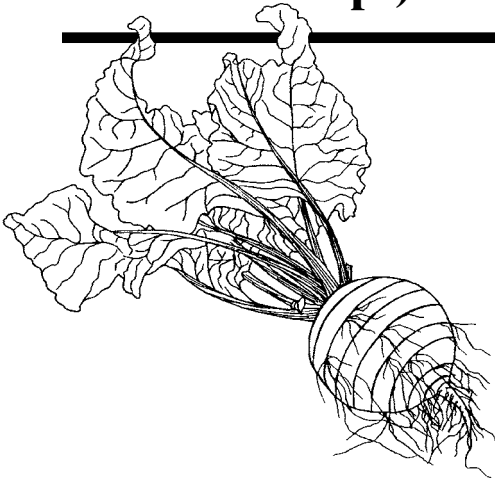


CULTURE AND CULTIVARS

FOR THE GARDENER,
BEDDING PLANT GROWER,
GARDEN CENTER SUPPLIER,
AND DIRECT MARKETER

Growing Root Crops (Beets, Carrots, Parsnips, Radishes, Rutabagas, and Turnips)



CULTURAL PRACTICES

Soils, pH, and Fertility

Carrots, parsnips, radishes, salsify, scorzonera, and turnips require loose soils to develop proper size and high quality. Good soil depth is also very important for carrots, salsify, scorzonera, and parsnips. Heavy soils can be made lighter by adding compost, leaf mold, or vermiculite in a foot-wide band on the row. Spade deeply to thoroughly mix in the amendments and then plant seeds.

All root crops, except beets and parsnips, grow best in soils with a pH between 6.2 and 6.8; beets and parsnips require a pH of 6.6 to 7.2 for maximum yields. Fertilize and lime as directed by soil test results (kits may be purchased from your county extension office or local garden center). Soil testing is recommended at least every three years to monitor soil pH and fertility.

In the absence of a soil test, for beets, carrots, parsnips, salsify, and scorzonera, apply to each 100 square feet either 4.5 pounds of 5-10-10 (or equivalent) fertilizer (where potash tends to be low) or 4.5 pounds of 5-10-5 (where potash levels are expected to be high—for example, areas where wood ashes, manures, or high rates of complete fertilizers have previously been applied).

For radishes, rutabagas, and turnips, apply 1.5 pounds of 5-10-10 fertilizer plus 0.5 pound of 0-20-0 (regular superphosphate) or steamed bonemeal. Do not apply excessive nitrogen to radishes and turnips, or you may get more top growth than root development. Since fresh manure causes forked and misshapen roots, do not add it in the salsify bed under any circumstances. On all root crops, only apply fully composted manures in the fall before planting.

Four to six weeks after seeding, side-dress carrots, parsnips, salsify, and scorzonera with either 0.25 pound (4 ounces) of ammonium nitrate or 1.5 pounds of 5-10-10 fertilizer per 100 linear feet of row and rutabagas with 1.5 pounds of 5-10-10 fertilizer per 100 linear feet of row. Place the fertilizer about 3 inches to either side of the plants and lightly work into the soil.

Selecting Cultivars

Try hybrid root crops (marked with *); they are often a dramatic improvement in taste, texture, holding ability, and pest resistance compared to nonhybrids.

For all processing uses, Danvers and Nantes type carrots are best for overall production and quality in Pennsylvania's predominantly limestone soils. For fresh table use, Nantes types are superior since they are bred for flavor. Nantes types have a blunt tip that can easily penetrate the soil. Hybrid Nantes cultivars are almost always superior to the original, open-pollinated cultivars.

Imperator type carrots generally require very deep and loose soils, or they become distorted, forked, and split. They then frequently break when pulled. Chantenay types grow very well in Pennsylvania soils but are generally inferior for all uses.

Planting Dates

Approximate planting dates for central Pennsylvania are as follows:

- Beets and carrots: April 1 to July 10
- Parsnips, salsify, and scorzonera: April 15 to 30
- Radishes (spring and fall types): April 1 to 30 and August 10 to September 1
- Radishes (winter types): July 25 to August 5
- Rutabagas: July 1
- Turnips: April 1 to 30 and July 25 to August 5

Note: Seed spring crops about 3 weeks earlier in the warmest regions of the state and about 10 days later in the coldest regions. Fall crops should be seeded up to 10 days earlier in the colder, short-season areas and up to 3 weeks later in the warm, long-season areas.

Depth of Seeding

Carrots, parsnips, and turnips should be sown 0.25 to 0.5 inch deep. A planting depth of 0.5 inch is recommended for beets, radishes, and rutabagas. Salsify and scorzonera should be sown 1 inch deep.

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SUGGESTED CULTIVARS AND DESIRABLE CHARACTERISTICS

<i>Cultivars</i>	<i>Days to Maturity</i>	<i>Disease Resistance</i>	<i>Suggested Uses</i>	<i>Comments</i>
Beets				
☉ Kestrel*	53	CLS, DM, PM, RRR	G	Bolt resistant; best harvested early for baby beets
☉ Red Ace*	53	CLS, DM, PM, RRR	C, G	Sweetest, best-tasting beet; uniform; mint-green leaf; red petiole; drought tolerant
Red Cloud*	53		C, G	Rounder than 'Red Ace'; reddest
Forono	55		C, G	5 by 2 inches; uniform slicing; improved 'Formanova'; bolt resistant
☉ Golden Beet	55	APT	C, G	Yellow flesh; nonbleeding; yellow petiole
☉ Rodina*	58	DM, PM, CLS, RRR	C, G	Hybrid 'Formanova'
☉ Ruby Queen	60	APT	C, G	Standard; improved Detroit type; AAS 1957
Detroit strains	63		C, F, G	Original standard cultivar; no zoning; deep red
Carrots				
☉ Coreless Amsterdam	55	APT	C, F, G	Early Nantes type; 6.5 inches
Thumbelina	58		G	Best round (French) baby carrot; harvest at golf-ball size; AAS 1992
Touchon Deluxe	58		C, F, G	Bright-colored Nantes type; 7 inches long
☉ Nelson*	60	APT	C, F, G	Hybrid Nantes type that takes stress; tender; crisp
Ingot*	67		C, F, G	High carotene; deep color; full flavor; 8 inches
☉ Scarlet Nantes	68	APT	C, F, G	Standard, nonhybrid Nantes type; red orange
☉ Nevis*	68	ALS	C, F, G	Heat tolerant; deep orange; Nantes type
Negovia*	69		C, F, G	Sweet, excellent flavor; 8 inches long
☉ Bolero*	72	ALS, CLS, PM	C, F, G	8 inches; for fall and winter harvest/storage
Danvers 126 (half-long)	75		C, F, G	Ideal for all processing and cooking uses
☉ Napoli	210	APT	C, F, G	Best planted in fall in high tunnels; overwinter for spring harvest; extra sweet
Parsnips				
☉ All American	110		G	6 inches; broad shoulders; large; strong taper
Harris Model	120		G	Narrow shoulders; smooth; gradual taper
Andover	120	BC	G	11 inches; superior storage
Radishes (Spring or Fall Planting)				
Cherriette*	20		G	Early; uniform; stress tolerant
☉ Cherry Belle	22		G	Tops very short; AAS 1949
Fireball*	22		G	Very uniform; scarlet red; sweet; holds
☉ Cabernet*	22	CLR, RRR	G	Very uniform; disease resistant; split resistant
Fire 'n Ice	25		G	Improved 'French Breakfast' type; 3.5 by 0.75 inches
Sparkler	25		G	Scarlet roots with white tips; tops long
☉ Altabelle	26	DM, RRR, F	G	Globe shaped; bright red
☉ Champion	26		G	Very large; firm; mild; crisp; large tops; AAS 1957
White Icicle	28		G	Long; cylindrical; white; tender; mild
☉ German Giant (Parat)	29	APT	G	Sweet; mild; tender at any size
Radishes (Winter)				
☉ China Rose	55	APT	G	Long; rosy skin; white flesh; long storage
☉ White Chinese Celestial	60	APT	G	3 by 7 inches; mildest of winter types; white throughout
Oriental/Daikon				
☉ Summer Cross (Minowase)	45	APT	G	Crisp; white; mild; 6 to 14 inches; late-spring/fall use
Snowy*	50		G	9 by 3 inches; early; bolt tolerant

SUGGESTED CULTIVARS AND DESIRABLE CHARACTERISTICS (CONTINUED)

<i>Cultivars</i>	<i>Days to Maturity</i>	<i>Disease Resistance</i>	<i>Suggested Uses</i>	<i>Comments</i>
<i>Rutabagas (or Swede Turnip)</i>				
☉ American Purple Top	90	APT	G	Firm roots; crisp; mild; sweet; purplish-red top; creamy-yellow flesh
☉ Helenor*	90		G	High yielding; good color early; sweet; light-orange flesh
☉ Laurentian	90	APT	G	Deep-purplish top; yellow flesh; most popular
<i>Salsify (Oyster Plant)</i>				
☉ Mammoth Sandwich Island	120	APT	G	White skin; white flesh; used in oyster soups
<i>Scorzonera (Spanish or Black Salsify)</i>				
☉ Belstar Super	80	APT	G	Black skin; white flesh; used in clam soups
<i>Turnips</i>				
☉ Tokyo Cross*	35	APT	G	Early harvest; white; smooth roots; long harvest; AAS 1969
☉ White Lady*	40		G	Tender and delicious; white roots; bolt resistant
☉ Just Right*	40	APT	G	All white; very crisp; best for fall crop; AAS 1960
☉ Royal Crown*	50	APT	G	Hybrid form of 'Purple Top White Globe' that is more tender; bolt resistant and early; cut-leaf greens
☉ Purple Top White Globe	58	MR	G	Popular; white skin and flesh; reddish-purple top
<i>Turnip Greens</i>				
All Top *	28		F, G	More tender; holds longer in hot weather
☉ Just Right*	28	APT	F, G	For fall harvest; glossy and tender leaves; snowy white; tender roots at 60 days; AAS 1935
☉ Shogoin	35	DMT, MR	F, G	Aphid tolerant; tall and strap-shaped leaves
☉ White Lady*	35		F, G	Long, bright-green tops; sweet, tender roots at 45 days
☉ Scarlet Queen Red Stems*	43		F, G	Dark-green leaves; red stems
☉ Seven Top	45	APT	F, G	Woody and inedible roots; very tender tops
☉ Topper*	45		F, G	Fewer lobed leaves and higher yielding than 'Seven Top'
☉ Royal Crown*	50	APT	G	More tender hybrid form of 'Purple Top White Globe'; bolt resistant and early; cut-leaf greens

* = F1 hybrid

 = also recommended for direct market and sustainable agriculture enterprises since it has high yield potential, pest resistance/tolerance, and very good eating quality

Disease resistance/tolerance: **ALS** = alternaria leaf spot resistant/tolerant; **APT** = apparent pest tolerance (little to no pest damage over several years of observation); **BC** = brown check resistant/tolerant; **CLR** = club root resistant/tolerant; **CLS** = cercospora leaf spot tolerant; **DM** = downey mildew; **F** = fusarium wilt resistant/tolerant; **PM** = powdery mildew; **RRR** = rhizoctonia root rot resistant/tolerant

Suggested uses: **C** = canning; **F** = freezing; **G** = fresh from the garden

Comments: **AAS** = All-America Selections winner

Transplanting

Do not use transplants. Their use will result in misshapen and poor-quality roots. Beets are an exception if carefully transplanted into loose soil.

Spacing Between Rows

- Radishes (spring or fall planting): 1 foot
- Beets: 1 to 1.5 feet
- Parsnips and rutabagas: 1.5 to 2 feet
- Carrots, turnips, and winter radishes: 1 to 2 feet
- Salsify and scorzonera: up to 15 inches

Spacing Within Rows

- Radishes (spring or fall planting): 1 inch
- Beets and carrots: 1 to 3 inches
- Turnips and winter radishes: 2 to 6 inches
- Parsnips, salsify, and scorzonera: 3 to 4 inches
- Rutabagas: 5 to 8 inches

Special Precautions

Parsnips, radishes, rutabagas, salsify, scorzonera, and turnips are cool-season vegetables that give the best quality when they reach usable size under moderately cool temperatures. Close relatives such as cabbage, broccoli, cauliflower, and kohlrabi should not be planted consecutively in the same location because of the potential for increased disease and insect problems.

Carrots and parsnips are slow to germinate; therefore, every effort should be made to avoid soil crusting. Soil crusting can be minimized by placing a thin band of vermiculite, sand, or perlite over the seed row; not overworking heavier garden soils; not working soils that are too wet; or scattering a few radish seeds among the carrot and parsnip seeds to help break the crust. Salsify and scorzonera are also slow to germinate, and fresh seed should be used each year since seed remains viable for only 1 to 2 years. Just-sprouted salsify resembles grass, so use care when weeding.

Parsnip seeds retain vitality for only 1 to 2 years; therefore, old seed

should not be used. After plants are well established (in 5 to 6 weeks), thin the stand to 3 to 4 inches apart.

Spade soil fairly deep for carrots, salsify, scorzonera, and parsnips and avoid compacting the soil as much as possible during the growing season. To reduce greening of the tops or shoulders of carrot and parsnip roots, cover them during the last cultivation.

Since beets, rutabagas, and turnips have a fairly high boron requirement, consider sprinkling each 100 square feet of seeded row with a solution of 2 level teaspoons of Borax powder dissolved in 2 gallons of water (1 teaspoon per gallon). Although boron is an essential element, higher rates can be toxic to beets, rutabagas, turnips, and other crops, so do not apply Borax more than one time per season.

Radishes are sensitive to temperature and day length. Long days cause flowering or seed stalk formation (bolting), and warm temperatures encourage elongated tops and misshapen, elongated roots.

HARVEST AND STORAGE SUGGESTIONS

Beets can be harvested when the roots are between 1 and 3 inches in diameter. Smaller size is best when tops are to be used as greens.

Harvest carrots when the roots reach acceptable size—normally, when the roots of the Nantes types are 0.75 to 1 inch in diameter and Danvers types are up to 2.5 inches in diameter at the top. Carrots are especially good if left in the soil for some frost and harvested before the ground freezes.

Parsnips, salsify, and scorzonera are usually left in the ground until late fall or they can be overwintered. If you plan to dig them from time to time during the winter, cut the tops off the salsify and scorzonera plants and cover the row with a suitable mulch to keep the soil from freezing too deeply. Salsify and scorzonera develop best flavor after several frosts, so delay harvest until that time.

Turnips reach edible size in 60 days or less, and rutabagas need about 90 days. Harvest mature turnips when the roots are about 1.5 to 2

inches in diameter; rutabagas should be 2.5 to 4 inches in diameter.

Radishes develop from planting to harvest more quickly than any other crop. They remain in prime condition only a short time, especially in warm weather. Harvesting must be done promptly, or the roots become pithy; storing them for more than a week in a refrigerator may also cause even high-quality radishes to become pithy.

All these crops are best stored at temperatures near 32°F with a relative humidity of 95 percent. Beets, carrots, parsnips, and winter radishes will keep for most of the winter if stored properly. Turnips, rutabagas, salsify, and scorzonera keep for several weeks to a few months, while spring radishes keep for only about a week.

Ethylene gas is one cause of the bitter flavor in stored carrots and parsnips. Never store these crops with or near apples, pears, tomatoes, or other natural ethylene producers.

WEED MANAGEMENT

Dense weeds not only rob vegetable crops of moisture, light, and nutrients but can also harbor insects and create an ideal environment for many disease-causing organisms. Eliminate young weed seedlings with shallow hoeing or cultivating. Never allow weeds to set seed. Place organic mulches such as straw (4 inches deep), newspaper (4 inches deep), or cardboard around plants and between rows to reduce weeds and conserve moisture. Only apply organic mulches after the soil is warm (about June 10) because they decrease soil temperatures and can therefore increase frost severity. If using newspaper or cardboard, we strongly recommend wetting it thoroughly after applying it to the soil. Additionally, consider placing compost or composted manure on top of the newspaper or cardboard to promote degradation and eliminate temporary nitrogen tie-up.

Manage perennial weeds year-round near and in plantings as they can harbor disease-causing organisms. To help keep weeds and weed seeds out of plantings during the fall and winter months, consider sowing a

cover crop in late summer or fall (for example, annual ryegrass or spring oats mixed with hairy vetch). Turn the cover crop into the soil about one month before spring planting.

As a general rule, avoid using herbicides for weed management in small planting areas for several reasons. First, no one herbicide that can be safely used on all kinds of vegetables is available. Second, herbicides are difficult to apply at proper rates in small areas with hand sprayers. In most cases, some areas will receive too little herbicide for effective weed management and other areas may receive such heavy rates that the crop will be damaged or killed. You also risk damaging or killing your plants from spray drift.

DISEASE AND INSECT IDENTIFICATION AND MANAGEMENT

Pest management programs for vegetables can make use of both cultural and chemical control measures. Nonchemical methods should be used in order to prevent plant injury. Resistant cultivars, proper cultural practices, and sanitation are all important in an effective pest management program.

Diseases or insects may cause a serious reduction in the vigor, quality, and productivity of plants. The success or failure of a fungicide or an insecticide is related to correct identification of the pest problem, method of application, weather conditions, correct timing, dosage of pesticides, and selection of the correct pesticide.

Always follow the directions on the container package when mixing and applying pesticides. Never increase the amount of pesticide or decrease the amount of water you mix with the pesticide.

Diseases

CERCOSPORA LEAF SPOT OF BEETS

These spots are brown or gray with a purple border. They may develop late in the season. Most table beets are resistant to this disease.

Management: Follow a 2- to 3-year rotation (i.e., don't plant beets in the same area for 2 or 3 years). Remove

refuse from the garden as soon as beets are harvested. If necessary, a pesticide that contains fixed copper may help; follow the directions for mixing and application.

LEAF SPOT AND ROOT CANKER OF PARSNIPS

Spots develop on leaves and dead canker areas develop at the top of parsnip roots. This disease is promoted by wet conditions.

Management: Practice a 2-year rotation. Provide good soil drainage. Lime soil to obtain a pH of 7.0. Ridge soil over shoulders of roots.

LEAF SPOTS OF CARROTS

Lower leaves become spotted and may die.

Management: Grow carrots in a sunny location. Avoid growing carrots in the same area in succeeding years. If you anticipate a leaf spot problem, some fungicides can be helpful if started as first symptoms appear and repeated at 7- to 10-day intervals as directed on the label. Use a pesticide that contains one or both of the following fungicides: chlorothalonil or fixed copper (this information will be listed on the label). At harvest, remove carrot leaves from the garden. The leaves may be placed in composting piles.

ROOT-KNOT NEMATODES

Nematodes are microscopic worms that live in soil. Root-knot nematodes enter the root and cause small swellings to develop on the side of the main root and on fine roots. Damage to roots reduces plant vigor.

Management: Rotate crop types. Avoid planting susceptible crops in succeeding years. Susceptible crops include carrots, parsnips, tomatoes, lettuce, and cucurbits (squash, cucumber, melons, and pumpkin). Sweet corn is seldom affected and is a good crop for affected areas.

CLUBROOT OF TURNIP

Roots become swollen and distorted and leaves may wilt.

Management: Avoid areas where turnips and cabbage-related plants were grown within 7 years. If clubroot has been a problem in past years, apply hydrated lime (1 lb/30 sq ft) in the

spring before preparing the seedbed. Remove plants, including the roots (as much as possible), as soon as harvest is completed. Do not compost roots that have clubroot symptoms; discard them.

Insects

FLEA BEETLES

Flea beetles cause the most serious injury to young plants early in the growing season. Small, round, shiny beetles about $\frac{1}{16}$ inch long either eat small holes in the leaves or skeletonize them. These beetles jump readily when approached. Injury gives plants a ragged and bleached appearance and growth is slowed.

Management: Clean cultivation and weed management are important since the beetles feed on many weeds. Suspending a floating row cover above the crop immediately after planting can protect plants from damage. Plants with vigorous growth can withstand fairly high levels of feeding without reducing total plant health; lightly infested leaves can be discarded. When injury exceeds your tolerance, spray with an insecticide labeled to control flea beetle on vegetables.

GREEN PEACH APHID

Aphids are small, soft-bodied, greenish, sucking insects that feed by inserting their needlelike mouthparts into plants and sucking out the sap. They are often seen in large colonies that form on the leaves and stems. On peach trees, aphids overwinter as eggs that begin to hatch as the peaches bloom. During early spring, they stay on peach trees for several generations. Most aphids are wingless, but when conditions become crowded or food is depleted, some aphids develop wings and move to other plants and weeds. They produce many generations on the summer plants on which they feed.

Management: Clean cultivation and weed management are important since aphids feed on many weeds. When aphids first appear, spray with insecticidal soap or an insecticide labeled to control aphids on vegetables. Aphid populations are heavily influenced by temperature, rainfall, number of natural enemies present,

and pesticide applications. Aphid outbreaks tend to be most frequent in hot, dry weather, while heavy rains (or directed sprays of water) often reduce the aphid population to acceptable numbers.

LEAFMINERS

Plants are often disfigured and damaged by several species of small flies that live in the maggot stage in the leaf tissue between the upper and lower surface. Feeding causes large, white blotches and winding trails through the interior of the leaves, which are rendered unattractive and unfit for human consumption.

Management: Row covers can protect plants from leafminer damage. Individual leaves can also be removed and destroyed as feeding damage is noticed. Otherwise, when mines first appear, spray with an insecticide labeled to control leafminer in vegetables. *Note:* Insecticides cannot control maggots already inside leaves at the time of application.

CARROT RUST FLY

The maggot of the rust fly is a pest of both carrots and parsnips.

Management: Since rust fly is not a problem every year, attempts at control may not prove practical. Row covers can be used to protect the crop. When rust fly injury is first noticed, spray with an insecticide labeled to control rust fly in vegetables.

CABBAGE MAGGOT

Radishes, turnips, and rutabagas are favorite hosts for the cabbage maggot, which produces four and sometimes five broods (generations) per season. The first brood emerges in April when the yellow rocket weed is in bloom.

Management: Do not plant in the same location that plants in the crucifer family (broccoli, Brussels sprouts, cabbage, cauliflower, kale) were grown the previous year. Avoid planting in fields that have recently decaying organic matter (for example, avoid planting immediately after plowing under animal manure or a cover

crop). Maintain plant vigor. Remove and destroy infested plants. Crops can be protected by using a floating row cover held at least 6 inches from the plants to prevent adult flies from laying eggs near the bases of the plants.

Cool, wet springs promote conditions that contribute to high populations of cabbage maggots. Fields of cruciferous vegetables should be scouted and closely evaluated for cabbage maggots, especially during years with favorable conditions. The first summer generation of the cabbage maggot is the most damaging to plant health. Young plants are not able to withstand much root feeding from the cabbage maggot before wilting and death occur, especially if temperatures are low. Plants growing in warmer conditions can grow past low to moderate numbers of cabbage maggots.

Prepared by P. A. Ferretti, professor emeritus of vegetable crops; E. S. Sánchez, assistant professor of horticultural systems management; T. E. Elkner, Lancaster County senior extension educator; J. D. Peplinski, coordinator, plant disease clinic; S. Fleischer, professor of entomology; and G. Pryor, state master gardener coordinator.

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