipment.
- For early harvest (July–August): Potatoes have sized up to make a harvest worthwhile. Treat these new potatoes very gently, as they have not developed firm skin yet. Many mechanical harvesters aren't designed for early potatoes. If you don't have a bedlifter, and hand forking is not an option, you can attempt to use a mechanical harvester by digging deep and allowing soil to remain on the chains. Preventing the potatoes from getting in touch with the metal chains should protect the skin. Also, your crew should handle the potatoes with care when picking them up from the ground. Bring the new potatoes into a pack shed and allow some skin to form by forcing air through the stack using a plenum. Once the potatoes are dry, you can attempt to wash them gently with a brusher washer.
- Harvest for storage (mid-September into October): If at this point the vines have died back, the potatoes have formed a firm skin that doesn't get easily damaged by the mechanical harvester. Allow for daytime air temperatures to drop to around 60° for ideal harvest circumstances. When the tubers' core temperature is between 60–65°, they are less susceptible to bruising.

Harvest procedures

- If harvesting for new potatoes, dig them with a bed lifter or fork. Bring them into a barn and dry them with a high-speed fan until tubers are dry and skin does not peel off easily.

- Use a chain-type harvester for fall harvest. If picking up potatoes by hand, instruct the crew on how to select (grade) in the field.
- After picking up potatoes in buckets, transfer them into 20-bushel bulk bins. Have a tractor with forks drive slowly along the harvested bed so the crew doesn't have to lug the buckets to the headland. If harvesting multiple beds, leave the buckets where you emptied them. This prevents unnecessary trips in retrieving buckets.
- If the harvester has a conveyor that places the potatoes in a bin, set up a conveyor in the barn to sort culls before they go into long-term storage.
- Curing potatoes for long-term storage is done at 59°F and 95% relative humidity for 1–2 weeks. Prevent condensation and allow for fresh air intake.

Washing procedures

- Wash hands and sanitize equipment before cleaning potatoes.
- It's best to avoid washing or brushing new potatoes, as this removes their tender skin.
- If possible, only clean potatoes by dry brushing them.
- If this isn't an option, you can wash them with a brusher washer.
- For drying, put 2 fans blowing at high speed towards the pallets with the washed potatoes.
- Potatoes are sorted for quality and size. Size A potatoes must be larger than 1 ⅞ inch.
- Distribute washed potatoes within a week.

Additional resources

- U.S. Standards for grades of Potatoes
- Potato Harvest and Storage Factsheet
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for potatoes

Cleaning in the field	Select potatoes that are free from blemishes, bruises or rot.
Packing in the field	Load into 20-bushel bulk bins.
Packing for delivery	50 lbs. in paper bags, sorted by size See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	Potatoes need to be stored in absolute darkness to avoid greening of the skin. When curing potatoes, gradually bring the temperature down to the recommended level of 50°–60°. Extended storage is best at 39–41° and at 90–95% humidity for tablestock. At this temperature, the carbohydrates in potatoes convert to sugars over time, so potatoes stored in this way aren't suitable for frying and are only for tablestock.

Radishes

Yield	An average of 0.5 bunches of marketable radishes per row foot. Watermelon radishes yields are measured in pounds (harvested without tops), and yields range from ⅓–½ lbs. per row foot.
Standards	**Harvesting*** 60–80 bunches per person, per hour
	Washing 150 bunches per person, per hour
Tools and supplies needed	Rubber bands or twist ties (customer preference may influence this), and regular 1⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Radishes are about 0.75–1 inch in diameter.
- Radishes are round, similar in size, have good color, and are free of blemishes and cracks, and contain no pithiness.

Harvest procedures

- Wash hands before harvesting radishes.
- One person harvests several rows of radishes, preferably in the morning. Keep harvested radishes in the shade.
- Depending on their size, 1 bunch contains approximately 10–12 radishes, which is common in CSA shares and at farmers' markets. When wholesaling, a bunch needs to contain 10–12 radishes and weigh 0.5–0.75 lbs.
- Only take radishes that are free of blemishes and without splits.
- Hold the radish bunch with one hand and put the rubber band over the radish end of the bunch two times. Make sure all radishes stay in the bunch, but don't make it so tight that stems break.
- Don't count and box the bunches as you make them. Instead, place 4–5 bunches in a pile. When there are quite a few piles on the ground, someone can pick them up and pack them into 24- or 48-count harvest boxes.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- When washing radishes, use a rinse conveyor or a mesh table to properly clean off the soil from the roots. Some growers have connected a valve operated by a foot pedal to a stationary nozzle to free up a hand, which increases efficiency. Treat radishes gently as they can easily break off the stem.
- Radish leaves are quite fragile. Protect the leaves with your hand when spraying directly at the bunch.
- Dunking radishes to clean off the leaves isn't recommended, but when necessary, add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much peracetic acid solution to add to water.

Additional resources

- Radish Postharvest Factsheet
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for radishes

Cleaning in the field	Yellow leaves are discarded or pulled out of the bunch.
Packing in the field	48 bunches to a picking crate
Packing for delivery	48 bunches weighing 20 lbs., or 24 bunches weighing 10 lbs., in a regular 1 ⍰-bushel box. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	32° and 95% humidity. Radishes are not sensitive to ethylene exposure and produce very low levels of ethylene.

Rutabagas

Yield	An average of 2.55 lbs. of marketable rutabaga per row foot.
Standards	**Harvesting*** Depends on size, but 400 lbs. per hour is not unusual. Expect to harvest more than 400 lbs when rutabagas are large.
	Washing 350–400 lbs. per hour per person when using a brusher washer.
Tools and supplies needed	A tractor with a forklift, 20-bushel bulk bins, harvest buckets and sharp knives, or 1 ⅓-bushel harvest boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Before the ground freezes or before the tubers get too big for consumption. Rutabagas should not weigh more than 3 lbs.
- Rutabagas aren't a pretty looking crop to begin with, but only harvest tubers that are relatively round and don't weigh more than 3 lbs. You can feed unmarketable ones to farm animals.

Harvest procedures

- Pull rutabagas out of the ground, trim off any excess roots, then cut the stem about an inch above the tuber. Leave them in a windrow or put them directly in a bucket or harvest box.
- When harvesting for long-term storage, transfer the buckets into 20-bushel bins. A tractor with forks drives slowly along the harvested bed so that the crew doesn't have to lug the full buckets to the headland. If harvesting multiple beds, leave the buckets where you emptied them. This prevents unnecessary trips to retrieve buckets.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Wash in a barrel washer or a brusher washer.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for rutabagas

Cleaning in the field	Dirt is rubbed or cut off the bottom part of the tuber.
Packing in the field	1,000 lbs. per 20-bushel bulk bin
Packing for delivery	25 lbs. per plastic bag See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack in closed containers or bags for long-term storage.

Scallions

Yield	An average of 1 bunch per row foot
Standards	**Harvesting*** 50 bunches per person, per hour, or approximately 300–450 hours per acre
	Washing 100 bunches per person, per hour
Tools and supplies needed	Rubber bands or twist ties (customer preference may influence this), regular 1 ⅓-bushel boxes, and serrated knives. Use a tractor and bedlifter if available.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- When scallions are about pencil size to ½ inch in diameter with tops at least 12 inches tall.
- Scallions have dark green foliage, aren't crushed or damaged, and have no signs of any defects from insects, bacterial rot or other pathogens. Roots are pure white.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Pull scallions out by grabbing them as low as possible at the stem to avoid crushing the green part of the stem. If possible, precede harvest with a bedlifter.
- Each bunch contains about 6–8 scallions, weighing about 4 oz. If needed, clean off any yellow leaves before placing a rubber band or twist tie around the bunch. Make sure all scallions are even at the root base.
- Shake some of the soil particles off the roots and cut them at approximately ½ inch with a serrated knife.
- Don't count and box the bunches as you make them. Instead, place 4 or 5 bunches in a pile. When there are quite a few piles on the ground, someone can pick them up and count them into plastic harvest boxes, placing either 24 or 48 bunches in each harvest box.

Washing procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Place scallions on a wire mesh table and rinse them off by hand, but don't dump them into a washing tub, as waterlogged scallions will rot easily. Some growers have connected a valve operated by a foot pedal to a stationary nozzle to free up a hand, which increases efficiency.
- Alternatively, run scallions through a rinse conveyor washer, and make sure you use the appropriate pressure on the nozzles to avoid crop damage. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.

Additional resources

- Postharvest Factsheet Scallions
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for scallions

Cleaning in the field	Remove yellow leaves. Cut roots at ½ inch. Leaves are cut to the length of the box if needed (this isn't preferred).
Packing in the field	24 or 48 bunches to a regular 1 ⅓-bushel box
Packing for delivery	24 or 48 bunches to a regular ½ or 1 -bushel box weighing approximately 5–6 lbs. or 10–12 lbs. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–42° and 95–98% humidity. Cover in closed containers or bags if stored for a few days. Scallions are not overly sensitive to ethylene exposure.

Spinach

Yield	An average of 1 lb. per bed foot for baby spinach and an average of ¼ lbs. per row foot for full-grown spinach, because the rows are much farther apart.
Standards	**Harvesting*** 4–8 boxes per person, per hour, with each box containing about 8 lbs. The wide range is due to leaf size; baby spinach takes significantly longer to harvest than full-grown spinach. Machine harvest, using a piece of equipment mounted by a three-point hitch, can be up to 35–50 boxes per hour and takes 3 people. Field conditions have a big influence on the rate; you'll need to slow down the machine dramatically for sorting for weeds, yellow leaves and leaf miner damage.
	Washing 8–10 boxes per person, per hour
Tools and supplies needed	A machine harvester or harvest knives, and regular 1 ⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Leaves are 4–6 inches tall, healthy and dark green.
- Spinach needs to be free of weeds, yellowing, necrosis or other blemishes. It can't have signs of white mold, leaf miner damage or other pest damage.

Harvest procedures

- Wash your hands and sanitize knives before harvesting.
- Harvest in the morning hours to avoid field heat accumulation.
- Use different boxes for harvesting in the field and for distribution.
- Walk the fields before harvesting to inspect the crop for animal damage or feces. Mark these spots with a flag so the tractor operator or harvest crew can avoid harvesting near them.
- When machine harvested**:**
    - Weed the field thoroughly before harvesting, as people on the machine won't be able to keep up with sorting at the speed of harvesting.
    - During harvest, remove all yellow leaves from the belt before they fall into the crates. When using a handheld harvester, you'll sort after harvesting.
- When hand harvested with a knife:
    - Hold a small bunch of leaves at the top of the plant with one hand and cut in one motion with the other hand.
    - Remove any yellow leaves and stems from previous cuttings (if this isn't the first cut).
    - Place the leaves in a box.

Washing and storage procedures

- Wash hands and rinse boots before entering the wash-and-pack shed, and cover up field clothes with a bib. If a long-sleeve shirt contains soil, remove this as well.
- Add a sanitizer to the wash water. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much hydrogen peroxide and peracetic acid solution to add to water.
- Wash spinach at least twice, unless using a passthrough, conveyor-style washer (where water isn't

circulated).

- Don't leave greens in water for longer than 1 minute. Leaves tend to get waterlogged after a few minutes, which causes them to deteriorate faster.
- Dry spinach in a centrifuge, but take care that leaves aren't damaged, as this can cause bacterial soft rot (*Erwinia* and *Pseudomonas*) in storage. There are different sizes and models of commercial-grade salad spinners available through restaurant equipment suppliers.
- Pack according to the market:
    - For wholesale, baby spinach goes in 5 oz., 10 oz. or 16 oz. clamshells
    - For restaurants, full size spinach goes in in ½-bushel or 1 ⍰-bushel boxes
    - For a CSA or farmers market, put baby spinach in clamshells and bag full-size spinach

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for spinach

Cleaning in the field	Stems or yellow leaves are removed
Packing in the field	8 lbs. per regular 1 ⅓-bushel box
Packing for delivery	3 lbs. per regular ½-bushel box, or in 5, 10 or 16 oz. clamshells See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–42° and 95–98% humidity. Cover in closed containers or bags if stored for a few days. Spinach is highly sensitive to ethylene exposure, which will turn the leaves yellow. Allow for good air exchange and don't store it with crops that release ethylene.

Strawberries

Yield	An average of ¾ pint per row foot (in a dry year over a 2-week harvest window) Expect different yield numbers for everbearing berries.
Standards	**Harvesting*** 15 quarts or 25 pints per person, per hour
Tools and supplies needed	Boxes with pint or quart baskets and, if needed, netting to cover berries. Bowls to pick in are optional if berries aren't picked directly into pints or quarts.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Strawberries are ripe (75% of their surface shows a pink or red color) and firm.
- Discard overripe berries, as they don't hold up until the time of delivery.
- Berries are at least ¾ inch in diameter and free from blemishes or pest damage. Minor defects (less than 10%) are acceptable, but there's zero tolerance for decay or mold.

Harvest procedures

- Wash hands before harvesting strawberries.
- Pick berries in the morning when they are dry.
- Each person takes 1 row of strawberries, picking into a bowl or directly into pint baskets.
- When the bowl is filled, pour the berries into the pint containers inside a small box.
- Fill the pint containers until they have a rounded top, then place a net over the top.
- Make sure to keep the harvest crew in 1 section of the field at a time.
- Mark where you stop so you can start there the next day.
- Place the berries in a cooler within an hour of picking. A person who wasn't harvesting should do this. Otherwise, make sure you have clean hands and boots before entering the packing shed.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for strawberries

Packing in the field	In bowls or directly into pint or quart boxes
Packing for delivery	12 pints or 8 quarts per box See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	Store in a cooler overnight. Don't put the crop in a cooler if delivering on the same day as harvest. Store at 32°F and 90% humidity for 5–7 days.

Squash, Summer (Includes Zucchini)

Yield	An average of 4.33 lbs. of marketable zucchini per row foot, but higher numbers are possible with good fertility management, optimum irrigation and good insect control practices.
Standards	**Harvesting*** 5–6 buckets or 120 lbs. per person, per hour
Tools and supplies needed	Pocket or paring knives, ⅝-bushel buckets
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Yellow squash is 4–6 inches long and has a good thickness. Generally, harvest zucchini at a length of up to 7–8 inches with a thickness of 1 ¼–1 ¾ inches.
- On warm days, pick squash every day, and sometimes twice a day, to control the size you're harvesting.
- Fruit is straight (apart from crookneck types), firm from stem to tip and free from defects. Discard squash with soft tips. Misshapen squash indicates poor pollination.
- Plants with squash bug infestations need to be abandoned and worked under to avoid spreading to later successions.

Harvest procedures

- Wash hands and sanitize knives before harvesting squash.
- You need to harvest squash and zucchini from both sides of the plant to avoid misses.
- Zucchini needs to be cut from the plant, and while you can also cut summer squash, try to twist it off by hand without damaging the plant. The advantage of this is that viruses won't be transmitted between plants via the harvest knife.
- Protect the fruit from being damaged by the spines of the plant by wrapping your hand around the fruit, and carefully place it in the bucket. Many harvest crews will wear gloves to avoid damaging the tender fruit with their fingernails.
- When the bucket is full, carefully put it next to the harvest lane.
- If the vines give you a rash, wear a long-sleeved shirt.
- After harvesting all of the squash and zucchini, pick up buckets with a harvest truck or wagon.
- Count into boxes in the pack shed.

Washing procedures

- Using adequate mulch like straw can keep the fruit clean, which makes washing unnecessary. Sort and pack squash in a well-lit packing shed. Many blemishes are discovered during this process.
- If washing is necessary, use a rinse conveyor washer or use a brusher washer. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water. Make sure you use the appropriate pressure on the nozzles to avoid crop damage.
- Under no circumstance should you dunk squash in cold water, as this can create cross-contamination of pathogens that are absorbed through the skin of the fruit.

Additional resources

- Wholesale Grading and packing Instructions Zucchini

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for summer squash and zucchini

Packing in the field	Fill buckets
Packing for delivery	40–60 pieces per 1 ⍰-bushel box, or half that amount when packed in a ½-bushel box. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	Chilling injury is caused when summer squash is kept at temperatures below 41° for more than a day or two. For 1–2 weeks of storage, keep squash at 41–50° and 95% humidity. Zucchini is sensitive to ethylene exposure, which will cause it to soften and turn color. Allow for good air exchange and don't store zucchini with crops that release ethylene.

Squash, Winter

Yield	Yields of marketable winter squash per row foot vary greatly depending on the variety, insect control and season. Butternut yields are double that of many of the buttercups and Japanese types. Expect anywhere between 1.5 lbs. and 3 lbs. per row foot.
Standards	**Harvesting*** 400–600 lbs. per person, per hour when loading into a 20-bushel bin
	Washing 400–600 lbs. per person per hour when using a brusher washer
Tools and supplies needed	⅝-bushel buckets, a tractor with a forklift, and 20-bushel bins
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Squash have full color, which varies based on the variety. Green acorn squash develops an orange ground spot. Harvest kabocha squash when they're slightly on the green side, as they continue to mature after harvest.
- Squash are mature and are free of blemishes and black rot infestations (on butternut squash, this looks like concentric circles).

Harvest procedures

- Harvest squash before nighttime temperatures drop into the 40s if possible, as these temperatures can cause chilling injury, which accumulates over time.
- The harvest crew goes down the rows and pulls the squash off the vines. Cut stems on acorn and butternut very short so they don't puncture other squash in the bin.
- Put each variety of squash in a windrow down the length of the bed (out of the vines so they are easy to see), or you can put them directly into buckets.
- It's time to pick up the squash when there is a good amount of one variety harvested.
- One person rides in a bulk bin and another person hands them the squash until the bin is full enough for both people to gently fill from outside the bin. Or, carefully empty the buckets into the bulk bin.
- Each variety of squash should have its own bin.
- Butternut and buttercup squash need to be cured in the greenhouse at 85° for 7–10 days to be sweet tasting. Cover the greenhouse with 80% shade cloth. Other varieties don't need to be cured.

Washing procedures

- Wash squash in a rinse conveyor washer or brusher washer just before delivery.
- Squash is sorted for quality and size.
- To dry them, put 2 fans blowing at high speed towards the pallets of washed squash.
- For a CSA delivery, distribute sweet dumpling, delicata squash, buttercup and kabocha varieties first, as they don't keep very long. Keep butternut for the last deliveries.

Additional resources

- Postharvest Factsheet Winter squash
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for winter squash

Packing in the field	Fill buckets and place them in a 20-bushel bin
Packing for delivery	Put 35–40 lbs. in a 1 ⍰-bushel box See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	To avoid chilling injury, don't store winter squash below 50° or otherwise expose it to a temperature this low. The best temperature for long-term butternut squash storage is 59°. Winter squash is moderately sensitive to ethylene exposure, which will cause it to soften and turn color. Allow for good air exchange and don’t store winter squash with crops that release ethylene.

Sweet Potatoes

Yield	An average of 1.2 lbs. of marketable, cured sweet potatoes per row foot, with climate having a great influence on yield. Sweet potatoes continue to put on weight until harvest, and size is controlled in southern states by timely harvesting. In the Northeast, reaching optimum yield requires a full growing season.
Standards	**Harvesting*** 200–250 lbs. per person, per hour
Tools and supplies needed	Buckets, bulk bins, and either a tractor with a potato digger or a tractor with a bedlifter and another with a forklift. Use a hand fork when harvesting by hand.
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Harvest sweet potatoes before the soil temperature goes below 55°.
- Grade 1 sweet potatoes for wholesale are 3–9 inches long, and the tubers have a diameter of 1 ¾–3 inches. Individual tubers cannot weigh more than 1.125 lbs.
- In North Carolina, the correct harvest date is when most of the tubers have reached their optimum dimension for a high pack-out. In the Northeast, the time when tubers reach their optimum size greatly depends on the season and location.
- All harvested tubers are free from defects.

Harvest procedures

- Before using a bedlifter or root digger, you may have to mow the vines or cut them by hand and set them aside.
- For bulk harvest: Place about 30 buckets on the harvester. One person drives the tractor while 3–4 people sort out the good potatoes on the machine and place them on the outside chains. One or 2 people change the buckets on the back of the harvester. Bring the full buckets to the harvest lane. One person drives the tractor with a bulk bin down the harvest lane and carefully dumps the potatoes into the bin.
- Sweet potatoes are easily bruised, so you need to handle them gently.
- You need to cure sweet potatoes in a greenhouse or a curing chamber for 10 days at 85°. Cover the greenhouse with 80% shade cloth. Cover up the bins with tarps to protect against sunscald, but allow them to breathe (don't use plastic).

Washing procedures

- After curing, you can easily remove any soil particles left on the sweet potatoes by hand. Some soil particles left on a sweet potato don't harm it, but you should remove most dirt before long-term storage. If you need to wash sweet potatoes it's best to do this after curing and right before delivery, because the washing procedure can shorten their life and introduce mold.

Additional resources

- Sweet Potatoes Visual
- Postharvest Factsheet Sweet Potatoes
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for sweet potatoes

Cleaning in the field	Remove large chunks of dirt
Packing for delivery	Sort by size and pack into 40 lb. sweet potato boxes. For a CSA delivery, pack potatoes in a 2–3 lb. paper bag, and pack these in boxes. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	55° and 80% humidity. Sweet potatoes are moderately sensitive to ethylene exposure, which affects flavor and color. Allow for good air exchange and don't store them with crops that release ethylene.

Tatsoi

Yield	An average of 0.2 lbs. per row foot
Standards	**Harvesting*** 40 lbs. per person, per hour
	Washing 8–10 boxes per person, per hour
Tools and supplies needed	Knives and regular 1 ⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Tatsoi is approximately 4–6 inches tall.
- Tatsoi is dark green, free from holes and yellow leaves.

Harvest procedures

- Wash hands and sanitize knives before harvesting.
- Harvest in the morning to avoid field heat accumulation.
- One hand holds a small bunch of tatsoi by the top of the leaves. The other hand cuts with a knife in a smooth motion.
- You can also harvest tatsoi as a head, the same as bok choy.

Washing procedures

- Wash tatsoi at least twice, except when using a passthrough, conveyor-style washer.
- Add a sanitizer like hydrogen peroxide and peracetic acid to the water of the first rinse tank. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water.
- By going through the 2 tubs of cold water the greens stay fresher longer and are very clean.
- Don't leave greens in water for longer than 1 minute. Leaves tend to get waterlogged after a few minutes, which causes them to deteriorate faster.
- Dry the loose leaf tatsoi in a centrifuge or salad spinner, but take care that leaves aren't damaged, as this can cause bacterial decay. There are different sizes and models of commercial-grade salad spinners available through restaurant equipment suppliers.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for tatsoi

Cleaning in the field	Remove stems or yellow leaves
Packing for delivery	3 lbs. in ½-bushel boxes
Storage	At 32°–42° and 95–98% humidity. Cover in closed containers or bags if stored for a few days. Tatsoi is highly sensitive to ethylene exposure, which will turn the leaves yellow. Allow for good air exchange and don't store with crops that release ethylene.

Tomatoes

Yield	Yield figures are averages based on growing tomatoes in a protected environment like a caterpillar tunnel. Outdoor yields vary year to year due to weather impacts. All figures are per row foot: ● Early beefsteak (all sizes): 6 lbs. ● Cherry tomatoes: 4 pints, with variation between varieties ● Heirlooms: 2.8 lbs. ● Midseason beefsteak: 6 lbs. ● Plum tomatoes: 5 lbs.
Standards	**Harvesting** (rates include sorting and packing as applicable)* ● Early, small beefsteak in quart baskets: 30–40 quarts (60–80 lbs.) per person, per hour ● Large beefsteak: 200 lbs. per person, per hour ● Cherry in pint baskets: 20–30 pints per person, per hour ● Heirloom: 80–100 lbs. per person, per hour ● Plum: 100–00 lbs. per person, per hour, depending on size
Tools and supplies needed	Buckets (for beefsteak, smalls and plums), tomato trays (for heirloom varieties), and pint or quart containers
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Tomatoes are well formed for their type.
- "Marketable" size depends on the market, but in general "marketable" implies the characteristics mentioned below.
- Maturity depends on how far removed you are from the end buyer. The buyer will communicate how they want to receive the product: either stage 1 (mature green), stage 2 (pink) or stage 3 (vine ripe).
- Tomatoes have a uniform color throughout the fruit with no sign of green shoulders or gray wall. Fruit is smooth, with small scars at the blossom and stem ends.
- Tomatoes show no signs of growth cracks, cat-facing, zippering, sunscald, insect injury, insect frass or honeydew, or physical injury or bruises.
- Beefsteak tomatoes yield only to firm hand pressure. Soft and easily deformed tomatoes are overripe.
- Heirlooms are often soft. While this isn't a true indicator that there's something wrong with them, softness can be challenging for growers who intend to ship their product, as a long truck ride can bruise these tomatoes.

Harvest procedures

- Avoid harvesting when the crop is wet either from rain or dew.
- Each person takes one side of a tomato row.
- Pick tomatoes into buckets or tomato trays (only use 1-layer trays for heirloom tomatoes and ones that are very ripe). Pick cherry tomatoes directly into pints or harvest buckets.
- For beefsteaks, remove the green stems to prevent puncturing tomatoes in the bucket. Place them face down when picking in a 1-layer tray. Generally, the stems from heirloom tomatoes or cherries aren't removed. In the case of the Sun Gold variety, removing the stem reduces storage.
- Heirloom and some beefsteak varieties are very soft and easy to damage. Harvest them very carefully into 1-layer tomato trays.
- Mark the spot where you stop harvesting with a bright flag so that you can begin there the next time

you harvest.

Cleaning procedures

- Tomatoes stay clean and washing is unnecessary when using adequate plastic and straw mulch.
- Washing decreases storage life and can introduce pathogens.
- As needed, clean tomatoes by wiping them with a clean cloth.
- Sort tomatoes for size and quality in a well-lit packing shed.
- If washing is necessary, use a conveyor brusher washer. Make sure to dry tomatoes after washing.

Packing procedures

- For a CSA or farmers market, you can pack small beefsteak tomatoes into quart baskets. Fill to a rounded top and possibly place a net on top to avoid spills. Each quart weighs approximately 1.8 lbs.
- Distribute cherry tomatoes in pint baskets. Fill to a rounded top and possibly place a net on top to avoid spills.
- Pack large beefsteak tomatoes into tomato boxes. A 5x6 box means that each layer in the box can accommodate 5 tomatoes on the short side and 6 tomatoes on the long side, or 30 tomatoes per layer.
- Sort heirlooms by size into 1-layer tomato trays.
- Distribute plum tomatoes in boxes of 20–25 lbs.

Additional resources

- Postharvest Factsheet Tomatoes
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for tomatoes

Cleaning in the field	Remove stems from all red beefsteak tomatoes except the heirlooms.
Packing for delivery	Communicate with your buyers or customers on the desired maturity (stage 1 mature green, stage 2 pink and stage 3 ripe) and how to pack. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	The ideal storage temperature for ripe tomatoes is 50° and 90–95% humidity. Light red tomatoes are best kept at 55° and mature green at 60°. You can ripen tomatoes faster by keeping them at temperatures as high as 75°. Tomatoes are sensitive to chilling injury when held for longer than 2 weeks below 50° or for longer than a week at 41°. Tomatoes are sensitive to ethylene, which also allows them to ripen. Ripe tomatoes also produce ethylene. Exposure will reduce shelf life.

Turnips, Bunching

Yield	Average of ½–1 bunch per row foot
Standards	**Harvesting*** 50–60 bunches per person, per hour
	Washing 100 bunches per person, per hour when washing by hand, and faster when using a conveyor washer
Tools and supplies needed	Rubber bands or twist ties (customer preference may influence this) and plastic 1 ⅓-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Turnips are 2–3 inches wide, with healthy tops for bunching.
- Turnips are white (not turning yellow). They have no tunneling or eating damage by cabbage root maggots or wireworm, and no cracks. Leaves are light to dark green, with no yellowing, necrosis or aphids.

Harvest procedures

- Pull the larger turnips out of the rows, clean off any dead leaves, and tie 3–5 turnips per bunch. Hold the twist tie tightly next to the stems and twist the bunch. Make sure the tie is tight enough to keep the turnips together during washing.
- All bunches should be uniform in size and weigh approximately ¾ lbs.
- Don't make bunches and count them into boxes at the same time, as this can cause mistakes in counting. Instead, leave piles of 4–5 bunches on the bed or in the wheel tracks. Periodically pause to box them to avoid over harvesting. Place all the bunches in the same direction in the box to keep the leaves clean.

Washing procedures

- Use a mesh table to wash the turnips. Be careful to keep the nozzle away from leaves as they are very tender. Some growers have connected a valve operated by a foot pedal to a stationary nozzle to free up a hand, which increases efficiency.
- Alternatively, use a rinse conveyor washer. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water. Make sure you use the appropriate pressure on the nozzles to avoid leaf damage.

Additional resources

- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for bunching turnips

Cleaning in the field	Remove dead and yellow leaves from bunches.
Packing in the field	15–20 bunches per plastic 1 ⅓-bushel box. Pack all the roots on just one side of the box so the greens don't get muddy.
Packing for delivery	15–20 bunches per 1 ⅓-bushel box for a CSA, packed in rows of 5. 24 bunches per 1 ¾-waxed-bushel box. Pack tightly, root to leaf. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 32°–41° and 95–100% humidity. Pack with ice in closed containers for storage longer than a few days.

Watermelons

Yield	Average of 0.8 watermelon per row foot
Standards	**Harvesting*** 50–75 watermelons per person, per hour
	Washing Use a conveyor washer
Tools and supplies needed	20-bushel bins or large green 1 ¾-bushel boxes
*Harvest rates don't include the time required to transport crops from the field to a wash and pack shed or storage facility.	

Ready-to-harvest and quality indicators

- Watermelons are ready to harvest when at least 2 out 3 ripeness indicators occur:
    1. The tendril closest to the melon is shriveled up (depending on variety).
    2. The melon has a yellow coloration on the side not exposed to the sun.
    3. The melon sounds hollow (the "poink") sound when tapped. This indicator can be hard to get right when your harvest crew is inexperienced with watermelons.
- Good quality watermelons should:
    1. Be symmetrical and uniform in appearance
    2. Have a surface that appears bright and waxy
    3. Have no dirt, scars, sunburn, transit abrasions, bruising or other surface defects
    4. Feel heavy for their size

Harvest procedures

- One or 2 people stand on a harvest wagon and the others each take a row of watermelons.
- For small watermelons like Sugar Baby: After a picker harvests a melon, they toss it underhanded to one of the people on the truck. Make sure you have eye contact with the catcher before you toss it.
- When dealing with large melons, the crew should bring them to a large melon bin (20–24 bushels) and carefully place them inside.
- Move the harvest wagon down the harvest lane as you pick.

Washing procedures

- Using adequate mulch like straw can keep the fruit clean and make washing unnecessary. Sort and box watermelons in a well-lit packing shed. Many blemishes are discovered during this process.
- If washing is necessary, use a rinse conveyor washer or brusher washer. Add a sanitizer like hydrogen peroxide and peracetic acid to the water in the circulation tank of the rinse conveyor vegetable washer. Use the guide *How to Wash Produce Using a Peracetic Acid Solution* to establish how much sanitizer solution to add to water. Make sure you use the appropriate pressure on the nozzles to avoid crop damage.
- Under no circumstance dunk melons in cold water, as this can create cross-contamination of pathogens that can be absorbed through the skin of the fruit.

Additional resources

- Watermelon Postharvest Factsheet
- Production Guide for Storage of Organic Fruits and Vegetables

Packing and storage summary for watermelons

Cleaning in the field	Brush off any soil or straw mulch
Packing in the field	If possible, sort by size in either large boxes or squash bins. Do a quick field inspection for any defects before placing them in the bin.
Packing for delivery	Sort by size and quality. Commercial melons are graded into 30-, 36-, 45- and 60-count sizes. Specialty types can be smaller. The majority of the pre-July 4 market is 36- and 45-count fruit. See the International Federation for Produce Standards for the correct PLU code. Add the prefix 9 for organic crops.
Storage	At 45°–59° and 85–90% humidity. Chilling injury will occur when stored below 45° for several days. Watermelons are sensitive to ethylene exposure, which will cause them to soften. Allow for good air exchange, and don't store watermelons with crops that release ethylene.