

CARROT

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Carrot (*Daucus carot* L.) is a crop primarily grown for its fleshy root which is used as vegetable. Its root is rich in carotene, a precursor of Vitamin A. It also contains appreciable amounts of thiamine, riboflavin and sugar.

Carrots are considered as root crops. In fact, they are one of the most popularly grown root crops in the world. Not only that, they're also the world's most consumed root crops. It originated from Central Asia with Afghanistan as the primary center of origin. It is one of the most important vegetables commonly grown in the Philippine highlands. The production areas are in Benguet, Mountain Province, Ifugao, Nueva Vizcaya, Cebu, Davao del Sur, Negros Oriental, and Bukidnon.

The effect of frosts in Atok, Benguet caused a one (1) percent decline in carrot production in the period January-June 2005 as total output settles at 16.8 thousand Metric tons. Among the highland vegetables, area harvested for carrots was largest at 1.45 thousand hectares but this was 0.14 percent below the 1.46 thousand hectares during the first half of 2004.

During the first semester of 2005, production of Benguet was 13.7 thousand metric tons or 81.4 percent share to total output. Cebu followed at 722 metric tons or 4.3 percent share. Other major producers were Mt. Province, Negros Oriental and Davao del Sur.

Sweet and succulent carrot are notably rich in anti-oxidants, vitamins and dietary fiber; however, they provide only 41 calories per 100 g, negligible amount of fat and no cholesterol. They are exceptionally rich source of carotenes and vitamin-A. 100 g fresh carrot contains 8285 mcg of beta-carotene and 16706 IU of vitamin A.

Beta carotene is one of the powerful natural anti-oxidant that helps protect body from harmful free radical injury. It also has all the functions of vitamin A such as vision, reproduction (sperm production), maintenance of epithelial integrity, growth and development. Carrots are rich in poly-acetylene anti-oxidant falcarinol. Fresh roots are high in vitamin C; provide about 9% of RDA. Vitamin C is water soluble anti-oxidant. It helps the body maintain healthy connective tissue, teeth and gum. Its anti-oxidant property helps protect us from diseases and cancer by scavenging harmful free radicals.

This root vegetable specially contain good amounts of many B-complex group of vitamins such as folic acid, vitamin B-6 (pyridoxine), thiamin, pantothenic acid, etc that acts as co-factors to enzymes during substrate metabolism in the body.

It also has healthy levels of minerals like copper, calcium, potassium, manganese and phosphorus. Potassium is an important component of cell and body fluids that helps control heart rate and blood pressure by countering effects of sodium. Manganese is used by the body as a co-factor for the antioxidant enzyme, superoxide dismutase.

Climatic Requirement

Carrot is grown preferably in elevated areas because it requires low temperature for root development. Carrot grows well and produces high quality root in areas with temperature range of 15.6°C to 18.3°C. In higher temperature, it produces long, slender roots with pale color.

Soil Requirement

Carrot prefers sandy loam to clay loam which is friable and has good drainage. It does not grow well on highly acidic soil. It yields extremely low at pH 5.2 and optimum at a pH range of 6.0 to 6.8. Avoid stony and heavy soils as these will promote incidence of root defects.

Varieties

Carrot comes in different colors - white, yellow, orange, purple and violet. Several hundred varieties exist, but there are four main types:

1. Imperator - has long roots (23-25cm), small shoulders and tapered tip;
2. Nantes - has medium length roots (15cm), uniform diameter and blunt tip;
3. Danvers - is large, with medium length roots (18cm), a processing type used for dicing and slicing; and
4. Chantenay - is short (13cm) with large shoulders, and usually a large, distinctly colored core. Practically, all varieties in the Philippines are of the Chantenay type. Open pollinated and hybrid varieties are available commercially.

Other Varieties

1. Golden Kuroda All Grow - It has a maturity period of 115 - 127 days. Its shape is semi-conical and it has a length of 15 cm, deep orange in color and it weighs between 135 - 175 grams. It has a higher degree of resistance to blight and rotting with a blunt root - end.
2. Kuroda GT (Condor) - It has a maturity period of 90 - 110 days. Its shape is long-conical and it has a length of 20 - 24 cm, and deep orange in color.. It has large roots with smooth skin and has very good shipping and keeping quality.
3. Kuroda Improved (Hytec) - It has a maturity period of 110 -120 days. Its shape is conical and it has a medium length and deep orange red in color. It has highly uniform deep orange roots.
4. Hybrid S-505 (Sakata) - It has a maturity period of 110 days. Its shape is chantenay and it has a length of 18 cm, and deep orange in color. It has smooth skin and excellent orange color. It has a very high quality and is a high yielding hybrid in the tropics.
5. Hybrid Sigma (Noong Woo Bio) - It has a maturity period of 100 days. Its shape is cylindrical and it has a length of 20 -22 cm, deep orange in color and it weighs from 200 - 250 grams. It is suitable for spring sowing with a late bolting habit.
6. Nikko Kuroda (Golden State) - It has a maturity period of 110 -120 days. Its shape is conical and it has a medium length and deep orange red in color. It has a wide shoulder and smooth skin with a good shipping and keeping quality.
7. OP New Kuroda (Musashino) - It has a maturity period of 100 days. Its shape is cylindrical and it has a length of 18 - 20 cm, deep orange in color and it weighs from 200 - 220 grams. It has an attractive shape and outstanding uniformity.
8. OP New Kuroda (Noong Woo Bio) - It has a maturity period of 100 - 120 days. Its shape is cylindrical and it has a length of 15- 20 cm, deep orange in color and it

weighs from 180 - 200 grams. It has a good taste and is suitable for both fresh processing markets.

9. Winter Tokita - It has a maturity period of 68 - 70 days. Its shape is semi - conical and it has a length of 18 - 20 cm, orange red in color and it weighs from 250 grams. It has a strong resistance against leaf blight, rotting and cold, heavy yielder suitable for late harvesting. It is adaptable to cold and rainy season.
10. Kuroda - It has a maturity period of 68 - 70 days. It has a length of 18 - 20 cm and deep orange in color. It is well suited for tropical conditions. It has an improved interior quality with very attractive appearance.
11. Super Kuroda - It has a maturity period of 90 - 100 days. It has a length of 18 - 20 cm and red orange in color. It has smooth skin, resistant to cracking, and resistant to blight.
12. Kuroda EW-35- It is deep orange in color and is strong against soft rot and leaf diseases in the wet season.

Cultural Management

- A. **Land Preparation.** Deeply plow the soil, then harrow and level the surface for seedbed preparation. Prepare raised seedbed of 50 to 100 cm wide. Carrot has an average root-zone depth of 90 cm and requires a well pulverized soil to allow better root penetration. Thorough field preparation is very necessary for the plant because it is small- seeded and usually planted direct in the field. Crops planted in a well-prepared field seem to have better well-shaped, marketable roots than plants grown in a poorly prepared soil which tends to have irregularly-shaped roots.
- B. **Crop Establishment.** One hectare of carrots would require 6 to 8 kg seeds. The seeds are uniformly distributed in furrows and covered with fine soil at about 2 cm thick. It may take about 2 weeks from sowing to complete the emergence of the seedlings. In areas with pronounced wet and dry season, planting time is from September to February. Drill seeds at about 1 cm depth spaced at 5 cm between hills and 20 cm between rows. Cover the seeds with fine soil. In low elevation areas, the best time to plant is from the last week of October up to February or during the coolest part of the year. In the highlands, planting can be done throughout the year.
- C. **Fertilization.** In the absence of soil analysis, the general fertilizer recommendation for carrot is 150-140 kg NPK per hectare. Basal application of complete fertilizer (14-14-14) is done on the last harrowing at a rate of 11 bags per hectare. Side dress 2 bags urea (40-0-0) and 2 bags muriate of potash (0-60-0) at 50-60 days after sowing.
- D. **Irrigation.** Carrot requires 15-35 mm water per weeks during the growing season. Proper watering is essential for root development. When watering, make sure that the soils are soaked thoroughly. Carrot is sensitive to moisture during root enlargement period. Continuous excessive soil moisture during this stage results in undesirable short thick tuber with low carotene content and poor color and will cause the roots to crack.

- E. **Cultivation and weeding.** For the first few days, carrots grow slowly and cannot successfully compete with weeds. To suppress weeds and keep the soil surface loose, shallow cultivation is recommended as soon as the first true leaves appear. Shallow cultivation is advised to avoid root injury.
- F. **Mulching.** As the plant matures the crowns start to appear at the soil level, mulch with compost. This will protect the roots from sunlight exposure which will turn them green.
- G. **Thinning and Hilling Up.** Thinning is done to provide enough space to the growing roots. Start thinning at 30 days after sowing, at a spacing of 10 cm between plants. Hill up immediately after thinning to cover the growing roots, control weeds, and cover the side dressed fertilizer. Second weeding and hilling up is done 45 days after the first weeding

H. Pest Management

1. **Cutworms (*Agrotis ipsilon*).** Cutworms are grayish, fleshy caterpillars up to 5 cm long, which curl up when disturbed. Plants may be chewed off above or below ground level and may be damaged higher up by climbing cutworms. Most of the cutworm damage is to newly set plants in the field, but they are often found attacking seedlings in plant bed and greenhouses. Late infestation of variegated cutworm occasionally occurs.

Management

- a. Prepare the soil two weeks before planting to cultivate in cover crops and destroy weeds.
 - b. Check plants frequently and treat when damage is first observed.
 - c. Spray with biological insecticide such as *Bacillus thuringiensis* (Bt) and Nuclear Polyhedrosis Virus (NPV) following the recommended rates.
2. **Slugs.** Slugs exist in various sizes up to 10 cm. They eat holes in the leaves and leave a trail of mucus, which makes plants unsightly. The control of slug populations has been a continuing problem in the Cole crop industry.

Management

- a. Slugs prefer areas which are cool, moist and high in organic matter. Sod crops, weedy fence lines and hedgerows fulfill these conditions.
- b. Cultural practices aimed at controlling slugs should begin at least one year before the susceptible crop is put in. If possible, sod crops should not be followed by Cole crops.
- c. A cultivated strip around the crop has been shown to reduce the number of slugs migrating from weedy field borders. If urea (4 kg/ha) is sprayed on this cultivated strip, slug movement may be further impeded. The salt irritates

- the slugs as they move over it. Repeated applications are necessary as rainfall washes it into the soil.
- d. Spread rice hull ash or slug pellets around the plots just to cover the soil

Aphids (*Brevicoryne brassicae*)

Damage/Symptom

The aphid is a major pest of carrots worldwide. Aphids are small, soft bodied, slow moving insects. A colony consists of winged and wingless adults and various sizes of nymphs. Aphids may be black, yellow or pink, but mostly are various shades of green. They are often found in large colonies on the undersurface of leaves; however, aphids will feed on heads, flower stalks as well as leaves, resulting in unmarketable produce. Aphids feed by piercing plants and sucking out plant sap, resulting in distorted plant parts and a slowing of plant growth. The plants may be covered by a sticky substance, called honey dew, which is excreted by the aphids.

Management

1. There are many natural enemies that will feed on aphids, thus helping to reduce the populations of this pest in the field. Natural enemies that produce larvae which will feed on aphids include syrphid flies, lacewings and the predaceous midge. Adults and larvae of minute pirate bugs, big eyed bugs, lady beetles, soldier beetles and parasitic wasps like *Diaeretiella rapae* will also consume aphids.
2. Cultural controls include using high pressure sprinkler irrigation to knock the insects off of plants, as well as using living mulch such as clover interplanted with the crop.
3. If using chemical controls, check plants frequently and treat when damage is first observed.

Armyworm

Damage/Symptom

During the daytime, armyworms hide under vegetation, loose soil or in soil cracks. Caterpillars consume more and more vegetation as they grow. Since they feed at night and hide during the daytime, armyworms often cause considerable damage before being discovered.

Management

1. Spray with Bt following the recommended rates.
2. Maintain populations of ground beetles and tachinid flies.
3. Spread ash baits along the field borders. I
4. f needed, spray recommended pesticide

Diseases

Powdery Mildew

Damage/Symptom

Covers a plant with a downy, white fungal coating that sucks nutrients out of the leaves.

Management

1. Bicarbonate sprays can help to prevent mildew.
2. Destroy seriously affected vines, or place them in sealed containers for disposal with household trash.
3. Avoid powdery mildew by planting resistant cultivars

Bacterial Soft Rot

Damage/Symptom

Bacterial soft rot appears as a soft, watery, and slimy decay of the taproot. The decay rapidly consumes the core of the carrot, often leaving the epidermis intact. A foul odor may be associated with soft rot. Aboveground symptoms include a general yellowing, wilting, and collapse of the foliage.

Management

1. In the field, maintain good drainage
2. Avoid practices that could wound roots.
3. Avoid prolonged irrigation of mature carrots during warm months of the year.
4. In the packinghouse, handle carrots carefully to avoid bruising and store them under cool conditions.
5. Chlorine added to the wash water helps to eliminate the soft rot bacteria from carrot surfaces.

Avoid injury to the roots during harvest and remove the infected roots.

Alternaria blight

Damage/Symptom

Alternaria leaf blight symptoms appear as dark brown to black irregularly shaped lesions on leaf blades and petioles. Spots are initially surrounded by a yellow margin and often begin on the older leaves. Leaves can be killed when spots grow together. Lesions that develop on petioles may kill entire leaves. Leaves weakened by blight may break off when gripped by mechanical harvesters, resulting in the roots being left in the ground. The pathogen also causes damping-off of carrot seedlings.

MANAGEMENT

1. Cultural Control
2. Planting *Alternaria*-indexed seed or treating seed in a hot water bath is very important.
3. Turn under carrot residue by tillage or plowing to hasten decomposition of debris.
4. Practice 2-year rotations: avoid continuous carrot culture. Do not plant new fields near existing fields with blight symptoms.
5. Many growers use sprinkler irrigation throughout the growing season. In areas with rainy weather, furrow irrigation may aid in disease reduction

Organically Acceptable Methods

1. Cultural control,
2. Hot water dips

Monitoring and Treatment Decisions

Seed treatments may reduce *Alternaria dauci*. Assay the seed and if pathogen is found, treat. If seed are not treated, apply fungicides when the first blight symptoms appear, at biweekly intervals, and/or when conditions are favorable for disease development.

Diseases caused by Nematodes

The most common carrot nematodes are:

Meloidogyne incognita - provokes the development of galls, which make the roots look as if they were covered with knots. Infected plants are stunted and sickly, with knots on their small feeding roots. This disease is caused by nematodes which can persist in the soil for years.

Heterodera carotae - This affects root growth, with many secondary roots developing in which the parasite can be found.

Ditylenchus dipsaci y d. - Destructor these cause little stains on the carrot surface.

Management

Rotation with non susceptible plants, such as corn, can reduce the number of nematodes in the soil. Growing carrots in a new area will also control the disease. Care should be taken to avoid carrying any soil from the old site to the new site.

Harvesting

Carrot matures in 65 to 110 days after planting. Uproot the plant and cut the leaves up to 2 centimeters from the base of the roots. Washing is not recommended until produce reaches the market.

Post-harvest Handling

Cut the leaves 5-8 cm from the shoulder. Wash the roots and air dry. Sort and classify according to size and appearance. Roots that are cracked, deformed, and forked are considered non-marketable, but can still be cooked or processed.

Packing

Pack the marketable roots in bamboo baskets, plastic crates, plastic sacks, or polyethylene bags.

Marketing

Carrot is sold either on a wholesale, contract, auction, or consignment basis. In Benguet, carrot is usually sold unsorted and unwashed as buhos or palaspas by growers.

Uses

The use of carrots was mainly medicinal, to cure stomach problems and treat wounds, ulcers, and liver and kidney ailments. Carrots are consumed fresh as a salad crop or cooked. They are also processed either alone or mixed with other vegetables. The juice is extracted and used as a drink. Tender roots are pickled or made into jam and sweetmeats in some countries. Carrot cake and carrot pudding can also be made. The aromatic seeds are used as a stimulant and to relieve flatulence. The entire plant can also be used

Cost and Return Analysis of Carrot (Planting Area: 1,000 sq. meters)

Seedlings	3,150.00
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Inputs:

Fertilizer	21,000.00
Pesticide (Insecticide & Fungicide) meter	1,770.00
Sub-total	22,770.00

Labor:

Clearing	2	mandays	150.00	600.00
Bed Operations	2	mandays	150.00	600.00
Planting	2	mandays	150.00	600.00
Hilling Up	4	mandays	150.00	1,800.00
Spraying	1	manday	150.00	900.00
Harvest (2x)	10	mandays	200.00	400.00
Sub-Total:				4,900.00

Administrative Cost (per month)	6,000.00
Land Rental	4,000.00
Packing Materials & Transportation	6,000.00
Overhead & Contingency (10%)	2,510.00
Sub-Total	18,510.00

Grand Total:	23,410.00
Cost per Kilo (Php 53, 530.00 / 3, 500 kilos projected harvest)	Php 15.59 / kilo
Mark Up (50%)	Php 23.00 / kilo

References

A to Z of Common Carrot Varieties. [www.carrot museum](http://www.carrotmuseum.co.uk)
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Pictures



Carrot plants



Diseases

Powdery Mildew

mtvernon.wsu.edu



Bacterial soft rot Oregon State University



Alternaria Blight David B. Langston, University of Georgia, Bugwood.org



www.ctahr.hawaii.edu/nelsons

Root knot Nematode University of Hawaii,

Pests

Cutworm

A.M. Varela, icipe

Army worm

University of Arkansas

