

**AG FACTS**

## COMMERCIAL VEGETABLE RECOMMENDATIONS

# RADISH, RUTABAGA, TURNIP

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**R**adish (*Raphanus sativus* L.), rutabaga (*Brassica napus* L. Napobrassica Group), and turnip (*Brassica rapa* L. Rapifera Group) are members of the Cruciferae (mustard) family. Radishes are triple or quadruple cropped on about 2000 acres of land in Michigan (total of 6000 planted acres). There are about 500 acres of turnips and turnip greens and 100 acres of rutabagas in Michigan.

Radishes produce 2 to 5 tons per planted acre; rutabagas 15 to 20 tons, turnip roots 10 to 15 tons, and turnip greens 5 to 9 tons.

## Types, cultivars, use

The most common type of radish is the round, red radish. Other radishes include white radish, oriental radish (also called daikon), and winter (black or red) radish. Red and white radishes are used primarily as fresh salad items. Daikon is commonly pickled or stir fried.

Red radishes come in several shapes, from round to oval. During hot weather the roots tend to elongate, causing round roots to become somewhat oval. Since round roots have become standard in the market, oblong and oval cultivars have lost popularity. Some cultivars are called "short top," indicating that they produce short leaves during hot weather. Short top cultivars are usually less susceptible to bolting (pre-mature seed stalk development) than regular cultivars. On the other hand, short top cultivars usually do not produce sufficient leaves for mechanical harvest dur-

ing cool weather. Regular cultivars are planted up to May 10 and after September 1 and short top cultivars are planted the rest of the summer.

Rutabagas have large (up to 6 inches), round white or tan roots, with white or yellow flesh. Yellow-fleshed cultivars are the most popular. Rutabagas have smooth, fleshy leaves similar to collard leaves. Rutabaga roots are usually eaten as a cooked vegetable. They can be stored for several months in a root cellar and were a popular winter vegetable in the days before refrigeration and long-distance shipping of fresh produce. Rutabaga consumption has declined as fresh produce has become more available throughout the year.

Turnips are much smaller than rutabagas (2 to 3 inches in diameter) with white flesh. Most cultivars have purple shoulders and white exterior color. Some cultivars are completely white with no purple shoulders. Turnip leaves are hairy, and are commonly eaten as a cooked vegetable. Some cultivars that have been developed for leaf production produce very small roots.

## Climate and season

Radishes, rutabagas, and turnips are cool season crops. Seeds germinate at soil temperatures above 45 °F and plants grow best when daytime temperatures are below 75 °F. Radishes are planted from April 1 to September 1 in Michigan. They mature in 35 to 40 days with temperatures of 60 to 70 °F, and in 20 to 25

days when temperatures are above 80°F. Radishes maturing during long days and high temperatures produce elongated leaves and misshapen roots and become pungent and pithy. However, cultivars have been developed that produce high quality roots during hot, long days.

Rutabagas are usually planted for fall harvest June 1 to 15 in the Upper Peninsula (UP) and June 15 to 30 in the Lower Peninsula. Rutabagas mature 90 to 100 days after seeding and produce the best quality roots under cool conditions. Most Michigan rutabagas are grown in the UP where temperatures are mild throughout the growing season.

Turnips tolerate heat better than radishes and rutabagas. Turnips for greens are grown throughout the summer and are ready for harvest 30 to 40 days after sowing. Roots are ready for harvest 60 to 70 days after sowing. Bunched turnips were a common produce item in the past but are less popular now. Turnip roots are dug from midsummer to late fall and can be stored for several months.

All of these crops require a steady supply of water during the growing season. Lack of moisture causes irregular maturity and poor quality roots. Moisture stress exacerbates scab in radish.

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## Soils and field preparation

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All of these crops grow well on muck, sand, or loam soils. The roots expand uniformly and rapidly and are easy to harvest on soft, friable soils. These crops, as well as other members of the Cruciferae family, are subject to several soil-borne diseases. Club root (all crops) and scab (in radish) are especially serious problems that build up with repeated plantings. Radish color deteriorates when radishes are grown on the same land for many years. Rotate to other crops regularly to avoid soil-borne problems.

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## Fertilizer

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Maintain soil pH of 6.0 to 6.5 on mineral soil and 5.5 to 6.2 on muck soil. The incidence of radish scab usually increases when soil pH is above 5.5.

Radishes, rutabagas, and turnips all require **boron (B)** to produce good quality roots. Rutabagas are especially susceptible to boron deficiency because of the long growing period and large root size. Boron deficiency causes a disorder in rutabagas called brown heart, or water core, in which the interior of the root breaks down. In radishes and turnips, boron deficiency causes cracking and poor root development. Apply 10 to 20 lb of borax or 5 to 10 lb Solubor (1 to 2 lb actual boron) per acre before planting, or apply 1 lb Solubor (0.2 lb boron) per acre as a foliar spray 10 to 14 days after emergence.

These crops are also susceptible to **manganese (Mn)** deficiency, which causes a general yellowing of plant leaves, usually appearing about midway in the season. It is especially a problem in soils with a pH above 6.5. When manganese deficiency has been identified as a problem, make 2 foliar applications per crop of 4 lb manganese sulfate (1 lb actual manganese) per acre 7 to 10 days apart.

Apply fertilizer based on a complete soil test. The following are general recommendations for each crop for use when a soil test is not available.

### Radish

Apply 40 lb N, 50 to 100 lb P<sub>2</sub>O<sub>5</sub>, and 75 to 125 lb K<sub>2</sub>O per acre before the first crop of the season and disc in. Specific P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates will depend on levels of the nutrients available in the soil. Do not apply additional N, P or K for the second crop. If 3 or 4 crops are planted on the same land, apply 40 lb N with the last crop of the year. Excessive N and K appear to make radishes brittle and may cause cracking under some circumstances. Include 1 lb boron (10 lb borax) per acre in the broadcast fertilizer or apply 5 lb Solubor per acre to the soil surface before discing. Apply 0.2 lb B (1 lb Solubor) per acre as a foliar spray about 15 days after seeding.

## **Rutabaga and turnip**

Apply and disc in before seeding 50 lb N, 100 lb P<sub>2</sub>O<sub>5</sub> and 100 lb K<sub>2</sub>O per acre. Apply 2 lb B (20 lb borax or 10 lb Solubor) per acre to the soil before planting. Apply 0.3 lb B (1.5 lb Solubor) per acre as a foliar spray 2 or 3 times, beginning 30 days after seeding. Include a nonionic surfactant in the solution.

## **Spacing and planting**

Precision seeding improves establishment of all of these crops. Uniform spacing produces a high percentage of marketable radishes and turnips. Rutabagas require sufficient space to produce uniform, large roots. Vacuum and belt-type seeders work well with uncoated seeds of these crops, since the seeds are round and uniform in size. All seed should be treated with a soil fungicide to protect against damping off. At planting apply a liquid or granular soil insecticide to control cabbage maggots.

### **Radish**

For machine harvest, plant in rows 9 to 10 inches apart with 12 to 15 seeds per foot of row. It takes 15 to 18 lb of seed to plant 1 acre. Row spacing is dependent on harvesting equipment. Plant seed ¼ to ½ inch deep in moist soil.

### **Rutabaga**

Use seed that has been graded by size to improve uniformity of germination and maturity in the field. Plant rutabaga seed ½ inch deep to obtain a final stand of 4 to 6 inches between plants in rows 24 to 30 inches apart. With high quality seed, plant to stand. Otherwise, plant to double the desired stand and thin to stand when rutabaga plants are 3 to 4 inches tall. Depending on seed size, it takes ½ to 1 lb of seed to plant 1 acre.

### **Turnip**

Plant turnips in rows 15 to 18 inches apart, with 4 to 6 seeds per foot of row. Plant turnips for greens in 12 to 14 inch rows.

## **Harvest and postharvest**

**Radishes** are at the optimum size for harvest for about 3 days during the summer. During cooler weather the harvest window is 5 to 7 days. They then become oversize and pithy. Check radishes daily as they approach maturity to determine the correct harvest date. Radishes are usually harvested with a machine that removes the tops. They are handled in bulk from the field until packed. Hydrocooling before packing improves shelf life.

The minimum size for red radishes by USDA grade standards is ⅝ inch diameter, with no maximum size. However, the most acceptable size in the market is a diameter of ⅞ to 1⅛ inch. Radishes are usually packed into 6 ounce or 1 pound plastic bags and then packed in 12 to 15 pound cartons. Bunched radishes have 18 to 20 radishes per bunch. The radishes in each bunch should not vary more than ½ inch in diameter.

**Rutabagas** are usually harvested with a root digger after removing the tops with a rotary chopper. Eating quality appears to improve if the roots are dug after the first frost.

Rutabagas are stored in bulk piles or bulk boxes. Remove as much soil as possible before placing in storage. Handle carefully to avoid bruising the roots. Store rutabagas in piles no deeper than 6 feet. Maintain good air circulation through the pile. Maintain storage conditions of 32 °F and 95% relative humidity. Under good conditions rutabagas should store for 6 months. When preparing rutabagas for market, cut off most of the neck, leaving about ¼ inch. Trim off the taproot and any side roots. Trim off superficial insect damage. Wash in cold water.

Rutabagas are normally waxed before marketing. Dry the roots completely before applying wax or the wax won't stick. The roots are often washed and dried and then allowed to air dry for 24 hours before waxing. The roots are coated with a hot paraffin wax called crude scale wax. It is a petroleum product and is available from petroleum refiners. Melt the wax and maintain it at 250 to 270 °F. Dip the rutabagas into the

wax for 1 to 2 seconds and remove immediately. If dipping a number of roots at the same time, make sure they do not stick together when drying.

Rutabagas are packed in 25 or 50 pound bags for shipping. Keep them refrigerated after waxing, since the wax reduces respiration and the roots begin to deteriorate internally at room temperature.

**Turnips** are dug with a root digger and stored in bulk boxes. Tops are removed at harvest. Wash the roots and trim off all leaf portions before packaging. Turnips are usually packed in 25 pound plastic bags or 1 pound packs.

The minimum size for U.S. No. 1 turnips and rutabagas is 1¾ inch diameter. Although there is no specified maximum size, most turnips are less than 3 inches in diameter. The most popular rutabaga size is 4 to 6 inches.

Turnips should store well for 4 to 5 months if held at 32°F and 95% relative humidity. Maintain good air movement in storage.

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## Physiological disorders

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**Cracking** is a serious problem in radish production. The radishes may crack while growing or during handling after harvest. Radishes become overly turgid and brittle as a result of over-fertilization and rapid uptake of water. Radishes often split in the field during periods of heavy rain. Cracking during harvest is a problem in the fall when night temperature falls below 45°F. The radishes come out of the ground whole, but crack when dropped or handled. Potassium salts are very soluble and may be the main factor in cracking. If cracking is a problem, reduce potash applications.

During the fall, harvest after 10:00 am. This will allow the roots to warm up slightly and translocate some water to the leaves. Cultivars that are very susceptible to cracking should not be grown for fall harvest.

**Brown heart** of rutabaga is a result of boron deficiency. Internal root tissue becomes brown and water

soaked. As the roots mature they become punky. Severe boron deficiency causes misshapen roots.

Turnips react similarly to boron deficiency, with pitted spots on the surface and internal breakdown. Radishes grown with insufficient boron do not develop well and may be more susceptible to cracking.

**Purple or off color** of radish occurs when radishes are grown continuously on the same ground. It appears to be an autotoxicity response to plant residues in the soil. Frequent rotation will help avoid the problem. Grow radishes on new ground when possible.

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## Diseases

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**Black rot** (*Xanthomonas campestris*) is a problem with many members of the Cruciferae family. Although it occurs in radish, it usually does not result in crop losses because of the short crop period. However, it can cause crop losses in rutabaga and turnip. The bacteria is carried on seed and may infect and kill very young seedlings. Plants may also become infected during the season. It causes a characteristic yellow triangle where leaf veins intersect the leaf edge. Vascular bundles in the veins turn black. The disease may extend into the vascular system of the roots. To avoid black rot, use hot-water treated, certified seed. If a field is infested with black rot, rotate to non-cruciferous crops for at least 3 years.

**Black root** (*Aphanomyces raphani*) is a common disease on radish but it also attacks rutabaga and turnip and other cruciferous crops. Infected mature roots are misshapen and are black on the interior and exterior. It is primarily a problem during mid-summer with high soil temperatures. The primary control method is genetic resistance.

**Clubroot** (*Plasmodiophora brassicae*) is a disease of most members of the Cruciferae family. It causes extreme swelling of the roots. The fungus lives in the soil for many years. The disease has many races and appears to overcome genetic resistance rapidly. Some radish cultivars are resistant to some strains of clubroot. Crop rotation has not been an effective

means of control. If soil is infested with clubroot, grow cruciferous crops somewhere else.

**Downy mildew** (*Peronospora parasitica*) attacks all the cruciferous crops. It usually occurs during cool, damp weather in the fall. The disease causes yellow spots on the upper leaf surfaces with a white, cottony growth on the undersides of the leaves. Fungicide applications during cool, damp weather should control downy mildew.

**Root scurf/wire stem** (*Rhizoctonia solani*) is a potential problem on all the cruciferous crops. Wirestem occurs when young seedlings are attacked by the fungus but survive. The infected stems constrict and become tough and wiry at the soil line. When the fungus attacks mature radishes, it is called scurf. The outer surface of the root becomes covered with superficial black lesions. The symptoms are similar to black root. Seed treatment with a soil fungicide will help reduce infection. Some cultivars have genetic resistance.

**Scab** (*Streptomyces scabies*) is a soil-borne disease caused by the same organism as potato scab. It causes circular lesions with sunken centers on the root surface. It is a major radish disease but also attacks turnip and rutabaga. It is a more serious problem under dry conditions and at a soil pH above 6.0.

Since the same disease attacks potatoes, do not rotate radishes and potatoes. Irrigation during dry weather may reduce infection. Application of 1 inch of water within 7 days of seeding will reduce scab considerably.

**Soft rot** (*Erwinia carotovora*) attacks many vegetable crops as a secondary infection. Rutabaga and turnip are susceptible to primary infection by soft rot in the field. However, the bacteria usually enters the roots through wounds from other organisms. Soft rot develops and spreads rapidly after harvest. To avoid soft rot in storage, sort out and discard damaged and infected roots. Clean storages and bulk boxes thoroughly and spray all surfaces with a disinfectant before storing a new crop.

**Turnip mosaic virus** periodically causes economic losses in rutabagas and turnips. Mature leaves of in-

fecting plants turn yellow and fall off. Young leaves develop a yellow and green mosaic pattern. Infected plants normally do not develop marketable roots.

The virus is spread by aphids. Aphids can pick up the virus in 10 seconds of feeding and transfer it in 10 seconds. Thus insecticides are not very effective in reducing infection during bad years. Destroy infected crop residues, cull roots, and cruciferous weeds to reduce infection in succeeding years.

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## Insects

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**Cabbage maggot** (*Delia brassicae*) is a serious pest of all cruciferous crops. Adult flies emerge in early May and lay eggs on the soil beside the plants. The emerging maggots burrow into the plant roots. There are three generations of maggots each year, so the entire crop has to be protected. To control maggots, treat the soil with a soil insecticide at seeding. Rotate to non-cruciferous crops regularly.

**Cabbage and turnip aphids** (*Brevicoryne brassicae* and *Rhopalosiphum pseudobrassicae*) are often a problem in rutabagas and turnips. They suck sap from plants and transmit the turnip mosaic virus. They reduce the growth of the plants and make leaves unsightly. Heavy infestations cause leaves to curl inward. Insecticide applications will reduce aphid infestations.

**Flea beetles** (several species) are tiny black insects that chew small holes in leaves. They jump like fleas when disturbed. Heavy infestations reduce growth of roots. They may damage turnip and radish leaves sufficiently so that they are not suitable for marketing. Insecticide applications will help control flea beetles.

**Imported cabbage worms** (*Pieris rapae*) and **cabbage loopers** (*Trichoplusia ni*) can cause considerable leaf damage in rutabaga and turnip. Apply insecticides to control heavy infestations and if leaves are to be marketed. Moderate infestations usually do not reduce root yield.

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## Weeds

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There are many common weeds in the Cruciferae family, including shepherdspurse, yellow rocket, wild mustard, wild radish, pepperweed, and marsh yellowcress. Since they are closely related to radish, rutabaga, and turnip, they serve as hosts for many insects and diseases that attack these crops. They often become serious weed problems because of their tolerance to herbicides used in these crops. Crop rotation, herbicide rotation, cultivation, and clean culture will help reduce cruciferous weeds in these crops.

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## Additional information

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More information on production of radishes, rutabagas, and turnips is contained in the bulletins listed below, which are available from county Cooperative Extension Service offices, or from the MSU Bulletin Office, P.O. Box 6640, East Lansing, MI 48826-6640.

E-312 *Control of insects, diseases, and nematodes on commercial vegetables*

E-486 *Secondary and micronutrients for vegetables and field crops*

E-550 *Fertilizer recommendations for vegetable and field crops in Michigan*

E-675 *Vegetable varieties for commercial growers*

E-968 *Cole crop insect pests*

NCR-126 *Diseases of radishes in the USA*

NCR-330 *North Central weed control guide for vegetable crops*

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