

HARVEST MATURITY INDICATORS FOR FRUITS AND VEGETABLES



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The most critical handling points of any commercial fruit and vegetable operation is harvest—this is the starting point for the postharvest management process. Any mistakes made at harvest will be reflected and magnified down the line. Once an item is harvested, its quality cannot be improved, only maintained at best. The right decisions need to be made at the beginning, this means harvesting at a time of day when quality can best be maintained, at a stage of development or maturity that best fits your market, and only harvesting “number one, grade A” produce. Once harvested, all newly harvested produce should be handled in a timely fashion and put into cold storage until sold and shipped.

Harvest, from a labor and resource management standpoint, is the most time and resource consuming activity in the production and marketing of any product. It requires the pickers and supervisors to continually think if this one or that one is ready for harvest. Besides taking time to make a decision, pickers must be continually trained to maintain a skilled work force.

When To Harvest

Harvest should be done during the coolest part of the day, which is usually the early morning. The shelf life of produce is closely tied to its respiration rate. The higher the respiration rate, the shorter the shelf life. The respiration rate is directly related to the air and produce temperature. At high tempera-

tures, the respiration rate is higher, so the shelf life of produce is reduced. Keeping the produce’s temperature low increases shelf life. Optimum storage temperature and harvest temperature differences should be kept to a minimum. By harvesting during the cool part of the day the differences will be minimized, the shelf life will be prolonged, and precooling energy costs will be reduced. Besides waiting for the coolest part of the day, waiting for any surface moisture from dew or rain to dry will prevent postharvest disease problems.

How To Harvest

Specific harvest procedures for each crop will be covered later, but there are some general handling and harvest practices common to all produce. Produce should be handled with care to minimize mechanical damage. Mechanical damage renders the produce unmarketable and allows for disease organisms to enter. Some fruits and vegetables are more durable than others, but all should be treated with the same gentle handling.

Handling and harvest containers and utensils should be cleaned and disinfected daily. This will reduce postharvest losses due to disease. Cutting utensils should be sharp to prevent damage to the plant. Workers should be trained on how to use sharp knives and shears safely to prevent needless injuries. Transport vehicles and field handling areas should be cleaned after harvest daily, too.

Besides harvesting during the cool part of the day, harvested produce should be kept as cool as possible. Field collection and handling areas should be shaded and produce should be moved to the packing, handling, cold storage area as soon as possible.

Field Packing

Most people only think about grading and culling in the packing shed. The first steps in grading and culling should be done when you select what and what not to harvest. Most culling of diseased and inferior produce should be done in the field. They should be left in the field. It is a waste of time and labor to handle unmarketable produce. It costs money, in time and labor, each time each fruit or vegetable is handled. It pays to only harvest and handle marketable produce and to minimize the number of times it is done.

Some produce can be graded, cleaned, processed and packed into shipping containers in the field. The only handling steps left to do are precooling and storage until it is sold and shipped. Field packing requires a skilled labor force and a mobile packing line to supply containers and packing materials. Many very perishable and fragile fruits and vegetables are field packed to reduce the amount of handling.

Shed Packing

There is no difference in harvest procedures whether the produce is packed in a shed or in the field. For shed packing, harvested produce is placed in temporary holding containers until it is moved to the packing shed where it is graded, cleaned and packed. Harvest containers can be specialized to fit the crop and the packing line requirements.

Harvest Maturity

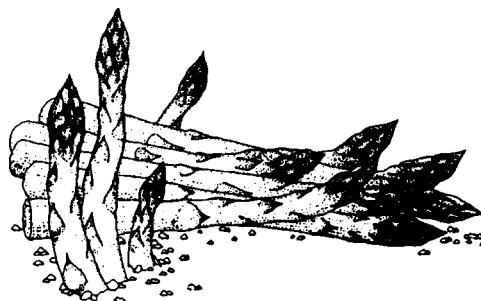
It is not well understood that there is a difference between ripe and mature. Produce that is ripe is mature and ripe produce is ready for sale and use. Produce that is mature may or may not be ripe but will ripen if given the right conditions. The best example is the mature green tomato. These tomatoes are harvested when they are green but at a stage where they will eventually turn red and soften somewhat.

There are many methods to determine produce maturity. The most common is the size of the individual item. Industry has set standards to which individual crops must conform. Size may be diameter and/or length. Another physical characteristic is firmness as determined with a pressure tester. Firmness is often correlated with chemical changes that occur during ripening. Chemical characteristics include soluble solids, iodine-starch test, and acidity. Soluble solids determine the sweetness of a crop, and the soluble solids to acidity ratio determines the overall flavor of the crop. The iodine-starch test determines the amount of starch converted to sugar in a crop. Days from full bloom will give an average maturity date based on previous records for the crop.

Following, are listed the optimum stages of maturity and harvest techniques for several common fruits and vegetables. As stated earlier, the appropriate maturity stage will depend on the chosen market. Baby vegetables will have much different and earlier harvest dates than "mature" full size vegetables. If the produce is going into long-term storage, the maturity stage can be different too. Different cultivars have different harvest maturities, too. If the produce is to be shipped, harvest in a less ripe stage so it will be firmer and travel better.

Vegetables

Asparagus. Most commercially grown asparagus is harvested by cutting. Spears should be cut with a knife at ground level or an inch below the surface. Asparagus may also be harvested by snapping the spears. The break point on snapped asparagus is where tissue starts to soften. With this method there is no waste to the consumer. Spears should be



at least a half inch in diameter and 8 to 10 inches long with the tips tight and stem bracts adhering

tightly to the spear. Spears are bunches with the tips even and cut to a uniform length.

Beans. Maturity for snap bean harvest is based on the diameter of the bean. USDA has six standard size designations for snap beans. Size 1 and 2 — any bean less than $18\frac{5}{60}$ inch in diameter — are considered too small, and size 6 — any bean more than $27\frac{7}{64}$ inch in diameter — is considered overmature. Beans should



be fairly straight and true to color. Specialized markets for French filet beans and baby beans accept size 1 and 2 beans. Size 6 beans could also be marketed as “shellie bean,” beans sold for shelling out the beans inside and discarding the pod. These are especially marketable if the bean seed is colorful.

Beets. Size is the harvest indicator for beets. Most beets are harvested when they are 1 to 3 inches in diameter. Baby size beets can be harvested at a smaller size. Beets prepared with tops are also harvested at a smaller size when the tops are still tender. Standard size beets can be sold with the tops intact, topped with stems no more than a half inch long or short-trimmed with stems no more than 4 inches long.

Broccoli. Heads should be harvested when the florets are tight and the color is a rich green with a purplish cast. Terminal head diameter should be at least 3 inches. Smaller heads can be bunched to achieve the specified count for the carton. Stems and heads should be cut at about 8 inches in length. Side shoots and large leaves should be trimmed leaving about a 6-inch bare stem. Any head that is yellowish in color and with open florets should be discarded.

Brussel Sprouts. Harvesting after a moderate freeze will improve the quality of brussel sprouts immensely. They become sweeter and more palat-

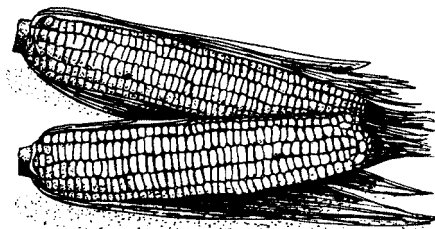
able. Harvest from the bottom of the stem up and only harvest firm sprouts that are 1 to $2\frac{3}{4}$ inches in diameter. Outer leaves should be removed.

Cabbage. Days to harvest and head firmness are harvest indicators for cabbage. Days to harvest will give you a good idea to when to start checking head firmness. Heads should weigh at least 1 pound. Outer leaves should be removed so all remaining leaves adhere tightly to the head.

Carrots. Size is the basis for harvesting carrots. Standard varieties should have roots at least 5 inches long and between $\frac{3}{4}$ inch and $1\frac{1}{2}$ inches in diameter. They may be sold with or without tops. If sold with tops, the leaves and petioles should be bright green and turgid and between 12 inches and 20 inches long. If sold without tops, the petioles should be trimmed to leave about a half-inch green “stem.” Baby carrots are harvested at an immature stage with the desired size about 3 inches long. Novelty varieties such as the round globe types are harvested before they become woody or split and when they have developed their characteristic shape.

Cauliflower. Unless you grow self-blanching varieties, the leaves around the head should be tied when the head is 1 to 2 inches in diameter. Head should mature two weeks after tying. The florets or curd should be creamy white and tight. Heads should be at least 4 inches in diameter and trimmed of excess stem and leaves.

Corn. Sweet corn is ready to harvest when the silks have dried to a golden brown, the kernels are plump and the ear is well filled.



Excess husks should be removed, but most left attached to protect the ear in shipment. Cobs should be at least 5 inches long.

Cucumbers. Size and color are harvest indicators for cucumbers. Slicer types should be straight and at least 6 inches long and no bigger than $2\frac{3}{8}$ inches in diameter. Pickling types will be shorter and smaller in diameter. The color can range from light to dark

green, with no yellow color. Yellow indicates the cucumber is over mature.

Eggplant. The color and condition of the skin are the harvest indicators for eggplant. The skin should be bright and shiny. A dull matte finish means the fruit is overmature, is seedy and maybe bitter.

Garlic. Garlic should be harvested when the tops start to dry down. They should be pulled and then cured in a warm (80° to 85°F), dry place for 2 weeks, then cleaned and graded by size.

Greens (Includes chard, collards, kale, mustard greens, and spinach). Greens are ready for harvest when the plant and/or leaves reach a size suitable for sale. They can be sold as whole plants or the older, larger leaves can be cut and sold in bulk. Whole plants should be groomed to remove damaged old leaves and should be at least 6 inches in diameter.

Herbs. Most leafy type herbs should be harvested before they bloom. Leaves should be of mature size.

Lettuce. Size is the harvest indicator for lettuce. Standard size will depend on the varieties, but can range from 3 inches in diameter for Boston-types, to



6 inches in diameter for iceberg-types. Baby lettuces will be smaller. Heads and leaves should be true to color for the type, and damaged leaves should be removed.

Melons. Cantaloupe or muskmelon stems slip or naturally break when the melons are ripe. Other indicators are soluble solids of at least 13 percent, softening at the bloom end, aroma, change in color of the internetting areas from green to yellow and of the netting to a yellowish color. The maturity of other non-slipping melons can be determined by days from bloom, percent soluble solids of at least

13 percent, softening at the bloom end, aroma, and rind color changes characteristic for the variety.

Okra. Size is the harvest indicator for okra. Pods should be no more than 2 to 3 inches long and the stem should be tender when cut.

Onions. Green onions are ready for harvest when they reach a salable size at least ½ inch in diameter but no more than 1 inch and between 8 inches and



24 inches long. Dry onions are ready for harvest when at least half the onions in the field have their tops fallen over. At that time, all the onions can be harvested, cured in a warm (80° to 85°F), dry place for 2 to 3 weeks, then cleaned and graded by size.

Oriental Vegetables. This is a wide variety of different types of vegetables. Chinese cabbage should be treated like cabbage, the leafy green types like greens, and fruit types like the respected fruits they are.

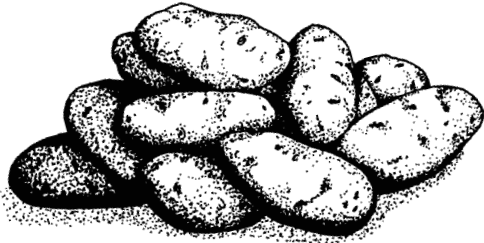
Parsnips. Parsnips should be harvested after several moderate freezes to improve their flavor. They should not be less than 1 inch in diameter but not more than 2¼ inches at the top and 8 inches long. Their tops should be trimmed to leave about a half-inch stem.

Peas. Harvest when the peas have filled out the pods. You can feel the individual peas when you feel on the pod. Pods should be green in color and turgid. Chinese-type edible pod peas are harvested when they reach a desired size. Sugar snap type edible pod peas should be round and firm. The stems should be left on the pod for all types.

Peppers. Green bell type and “hot” type peppers should be dark to light green and uniform in color. Red and colored peppers should be uniform in color, too. For all types, the lobes should be well formed, the pepper should feel firm and heavy

when lightly squeezed, and the pepper should be true to type in shape and form. Bell pepper diameter and length should not be less than 2½ inches.

Potatoes. Potatoes are usually harvested when the tops die back. The exception to this is the red new potatoes which should be harvested when they



are ½ to 2¼ inches in diameter. Size is what determines the grade of potatoes. Potatoes should be cured for 10 to 14 days in a cool (45° to 60°F) dry place to toughen the skin and to heal wounds before handled, graded and packed.

Pumpkins. Color and rind hardness are the harvest indicators for pumpkins. A deep orange rind color should develop and the rind should resist the pressure of a fingernail before a pumpkin is harvested. They should be harvested before frost and with some stem attached. Curing the pumpkins for 1½ weeks in a warm (80° to 85°F), dry place will prolong their shelf life.

Radishes. Size is the determining factor for when to harvest radishes. Standards are from ½ to 1¼ inches in diameter. They should be bunched by uniform size. Radishes are sold with and without tops and roots. If sold without tops and roots they should be trimmed closely. Oversized radishes can be pithy and woody.

Rhubarb. Size is the determining factor for rhubarb. Petioles should be at least a half inch in diameter with USDA Grade Fancy being more than 1 inch in diameter. Petioles should be at least 10 inches long. Remove the leaf blades before marketing.

Rutabagas. The proper harvest stage for rutabagas is when they are at least 1¾ inches in diameter. They are topped and trimmed of their roots and usually waxed for longer storage.

Squash. Summer squash should be straight unless they are crookneck types or patty pan types. The rind should be bright in color and have a shine. Zucchini and crookneck types should be no longer

than 8 inches and about 1 to 1½ inches in diameter. Patty pan types should be less than 6 inches in diameter. Baby types will be even smaller at harvest. Pickers should wear soft cotton gloves when harvesting summer squash to prevent handling damage to the tender rind. Winter squash is ready to harvest when the rind develops the color characteristic for the variety and when the rind resists the pressure of a fingernail. They should be harvested before frost and with some stem attached. Curing the winter squash for 1½ weeks in a warm (80° to 85°F), dry place will prolong their shelf life.

Sweet Potatoes. Sweet potatoes should be harvested in early fall before the first freeze. Vines need to be mowed and removed before the roots can be dug. Roots should be handled carefully during digging and before curing to prevent damage. Curing requires about a week under warm (80° to 85°F), moist (85 percent relative humidity) conditions. The curing process toughens the skin and heals wounds. Roots should be between 1¾ inches and 3½ inches in diameter, and 3 inches and 9 inches long.

Tomatoes. When to harvest tomatoes depends on the type and the market where they will be sold. Tomatoes are harvested mature green, vine-ripe, breaker stage and ripe. Mature green tomatoes are whitish green in color and very firm, they will in time soften somewhat and turn orange-red in color. Mature green tomatoes due to their firmness ship very well. Vine-ripe can mean breaker stage or ripe. Breaker stage is where the tomato is just showing the red color on the bottom. Tomatoes at this stage have reached their peak and are no longer drawing nutrition from the plant. They will color like mature

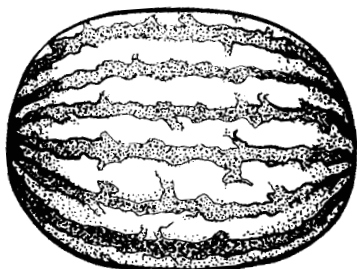


green tomatoes. They are softer than the mature green tomatoes so are usually packed in tray packs. Ripe is where the tomato has turned completely red and has softened. As with the breakers they do not

ship well so they are packed in tray packs to cushion them better. Standard tomatoes will be harvested in all three stages, while cherry and paste tomatoes are usually harvested vine-ripe red. Processing tomatoes are also harvested vine-ripe red.

Turnips. Turnips are harvested when they are at least 1 inch in diameter. They can be sold with tops, with short-trimmed tops or without tops. If tops are left on, the turnips care need to be taken to remove damaged and diseased leaves.

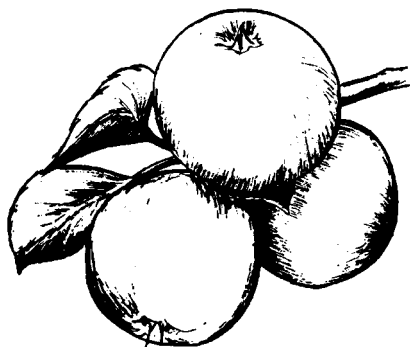
Watermelon. The color of the ground spot, the condition of the tendril at the joining of the fruit stem and the vine, and the sound when the melon is



thumped are harvest indicators for watermelons. The ground spot should be yellowish, the tendril should be withered and the thump should sound like a dull thud.

Fruit

Apples. There are several methods to determine the maturity of apples. Several are often used together to best determine the harvest date of apples. When the apples are harvested will also determine how they will be handled and marketed. Days from full bloom will give you a rough idea of when the apples will be ready for harvest and then



other methods can be used to pinpoint the best harvest date. Other methods include change in

ground color; ease of separation of fruit from the spur; soluble solids, measured with a refractometer; iodine-starch test where the flesh of halved apples is dipped in an iodine solution and the percent of area turning blue-black is estimated; and apple firmness determined with a pressure tester. Industry standards for soluble solids are at least 12 percent; for ground color a change to a yellowish cast; for iodine-starch test 60 percent of the area blue-black in color; ease of separation, the fruit should come off the spur easily without tearing or breaking the fruiting spur; and firmness, apples should be less than 20 pounds and more than 12 pounds. When apples are picked, the picker should hold the fruit in hand and apply pressure. If the fruit is grasped by the fingers, bruising can occur.

Apricots. Apricots do not mature uniformly so several harvests will be needed to get fruit at their optimal maturity. External indicators of maturity are size, color and suture rounding. Internal indicators are flesh color, loosening of the pit, and soluble solids. Color indicators can be matched with standard color plates.

Berries

Brambles (Raspberries and Blackberries). Fruit should be highly colored of the species' and variety's characteristic color. The fruit should separate easily from the cap or calyx. Pickers should handle the fruit very carefully, not holding more



than a few berries in their hand at a time, and using only low sided containers so fruit are not bruised by the weight of fruit on top of them.

Blueberries. Color and soluble solid to acid ratio are maturity indicators for blueberries. Fruit should be blue in color without any green with soluble solids of 10 to 15 percent and pH 3.43-3.73. Pickers should handle the fruit carefully, by not holding more than a few berries at a time and using only

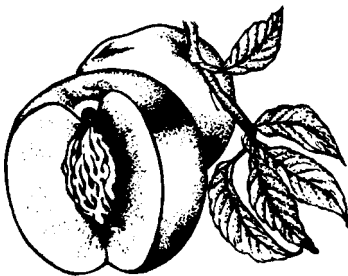
low-sided containers so fruit are not bruised by the weight of fruit on top of them.

Strawberries. Strawberries can be harvested when two-thirds of the fruit is colored red. As with other berries, pickers should handle the fruit very carefully, by not holding more than a few berries in their hand at a time, and using only low-sided containers so fruit are not bruised by the weight of fruit on top of them.

Cherries. Skin color and soluble solids are the most common indicators for sweet cherries. The soluble solids should be at least 16 percent. Fruit should have the characteristic skin color for the variety, which can range from yellow to black red. Color is the best indicator for sour cherries. They should be bright red.

Grapes. Many indicators can be used depending on the market. Wine and juice markets require grapes with specific soluble solids and acid content. Fresh market grape will depend on the flavor and aroma. Grapes will often color up before they are ripe, so soluble solids and the color change of the stems from green to brown may be a better indicator. Grapes should be harvested into shallow containers to prevent bruising from bunches on top of them.

Peaches and Nectarines. Ground color, flesh color, firmness, size and suture filling are the maturity indicators for peaches and nectarines. Yellow-fleshed fruit should have a yellow ground color and white-fleshed fruit a whitish ground color. The flesh of yellow fruit should at least match the



least mature flesh color on a standard peach maturity color plate set. Fruit firmness tested with a pressure tester should be between 10 and 16 pounds with a $\frac{5}{16}$ -inch plunger.

Pears. Pears are the only temperate fruit that must be harvested mature and then ripened off the tree. Soluble solids, days from full bloom, iodine-starch test, flesh firmness, ground color, and ease of separation from the branch are harvest indicators. Soluble solids are not usually used but should be at least 13 percent for marketability. Days from full bloom will give you an idea of when the pears will be ready for harvest, and then other methods can be used to pinpoint the best harvest date. The iodine-starch test is where the flesh of halved pears is dipped in an iodine solution and the percent of area turning blue-black is estimated. Sixty percent or less is the accepted amount of blue-black color for mature fruit. Pear firmness, determined with a pressure tester, should be 23 pounds, but can be less if the soluble solids are less than 13 percent. Ground color changes are from a green to yellowish green. With ease of separation, the fruit should come off the spur easily without tearing or breaking the fruiting spur.

Plums. Color is the major harvest indicator for plums. Each variety has its own characteristic color change, familiarity with standards for planted varieties is important. Soluble solids should be at least 17 percent, and pressure testing may be useful.

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United States Department of Agriculture, Agricultural Marketing Service Grade Standards for Fresh Produce

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