

CARROT

Botanical name: *Daucus carota* L.

Family: Umbelliferae

Chromosome no (2n):18

Origin: Afghanistan

Importance and Uses:

- It is valued as a nutritive food mainly because of high carotene contents.
- It is used as a cooked vegetable, salad, soups and stew etc.
- It increases the quality of urine and helps in the elimination of uric acid.
- Black carrots are used for the preparation of a soft beverage called *Kanji*, which is supposed to be a good appetizer.
- Red type is good for preparation of various types of sweets especially *Gajar Halwa* in northern India.

Classification of roots: Roots can be classified on the basis of shape as

1. **Long rooted:** 25 cm or more in length, generally tapering.
2. **Half-long rooted:** Does not exceed 20 cm.
 - i. Roots cylindrical with straight or sloppy shoulder e.g. Nantes
 - ii. Roots tapering with blunt or semi-blunt type e.g. Chanteney or Imperator.
3. **Short-stump rooted:** These are suitable for growing in heavy soils.
 - i. **Heart shaped:** e.g. Oxheart. ii. **Oval:** Early Scarlet Horn. iii. **Round:** French Forcing.

VARIETIES: The varieties of carrot are divided into two groups

Asiatic or tropical type	European Type or Temperate Type Varieties
<ol style="list-style-type: none"> 1. It produces seed in plains. 2. It does not require low temperature treatment for flowering. 3. Roots are long and red in colour with white or creamy core. 4. Rich in lycopene 	<ol style="list-style-type: none"> 1. It produces seed in hills 2. It requires chilling (4.8-10 °C) for flowering. 3. Roots are medium in size and orange in colour with centre core. 4. Rich in carotene

Varieties	
Pusa Kesar, Pusa Meghali, Pusa Vrishi, Pusa Rudhira, Pusa Ashita (black coloured), Hisar Gairic, Black Beauty	Pusa Yamdagini, Jeno, Imperator, Chanteney, Danvers, Early Nantes, Nantes, Nantes Half Long, Ooty, Pusa Nayanjyoti(hybrid)

Soil: Carrots prefer deep, loose, well-drained, sandy loam to loam soil with a slightly acidic reaction. The edible roots become misshapen due to poor soil structure or obstructions such as stones, clods or trash.

Climate: It is predominantly a cool season crop. A temperature range of 7.2 to 23.9°C is suitable for seed germination and 18.3 to 23.9°C for better root growth. The optimum temperature for better colour development of roots is 15.6-21.1°C.

Sowing time: In north Indian plains, sowing can be taken up from middle of August to beginning of December.

Seed Rate:6.25 kg/ha

Seeds are to be mixed with fine sand before sowing to facilitate even distribution.

The seeds should be rubbed to remove fine hair before sowing.

Soil preparation: The soil should be thoroughly pulverized so as to obtain fine tilth for getting the best crop, otherwise roots get deformed in shape.

Spacing: 30cm × 8-10cm.

The seed should be sown at a depth of 1-1.5 cm deep on the ridges and after germination maintain distance of 8-10cm between the plants with in row by following thinning of plants.

Manures (q/ha) and fertilizers (kg/ha):

Farmyard manure	100	50-	40-	:	40-80
q/ha		90	80P ₂		K ₂ O
		N:	O ₅		

The nutrient dose depends upon the nutrient status of the soil. Full dose of farmyard manure, phosphorus, potassium and half dose of N should be applied at the time of transplanting. Remaining nitrogen should be top dressed in two equal installments at an interval of one month each.

Interculture and weed control: Carrots grow slowly at the seedling stage, therefore, the removal of weeds is quite essential especially at an early stage. For effective weed control, a pre-emergence application of Propazine @ 1.12 kg/ha has to be done. Earthing up is also essential for better growth and development of roots.

Irrigation: A pre-sowing irrigation is to be given to ensure better seed germination. Carrots require abundant and well-distributed water supply. Cracking of roots occur due to exposure to dry weather followed by wet weather. Carrots should be irrigated before any wilting of leaves takes place. It should not be irrigated heavily as it leads to excessive vegetative growth and thus the quality of roots gets deteriorated along with delay in maturity.

Harvesting: Carrots for fresh market are harvested before plants reach full maturity in order to assure quality, while those for processing are allowed to grow longer in the season to maximize yield. For fresh market, smaller, tender, milder in flavour and uniform in appearance are to be harvested for getting good returns. The common Asiatic varieties attain the marketable stage at 2.5-4.0 cm dia at the upper end. A light irrigation before 2-3 days of harvesting is to be given to facilitate the pulling of the roots from the soil without any damage. Roots harvested with top are called **bunch carrot** while those without the tops are called **bulk carrots**. Most carrots for fresh market are now topped which greatly reduces water loss from the roots and increases storage life.

Yield: Asiatic types: 250-300 q/ha. **European Types:** 100-150 q/ha

1. **Root splitting:** Splitting or cracking of carrot roots is a major problem.

Possible reasons:

- Wider spacing as larger roots tend to split more.
- Dry weather followed by wet weather is conducive to cracking of roots.
- High nitrogen application

2. **Cavity spot:** It appears as a cavity in the cortex. In most cases, the subtending epidermis collapses to form a pitted lesion.

Possible reasons: Calcium deficiency associated with an increased accumulation of K and decreased accumulation of Ca.

3. **Forking:** It is a common disorder in carrot and radish formed by the enlargement of secondary root growth.

Possible reasons: Excess moisture during the root development. It occurs on heavy soils due to soil compactness.

Diseases: The important disease are leaf blight, leaf spot or Cercospora blight, powdery mildew, watery soft rot, black rot, and bacterial soft rot.

Insect-pests: The serious pests are rust fly and turnip moth

RADISH

- **Botanical Name:** *Raphanus sativus* L.
- **Family:** Brassicaceae/ Cruciferae
- **Chromosome No (2n):** 20
- **Origin:** Western Asia (China)
- **Edible Portion:** Modified roots (Fusiform) basically primary root hypocotyl
- **Winter season vegetable crop**
- Popular in both **tropical and temperate countries** of the world
- **Quick growing** crop, easily can be grown as **companion crop, intercrop** between rows of different vegetable crops, **can be grown along the ridges of beds (vacant areas around other vegetable crops)**

Uses:

- The roots and leaves are consumed both **as salad and as cooked vegetable.**
- The leafy tops are very rich in **vitamin A, B, C and minerals particularly Ca and Fe.**
- The roots are good appetizer, effective in curing liver, **gall bladder and urinary disorders, piles and gastrodynia.**
- It has **cooling effect** and prevents **constipation**
- **Red colour** is due to presence of **Anthocyanin**
- Pungency in Raddish is due to **isothiocyanate**

Varieties

Asiatic/tropical/subtropical type	European/temperate Type
These produce seeds in plains	Seed production is limited to high hills.
Pusa Desi, Pusa Reshmi, Pusa Chetki, Japanese White, Pusa Mridula, Punjab Safed, Punjab Pasand, Arka Nishant, Chinese Pink, Hisar Mooli No. 1, Kalyanpur No. 1, Kalyani White, CO-I, Jaunpuri Mooli, Kashi Sweta, Kashi Hans	Pusa Himani, White Icicle, Rapid Red White Tipped, Scarlet Globe, Scarlet Long, Silver Queen, French breakfast, and Palam Hriday

Soil:

- **Light, friable loamy or sandy loam soil** containing high amount of humus are suitable for radish cultivation.
- Usually, **the heavy soils** produce **rough ill shaped roots with small fibrous laterals.**
- **Heavy soils** results in **mis-shapening of roots and** make it unfit for cultivation.
- The optimum soil pH is **5.5-7.0.**
- Ploughing and 3-4 planking should be done to bring soil to the fine tilth and make it fertile

Climate:

- It is predominantly a **cool season crop** and best adapted to **cool or moderate climate.**
- The optimum temperature for best flavour, texture, root growth and development is **10-15°C.**
- However, different varieties respond to varied range of temperature. This is the fact that radishes are available **throughout the year by growing different varieties in different months.**
- **Indian types with greater temperature** adaptation can resist heat better than the European types.
- **The Asiatic types** are tolerant to **high temperature than European types.** During the

- hot weather, the roots become tough, pithy and pungent before reaching the edible type.
- **Long days coupled with high temperature** leads to premature bolting without adequate root formation.

Sowing time: In Northern plains, time of sowing is as under:

1. European type: September-March
2. Asiatic type: August-January
3. Mild Climate areas: Through out the year

Low Hills: August-September **Mid Hills:** July – October **High Hills:** March- August

Schedule of growing radish throughout the year in the plains

Variety	Sowing time	Harvesting time
Pusa Chetki	Early April-Mid August	Early May- September
Pusa Desi	Mid August- Mid October	Last week of September-Early December
Pusa Reshmi	Mid September- Mid November	Last October- early January
Japanese White	Mid October- Mid December	Mid December- Early March
Pusa Himani	Mid October- Mid February	Mid February- Mid April
White Icicle	Last October-end February	Late November- Early March

Seed Rate: 9-12 kg/ha

Asiatic type – 10 kg/ha

European type – 12-14 kg/ha

Soil preparation: The soil should be thoroughly pulverized so as to obtain fine tilth for getting the best crop, otherwise it results in deformed roots.

Spacing: European type - 30cm × 5-10cm

Asiatic types – 45 cm × 6-8 cm

The seed should be sown at a depth of 1.5- 3cm deep on the ridges for semi-long type and 1.25cm for round cultivar sand after germination maintain the distance of 5-10cm between the plants with in row by following thinning of plants.

Manures and fertilizers:

Farmyard manure (q/ha)	N	P ₂ O ₅	K ₂ O
100	50-90	50-80	40-80

Full dose of farmyard manure, P, K and half of N should be applied at the time of transplanting. Remaining part of N should be top-dressed in two equal instalments at an interval of one month.

Interculture and weed control: Weeding and hoeing are necessary after 20-35 days of sowing in mid maturity group of Asiatic type, while temperate and early Asiatic types require weeding after 15-20 days of sowing. Earthing up is also necessary to get well developed, quality and elongated roots as generally the growing roots tend to push out of the soil. Application of Pendimethalin 1.2 kg a.i./ha or Alachlor 1.5 kg a.i./ha or Fluchloralin (Basalin)@ 0.9 kg a.i./ha or Isoproturan 1.0 kg a.i./ha or metalachlor @ 1.0 kg a.i./ha in 750 litres of water as pre-emergence is very useful for effective weed control.

Irrigation: A pre-sowing irrigation is to be given to ensure high seed germination. Irrigation frequency and amount of water required depend upon the planting season and available soil moisture. The soil should have sufficient moisture to obtain tender and attractive roots. During summer, frequent irrigation is necessary otherwise the growth will be checked and root will be pungent making them unfit for market.

Harvesting: The roots are harvested when they are of usable size and relatively young. The roots are washed and graded according to size and are tied into bunches alongwith tops for marketing. European types are ready to harvest in 25-30 days. Asiatic types require longer period *i.e.* *Chetki* type 30-40 days and mid maturity group 40-60 days.

Yield:

European type	50-80q/ha
Asiatic type	200 –500 q/ha

Physiological disorders:

Pore extent or pithiness: It affects the marketable value of radish roots. Pores develop due to excessive root growth. Pores development is a sign of senescence. Delay in harvesting is the main reason for this disorder. Therefore, harvesting should be done at an appropriate time.

Elongated root or Forking: It is the secondary elongating growth in the root. It is due to excessive moisture during root development in heavy soils which leads to soil compactness. Use well decomposed organic manure to overcome this problem and ensure irrigation at proper time.

Diseases and insects:

Problem	Management
Damping off	Seed treatment with bavistin/thiram/captan
Alternaria blight	Seed treatment with bavistin/thiram/captan
White Rust	Arka Nishant is reported to be resistant
Aphids	Use systemic pesticides

Beet Root

Botanical Name:	<i>Beta vulgaris sp vulgaris.</i>
Family:	Chenopodiaceae
Origin:	Europe, North Africa & West Asia
Varieties:	Detroit Dark Red, Crimson Globe

Roots are served as boiled, pickled or as a salad. Beet root is rich in protein, carbohydrates, Ca, P, Fe and vitamin C. Red colour of table beets is due to *betacyclin* and yellow pigmentation is due to *betaxanthin*.

Climate: It is a cool season crop that can tolerate mild frosts and light freezes. It grows best in the winters in the plains of India. Optimum seed germination occurs between 65 and 75°F. Beets are very sensitive to low temperature and if exposed to 4.5°C – 10°C for 15 days, bolting occurs even if the roots have not attained marketable size. It grows well in warm weather but the best colour, texture and quality are achieved in a cool weather condition. Excessive hot weather causes **zoning** – the appearance of alternating light and dark red concentric circles in the rot.

Sowing is taken up during September- November in north India and from July to November in South India. The seed balls are planted at a rate of 7-9 kg/ha in rows 45-60 cm apart and thinned later to an in-row spacing of 8-10 cm. Beet root has multigerms seeds in a fruit containing usually 2-6 seeds.

Thinning is an essential operation in beet cultivation because the seed ball is actually a fruit containing 2-6 seeds each of which may germinate and produce a plant. Generally, the plants emerge in groups unless segmented seed or monogerm seed is used.

Manures and fertilizers:

Farmyard manure (q/ha)	N	P ₂ O ₅	K ₂ O
100	50-90	50-80	40-80

Full dose of farmyard manure, P, K and half of N should be applied at the time of transplanting. Remaining part of N should be top-dressed in two equal instalments at an interval of one month.

Interculture and weed control: Weeding and hoeing are necessary after 20-35 days of sowing. Earthing up is also necessary to get well developed, quality and elongated roots as generally the growing roots tend to push out of the soil. Application of Pendimethalin 1.2 kg a.i./ha or Alachlor 1.5 kg a.i./ha or Fluchloralin (Basalin)@ 0.9 kg a.i./ha or Isoproturan 1.0 kg a.i./ha or metalachlor @ 1.0 kg a.i./ha in 750 litres of water as pre-emergence is very useful for effective weed control.

Irrigation: The soil should be kept sufficiently moist until emergence of seedlings. Three irrigations are sufficient when there are winter rains.

Harvesting and Yield:

The marketable maturity is just depending on the size ranging from 3-5 cm diameter. Usually, the top is removed for marketing the roots. Yield varies from **250-300 q/ha**.

Physiological Disorder

Internal black spot, a physiological disorder is associated with boron deficiency. Plant usually remains dwarf or stunted