



## Carrots

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The carrot is of the parsley family which includes about 2,500 species such as dill, caraway, coriander, fennel, anise, parsley, parsnip, and celery. The cultivated carrot belongs to the genus *Daucus* L. which contains many wild forms. These grow mostly in the Mediterranean areas and in Southwest Asia, but some representatives are found in tropical Africa, Australia, New Zealand and the American continents.

The cultivated carrot is a biennial plant that normally requires two growing seasons with a cool rest period between them. This will complete its life cycle from the planting of seed to the maturing of seed. However, in a single season (60 to 90 days depending on the variety and growing conditions) the carrot "root" is produced in suitable size for marketing. The carrot root not only anchors the plant and absorbs nutrients from the soil but acts as a storage depot for carbohydrates, especially starch and sugar.

## Climate

Carrots grow best at mean temperatures between 60 and 70 F. During hot, bright, sunny days young plants may be badly injured or killed by the high temperatures that develop at or just below the soil surface. Prolonged hot weather later in the development of the plants may not only retard growth and depress yield, but may cause undesirable strong flavor and coarseness in the roots. Temperatures much below 50 F tend to make the roots longer, more slender, and paler in color than is typical.

## Quality

Carrots for fresh market are generally harvested before reaching full maturity and are shipped immediately. Fresh-market carrots should have the following qualities:

- long (9 inches plus), slender, smooth, with small-diameter necks
- uniform deep orange or gold color (including the core)
- mild, sweet flavor
- vigorous, blight-resistant leaves
- high percentage of usable yield

Fresh-market carrots are more tender, milder in flavor and brighter in external color than carrots which are harvested for processing. The fresh-market carrots are especially good for carrot sticks while processing carrots are good for cooking

and shredding. Wilted, flabby, soft, shriveled carrots or carrots with large green areas at the top are undesirable.

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## Varieties

Several hundred varieties exist, but carrots are sold more by shape and type than by variety. There are four main types of carrots:

*Imperator* -- long (9-10 inches), small shoulders, tapered tip; used primarily for fresh pack.

*Nantes* -- medium length (6 inches), uniform diameter, blunt tip; used for bunching, slicing, and mini carrots. They have good eating quality and are especially suited for local sales. They normally mature earlier than *Imperator* types.

*Danvers* -- large, medium long (7 inches), processing type; used for dicing and slicing. They require a long season (120 days) to develop tonnage and high sugar content.

*Chantenay* -- large shoulders, short (5 inches), usually with a large, distinctly colored core; used for dicing. These are older cultivars and usually not of the quality required by processors. They are now used primarily by home gardeners.

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## Seed Companies

Three midwestern seed companies were contacted regarding common varieties of carrot seed purchased and price quotes for these varieties. Green Barn Seed Company located in Deep Haven, Minn., said that the *Danvers 126* carrot is a good seller for dehydration. The price is \$2.70 for 4 ounces, \$9.00 for one pound and \$7.50 per pound for 20 pounds or more. The hybrids *Dominator* and *Prospector* are the most common fresh-market carrots, sold at a price of \$.235 and \$.17 per pound for 20 pounds or more seed purchased, respectively.

Jung Seed Company in Randolph, Wis., said that the *Red Cored Chantenay* is a popular seller for dehydration. The price for .5 ounce is \$1.45 or one pound for \$11.75. The hybrid *Lucky B* sells best at a price of \$54.95 for one pound. Jordan Seeds in Woodbury, Minn., said it sells varieties for the fresh market, and the most popular seller is *Nance* which sells for \$6.50 per pound.

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## Soil Requirements and Tillage

Deep sandy loams and muck soils are most desirable for carrot culture. Such soils are among the easiest to work and permit good development of the edible roots. Silt loams are also extensively used. In irrigated districts where moisture can be accurately controlled, silt loams and even clay loams produce high quality yields of carrots. These heavy soils are not recommended in nonirrigated areas where soil moisture is not subject to precise control. Growing carrots on heavy soils is more difficult than on light ones, even when soil moisture is controlled. Cloddy, stony, trashy or very shallow soils are undesirable. Carrots do well in soils of pH 5.5 to 6.8, but tolerance of slight alkalinity applies only to native western soils.

Carrot roots are very sensitive to soil compaction. Rows next to the wheel track often have more forked and stubbed carrots than rows in the center of a bed, and usable yields are reduced. Therefore, limit movement of equipment in fields as much as possible. During the first three weeks of growth, stay off the field completely.

Some farmers grow carrots on raised beds. This allows the soil to drain better and warm sooner in the spring. It is of most benefit on heavy and poorly drained soils.

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## Fertilizer

A good nutrition program maintains moderate to high nutrient levels in the soil with annual additions of fertilizer based on a soil test. Soil should be tested at least every two to three years. Nitrogen does not accumulate in soil over time, so it

should be applied annually. For an approximate yield goal of 350 hundredweight per acre, on medium soil organic matter level, 100 pounds of nitrogen per acre is recommended. The suggested method of application is to broadcast half and then sidedress half when plants are established. Phosphorus levels in Cass County are 10 parts per million (using the Olsen test), which translates to needing to apply 100 pounds per acre of phosphorus. Potassium levels in Cass County are 278 parts per million, which indicate that no additional potassium needs to be applied. Applying large amounts of potassium at one time may decrease quality.

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## Seeding Carrots

Plant carrots with a vegetable seeder equipped with a 2- or 3-inch scatter shoe or multiple-row shoe. The row should not be more than 4 inches wide because of difficulties passing the leaves through the harvester. Plant enough seed to obtain about 24 live seeds per foot of row for fresh-market carrots and 16 to 18 seeds for Danvers-type processing carrots.

Rows should be at least 15 to 20 inches apart. Closer spacing makes harvesting difficult and prevents air movement through the leaf canopy, which may result in increased blight infection. Plant carrot seeds 1/8 to 1/4 inch deep into moist soil. If soil is dry, irrigate the fields immediately after seeding. If irrigation is not available, plant seeds 3/8 to 1/2 inch deep. Make sure the seed is pressed firmly into the soil to obtain good soil to seed contact.

Approximately 2 to 3 pounds of carrot seed are needed per acre for fresh market cultivars and 1 to 2 pounds for processing cultivars. Always plant according to desired plant stand count, taking into consideration the germination rate and number of seeds per pound.

Rye or barley strips are often planted between every three to six rows of carrots to protect young carrots from wind damage. Remove windbreak strips when carrots are 4 to 5 inches high, either with herbicides or by tilling.

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## Harvesting

Fresh-market carrot harvest can begin in August and extends into mid-October. Carrots are mechanically harvested by undercutting the roots and elevating them out of the soil and into the machine by grasping the leaves. Thus, it is important to maintain healthy leaves until the carrots are harvested.

Handle carrots as carefully as possible after harvest to avoid damaging the roots. Injuries reduce shelf life and increase chances of decay. Fresh-market carrots are especially susceptible to injury because they are harvested before maturity to obtain the desired market-size roots. Fresh-market carrots can be stored for four to six weeks if held at 32 F and 95 percent to 99 percent relative humidity.

Harvest of processing carrots usually begins about September and extends into November. Because processing carrots are harvested when they are mature, they are less susceptible to injury and can be stored for four to five months under proper conditions (32 F and 95 percent to 99 percent relative humidity). Remove excess soil and rotten carrots, but do not wash carrots before storing them.

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## Insect Pests

Aster leafhoppers, green peach aphids and wireworms are the main insects that affect carrots.

The aster leafhoppers are the most important insect pest to be concerned about. The leafhoppers do no direct damage to carrots, but transmit aster yellows to carrots, celery, lettuce and weeds such as wild carrot, mare's tail (horseweed) and pineappleweed. Aster yellows is caused by a mycoplasma-like organism and can be controlled only by controlling the leafhopper and the weed hosts.

The adult aster leafhopper is light gray-green, is 1/8 inch long and is an active flier. The leafhopper over-winters in the egg stage on grasses and weeds and may also migrate from warmer regions.

Check fields for leafhoppers at least one or two times per week and treat if numbers exceed five to 10 per 100 sweeps with an insect net. Different varieties of carrots have different tolerances to aster leafhopper disease.

Green peach aphids are pests of many vegetable crops. Damage to carrots is less serious than to other crops because carrots are not subject to virus diseases and the aphids do not cause contamination problems as they do in leafy crops.

The green peach aphid adults are yellowish green and 1/16 inch long; the winged adults are black with green markings. They overwinter as eggs on peaches and other stone fruits and migrate to carrots in early summer. Aphid populations build rapidly, especially during warm, dry weather.

Check fields for aphids regularly and treat if necessary. Avoid excessive spraying because extremely high populations are often found in fields that are heavily sprayed with insecticides and fungicides. The aphids may develop resistance to insecticides and flourish where all natural enemies (insect predators, parasitoids and fungal diseases) have been eliminated.

Wireworms are sometimes a problem in fields that recently have been planted with sod or have had grassy weed problems. Adult wireworms (click beetles) are attracted to grassy weeds for egg laying, and the larvae live in the soil for two years, feeding on plant roots, including carrots.

Where wireworms are observed during tillage or where problems are suspected, treat with a soil insecticide before planting. It is not recommended to seed carrots into fields that have been sod up to two years previously.

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## Diseases

Alternaria leaf spot and Cercospora leaf spot cause similar symptoms on leaves and are difficult to distinguish in the field. Spots on leaves have a dark center surrounded by a yellow margin. The leaves curl when lesions appear on the edges of leaf segments. Both of these diseases can be controlled by regular applications of fungicides.

Storage rots are caused by a number of organisms. The most common is crater rot. To avoid storage rots, cool the carrots after harvest as quickly as possible to 32 F. Avoid mechanical damage to roots during harvest. Do not try to store carrots from poorly drained fields or fields that have suffered excess water damage during the growing season.

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## Weeds

Annual grasses and broadleaf weeds are the major weed pests in carrots. Most can be controlled with herbicides currently registered for use on carrots. However, a few resistant weeds are becoming serious problems. Mare's tail, pineappleweed and groundsel are somewhat resistant.

A good weed control program includes both pre- and post-emergence application of herbicides, crop rotation and cultivation.

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## Nematodes

Nematodes are parasites that live in the soil. They have not caused problems in North Dakota or Minnesota but have created problems in other vegetable producing states, such as Michigan. Northern root-knot, carrot cyst, root-lesion and pin nematodes are the most common parasites. The problem is especially severe in fields where carrots are grown continuously.

Soil fumigation has been the most effective means of nematode control in carrot production. If nematode problems are suspected, have soil and roots tested for nematodes.

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## Economics

### Production coefficients for producing onions in the Southern Red River Valley, North Dakota, 1993.

Selling price (\$/ton)	\$50
Market yield (tons/acre)	15
Seeding rate (lbs/acre)	2
Seed cost (\$/lb)	\$10
Land value (\$/acre)	\$757
Debt-to-equity ratio	.34
Interest rate on debt capital (%)	9.5
Interest rate on equity capital (%)	5.5
Herbicide (\$/acre)	\$60.41
Nitrogen per acre (lbs)	50
Phosphorus per acre (lbs)	100
Trace minerals per acre (lbs)	1
Nitrogen cost (\$/lb)	\$0.113
Phosphorus cost (\$/lb)	\$0.18
Trace minerals (\$/lb)	\$13
Transportation (miles one way)	150

### Economic and cash flow budgets for processed carrot production in the Southern Red River Valley, North Dakota, 1993.

	Profitability	Cash Flow
	-----	\$/acre ----
Gross Return	\$750.00	\$750.00
Variable Costs		
Seed	\$20.00	\$20.00
Herbicide	60.41	60.41
Fertilizer	36.65	36.65
Fuel and lubrication	98.31	98.31
Repairs	40.36	40.36
Operating interest	12.15	12.15
Total Variable Costs	\$267.88	\$267.88
Fixed Costs		
Miscellaneous overhead	\$33.83	\$16.15
Machinery depreciation	108.67	xx.xx
Machinery investment	74.82	146.88
Land taxes	6.31	6.31
Land ownership	49.01	25.05
Total Fixed Costs	\$272.65	194.39
Total Listed Costs	\$540.53	\$462.27
Return over variable costs	\$482.12	\$482.12
Return to owner labor and management	\$209.47	xx.xx
Cash flow (debt service, family living)	xx.xx	\$287.73

The **economic budget** is generated by charging market rates for all resources needed for production. It helps answer the question "Is this enterprise profitable?" The bottom line represents a return to labor and management.

The **cash flow budget** is an estimate of the out-of-pocket cash needed to run the enterprise, including not only direct costs but indirect cash costs such as principle and interest payments, insurance and taxes. It helps answer the question "Can I meet my cash obligations if I go into this enterprise?" Total cash expenses are subtracted from total cash receipts to calculate the net cash which is available for family living and other needs.

## Marketing

Carrots are a featured item in grocery store advertisements when supplies are good in quantity and quality. The best market seems to be in the winter months when used in stews and soups. Carrots need to be refrigerated and kept moist to keep from wilting.

Historical fresh-market grower prices from 1970 to 1991 indicate that the highest prices are received in December, January and February (\$7.00/hundredweight to \$21.00/hundredweight) with an average of \$10.70/hundredweight. Fresh market retail prices during the same time period ranged from \$.21 per pound to \$.52 per pound with an average of \$.29 per pound. Fresh-market carrots are usually packed in 1-, 2-, 3- or 5- pound plastic bags and then packed in 48- or 50-pound master bags.

Minnesota Dehydrated Carrot in Fosston, Minn. processes carrots for the human consumption market. The top-grade processed carrots are sold mainly to canning/soup companies, to be used in soups and stews. Also, the military buys a large portion of the dehydrated carrots to use in their Meals Ready to Eat (MRE) packages. The cull carrots are sold to be used in dog food.

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## **United States Production Area**

In 1991, California harvested the largest amount of carrots -- 56,000 acres. Florida followed with 9,000 acres, Texas and Michigan each harvested 6,800 acres and Texas harvested 6,300 acres. Minnesota harvested 1,800 acres. This acreage corresponds to a total of 1.6 billion pounds in California, 340 million pounds in Texas and 170 million pounds in Michigan.

Harvested acreage of fresh-market carrots were 77,570 acres in 1970. Acreage fluctuated up and down, peaked in 1989 at 101,900 acres and fell to 97,300 acres in 1991. This acreage corresponds to a yield of 1.1 billion pounds in 1970 and 1.9 billion pounds in 1991. The value of production for the fresh market was \$55.8 million in 1970 and increased to \$281.1 million by 1991. The average United States yield of fresh-market and processing carrots in 1989-1991 was 293 hundredweight per acre.

California, Washington, Michigan and Texas rank the highest in tons of processing vegetables produced in the United States from 1989-1991.

United States per capita use of carrots has increased from 10.4 pounds farm-weight in 1972 to 11.2 pounds in 1991. Of that total, the proportion of fresh, canning and freezing was 63, 10 and 27 percent, respectively, in 1972. The ratio changed in 1992 to 66, 9 and 25 percent, respectively.

United States cash receipts of carrots were \$70.2 million in 1970 and rose to \$273 million in 1990.

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## **North Dakota Production**

According to a survey of vegetable growers in the state which was presented to the North Dakota Agricultural Products Utilization Commission, there are 243 carrot acres in North Dakota. Cass County leads production with 230 acres, followed by six acres in Traill, four acres in Sargent, two acres in Burleigh, half an acre in Mountrail and Morton Counties, and two-fifths of an acre in Barnes County.

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## **Imports**

The U.S. imported 56 million pounds of carrots in 1970. The amount of imported carrots fluctuated but peaked in 1984 at 161 million pounds and at 137 million pounds in 1991. The imports average 6.2 percent of the total supply of fresh carrots in the United States.

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## **Exports**

United States exports were 51 million pounds in 1970 and peaked at 179 million pounds in 1991. The exports average 7.7 percent of the total use of fresh carrots in the United States.

For more information regarding seed companies contact:

**Green Barn Seed Company**

18855 Park Avenue, Deep Haven, MN 55391  
#1-800-882-7552

**Jordan Seeds**

6400 Upper Aston Road, Woodbury, MN 55125  
#612-738-3422

**Jung Seed Company**

Randolph, MN 53957  
#414-326-3121

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