



# Root Crops

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## Introduction

Root crops include a number of vegetables grown for their enlarged, edible storage roots. The root crops discussed here are all hardy, cool-season crops with a long storage life. While they belong to several unrelated plant families, these crops have similar cultural requirements. This profile will overview several root crops grown in Kentucky.

## Marketing and Market Outlook

Kentucky-grown root crops are mainly sold through local fresh markets, such as farmers markets, on-farm stands, produce auctions and community supported agriculture (CSA) programs. Root crops are typically inexpensive to grow and make a nice addition to a farmers market mix while helping extend the CSA marketing season. Quality heirloom variety root crops have been good sellers in some Kentucky farmers markets, and fresh roots can also be marketed to local grocery stores and restaurants, with many chefs showing continued interest in seasonal and heirloom vegetables. Fresh horseradish (used in the Jewish celebration of Passover) and Daikon (an Asian radish) may have sales potential to specialty or ethnic markets. Growers with access to approved kitchen facilities could process some root crops, such as horseradish, for value-added products. Wholesale opportunities for large volumes of root crops are limited in the Kentucky region. One marketing advantage of root crops is that they can typically be stored for relatively long periods until ready to market. However, when selling root crops with foliage still attached, growers should be aware that the shelf life is limited. Selling root crops demands an attractive presentation, often with other



vegetables in the display. Because many consumers are unsure of how to use some root crops, providing preparation instructions, along with recipe ideas, is an excellent way to promote them to customers. Some farmers market vendors have sold a mixed box, bag or basket of fall root crops while providing recipes and suggestions for use.

## Production considerations

### *Crop and cultivar selection*

Root crops grown in Kentucky, grouped by family, include:

- Apiaceae (parsley family) - carrot (*Daucus carota* subsp. *sativus*) and parsnip (*Pastinaca sativa*)
- Asteraceae (sunflower or aster family) - Jerusalem artichoke (*Helianthus tuberosus*) and salsify (*Tragopogon porrifolius*)
- Brassicaceae (crucifer or mustard family) - Daikon (Japanese white radish,



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*Raphanus sativus* subsp. *longipinnatus*), horseradish (*Armoracia rusticana*), radish (*Raphanus sativus*), rutabaga (*Brassica napus* subsp. *napobrassica*), and turnip (*Brassica rapa* subsp. *rapa*)

- Chenopodiaceae (goosefoot family) - beet (*Beta vulgaris*)

Carrots, Daikon radish, horseradish, parsnip, radish, and rutabaga are raised only for their roots, while beets and turnips may be grown for their tops as well. Salsify is cultivated primarily for its long, tapering root, but the grass-like leaves can also be added to salad greens. Jerusalem artichoke is considered a weed by many, while others consider its water chestnut-flavored tubers a gourmet item; the tubers are used fresh in salads, cooked like potatoes, or pickled.

Varieties within each crop can differ in root characteristics (such as size and color), disease resistance, and flavor. Consideration should be given to regional preferences, as well as whether to grow heirloom cultivars. Growers should select only adapted varieties that have the qualities in demand for the intended market.

#### *Site selection and planting*

Select a site with deep, loose, well-drained soil and good air drainage. A soil pH between 6.0 and 6.8 is preferred. Soil should be worked to a depth of 18 to 24 inches for root crops requiring the development of long, straight roots. Root crops can also be grown in well-shaped raised beds on well-drained sites. Raised beds warm up faster in the spring and make water management easier. Root growth can be impaired, yields reduced, and harvesting more difficult on heavy soils. Carrots, particularly, tend to develop multi-pronged or forked roots on heavy soils.

Root crops require cool weather conditions, and many are direct-seeded in the spring and/or late summer and fall. Horseradish is grown from small root pieces that are planted in early spring. Jerusalem artichoke is planted in the spring using small disease-free tubers or 2-ounce pieces of tubers containing at least two to three buds.

Optimum temperatures for root crop growth are generally slightly cooler than many warm-season vegetables and range from 50°F to 60°F for radishes to 65°F to 75°F for beets. High temperatures, particularly at night, can adversely affect root development. For example, the sugar content of beets will be lower when grown in warm weather; the beets will also have a lighter color. In addition, hot weather produces white bands in beet roots.



Irrigation is often necessary to provide uniform moisture for germination, particularly in fall plantings. Continuous moisture throughout the growing season helps maximize yields and quality. Boron may become a

limiting element for root crops.

#### *Pest management*

Except for those that are botanically related, root crops generally have few diseases in common. All are prone to damping-off, seed rots and root decay in wet sites. Leaf spots, blights, downy mildew, aster yellows and rusts may occur in some plantings. Some root crops, particularly carrots and parsnip, are susceptible to root knot nematode. Crops in the Crucifer family are prone to club root, which is primarily managed by maintaining a soil pH above 6.5. Sclerotinia may affect carrots and Jerusalem artichoke. Potential insect pests include aphids, leafminers, flea beetles and root maggots.

#### *Harvest and storage*

Root crops are generally hand-harvested in Kentucky. Some root crops can be dug with a potato harvester or moldboard plow. They should be dug when mature, but before becoming woody and tough. Harvested roots should be washed carefully and packaged according to market requirements. Some root crops, such as beets, carrots, Daikon, turnips and radishes may be bunched for fresh market with their tops intact. Others, including horseradish, parsnips and rutabagas, are topped after harvest. The storage life for bunched root crops is shorter than for those that have been topped. Depending on the crop, topped roots can be stored for several months under the proper temperature and relative humidity conditions. Carrots, Daikon,

parsnips, turnips and rutabagas require similar storage conditions.

Fresh market carrots should be harvested when they are  $\frac{3}{4}$  to  $1\frac{1}{4}$  inches in diameter. True baby carrots should not be allowed to exceed  $\frac{3}{4}$ -inch in diameter, although  $\frac{1}{4}$ - to  $\frac{1}{2}$ -inch is ideal.

Turnips for bunching are harvested when they are 2 inches in diameter. Bunches consist of four to six plants tied together. When turnips are sold without their tops, they are allowed to reach 3 inches in diameter before harvesting.

Fresh market beets are harvested when they are 1 to 2 inches in diameter and then sold in bunches of three to four roots. Bunched beets can be stored for up to two weeks, while beets without tops can be stored for several months.

Radishes are harvested as soon as they reach an edible size, about  $\frac{3}{4}$  to  $1\frac{1}{4}$  inches in diameter. If left too long in the field they will become pithy, pungent and split. Generally eight to 13 roots are bunched together for fresh market sales. Bunched radishes may be stored for only one to weeks. Radishes may also be topped and packaged in plastic bags.

Daikon roots are dug once they have reached the desirable size. Depending on the cultivar and intended market, the roots can be 2 to 4 inches in diameter and more than 6 inches long. Some cultivars grown in deep, loose soils can reach 20 inches or more in length. Daikon radishes are generally tied in bundles of five to 12 roots.

Horseradish is dug once the tops are frozen back. The most desirable roots are 6 to 8 inches in length and 1 inch in diameter. Horseradish may be stored in a cooler, cold cellar or in deep trenches outdoors. Roots may also be left in the ground until needed, but should be harvested before the ground freezes. Horseradish requires a concerted effort to eliminate it after it is established.

Jerusalem artichoke is not harvested until after frost.

The large, woody tops need to be cut with a mower prior to harvest. Tubers can be dug by hand or with a potato harvester. Due to their thin skin, tubers must be stored at a very high relative humidity to prevent shriveling. Under the proper temperature and humidity they may be stored for four to five months. Volunteer

plants can pose a problem for several years after harvest.

#### *Labor requirements*

Labor needs per acre will vary substantially depending on the crop, method of production, scale of operation, and harvest method. Organic production methods will have higher labor requirements for weed control since herbicides cannot be used. Likewise, hand-harvested crops will have higher

labor needs than those harvested with a mechanical harvester.

#### **Economic considerations**

Initial investments include land preparation, purchase of seed or seed stock, and possibly the installation of an irrigation system. If a significant amount of root crops will be grown for market, a root cellar or cold storage facility would allow the grower more flexibility in marketing the crop.

Root crop budgets will differ depending on the crop, size of operation, and production method. For example, 2016 production costs for commercial-scale, conventional, irrigated carrots are estimated at \$1,200 per acre, with harvest and marketing costs of approximately \$1,300 per acre. Total expenses per acre, including both variable and fixed, would come to approximately \$2,500 per acre. Presuming gross returns of \$2,800 per acre, returns to land, capital and management would come to approximately \$300 per acre.

Carrots grown on a smaller scale in a market garden for farmers market sales could show the following costs and returns based on a 100-foot row. Seed, fertilizer and fuel are estimated at \$35; an additional \$12 for machinery depreciation brings total costs to approximately \$47. Estimating a good yield of 170 pounds sold at \$1 per pound brings returns to labor,



management, marketing and land to \$123 per 100-foot row.

### Selected Resources

- Vegetable Production Guide for Commercial Growers, ID-36 (University of Kentucky) <http://www.ca.uky.edu/agc/pubs/id/id36/id36.htm>
- Alternative Field Crops Manual: Jerusalem Artichoke (University of Wisconsin and University of Minnesota, 1991) <http://www.hort.purdue.edu/newcrop/afcm/jerusalart.html>
- Beet Production, HIL-04 (North Carolina State University, 2001) <https://content.ces.ncsu.edu/beets>
- Cole Crops and other Brassicas: Organic Production (ATTRA, 2006) <http://attra.ncat.org/attra-pub/cole.html>
- Radish (Oregon State University, 2010) <http://horticulture.oregonstate.edu/content/radish-0>
- Root Crops (Carrots, Beets, Radish, Parsnips, Turnip & Rutabaga, Salsify) (Virginia Tech, 2015) <http://pubs.ext.vt.edu/426/426-422/426-422.html>

- Rutabaga (Swede) and Turnip (Oregon State University, 2010) <http://horticulture.oregonstate.edu/content/rutabaga-swede-and-turnip-0>
- Salsify and Scorzonera (Oregon State University, 2010) <http://horticulture.oregonstate.edu/content/salsify-and-scorzonera-0>
- Specialty Crop Profile: Horseradish (Virginia Tech, 2009) [https://pubs.ext.vt.edu/content/dam/pubs\\_ext\\_vt\\_edu/438/438-104/438-104\\_pdf.pdf](https://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/438/438-104/438-104_pdf.pdf)
- Turnips and Rutabagas (North Carolina State University, 2001) <https://content.ces.ncsu.edu/turnips-and-rutabagas>

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