Carnation

Cultivation Guide

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*The information provided is meant to be used strictly as a guideline and actual results may vary depending on local climate and growing conditions.

Carnations are among the most popular cut flowers in the world. They belong to the genus Dianthus of the family Caryophyllaceae. The species *Dianthus caryophyllus* is mainly used for the cut flower production.

Soil disinfection (*Before planting*)

Soil disinfection is a must in case the previous crop planted has been carnation or the soil is known to have *nematodes*. If carnations are planted in soil where carnations have never grown before, disinfection is not necessary.

Presently, **Formalin** is used to disinfect the soil. For drenching/spraying of beds, 10 litres of formalin should be mixed with 70 litres of water, per 100 m^2 area. After drenching, the soil should be covered with plastic sheet for about one week.

Another chemical which can be used against nematodes is **Basamid** (Dazomet) @ 30 – 40 gms /m^2.After sterilizing and subsequent washing out of the soil, it is advisable to do plantation after two weeks.

Climate

Temperature: Optimum temperatures for growing carnations are:

- Day: 25 – 28 ^{o}C
- Night: 14 – 16 ^{o}C

Light: Carnations like light. More light for the plants results in better growth, more production and harder plants which are less susceptible to diseases.

Humidity: The relative humidity is also an important factor. Carnations grow best if the relative humidity is in the range of 65 - 90%.

Greenhouse

Commercial cultivation of carnation requires a greenhouse. The greenhouse mainly protects the crop against rain and is needed for efficient control of pest and diseases. A good carnation greenhouse should meet following requirements:

- A good **height** of the greenhouse, preferably a gutter height of 4 m.
- T**op-ventilation** is required for the hot air to move out of the greenhouse. Such top-ventilation should not be covered with insect-net, as this reduces the ventilation capacity.
- Side ventilation having a small mesh insect-net covering. At the sides, movable plastic curtains are also required. They can be kept closed during cold periods, cold nights and rainy season.
- The plastic on the greenhouse should be clean, as more sunlight results in better production.

Shade net

Shade net is not required in hilly areas but plains may need it during summer mostly between 11 am to 4 pm. In general, the use of a shade net has a negative effect on the plants. For first 8 – 10 days after planting, if it is a sunny period, some shading might be needed until the plants are established.

Soil

In principle, Carnations can be grown on any type of soil provided the drainage and the structure is good. The soil structure should be loose up to 50 to 60 cm deep so that there is sufficient porosity and good drainage. If it is a heavy soil, some rice husk can be mixed (up to 5 kg/m^2). At the top layer of the soil, about 10 cm deep, well decomposed organic manure

should be mixed (up to 20 kg/m2). The ideal soil pH is between 5.5 and 6.5 and optimum EC is below 0.5.

Water

During summer, Carnations require maximum water amounting to about 8-10 litres/sq.mt per day. The preferred EC of water is less than 0.5. The pH of the irrigation water is best between 5.5 and 6.5. Most water sources have a higher pH. This problem can be easily solved by adding acid to the irrigation water.

Bed Layout

Options for bed making:
1. Beds of 90 cm width, with 6 rows of planting and path of length 45 cm. This is the best suited planting system for most areas of India. It provides an efficient usage of the greenhouse. Three drip lines are to be used.

2. Beds of 75 cm width, with 4 rows of planting and path of length 45 cm. In this planting system the density in the greenhouse is less, which might be preferred in areas where there is high occurrence of fungal diseases. Two drip lines are to be used. The bed height should be about 30 cm.

Cultivation Process

Planting

Before planting, make sure that the EC of the soil is between 0.5 to 0.8 in order to achieve good growth of the plants. If the EC is too high, the plants will struggle to grow.

The beds should be moist prior to planting. The best way to obtain this is to place first the drip lines on the bed, which should be fixed at both ends of the bed to avoid twisting. After this the first layer of the nets (squares 7.5 x 7.5 cm) should be placed on the bed and fixed at the end supports. Then the planting can be done in the squares and maintain a 15cm space plant between the plants.
Carnation plants should be planted very shallow to reduce and avoid foot-rot problems. If the cuttings are rooted in plugs, a maximum of 2/3 of the plug should be planted in the soil.

Pinching

After planting, the cutting continues to grow a main stem. If you do not pinch this, the main stem will produce ‘crown flower’. Pinching means to remove the head of this main stem at an early stage. This allows the side shoots to develop. These shoots produce the first set of flowers. Plants are usually pinched for the first time about 3 weeks from planting.

The normal way of pinching is breaking the head of the cutting and leaving 5-6 pairs of leaves behind. The first pinch produces 6 lateral shoots. To keep the plants in good conditions, the 1½ pinching system is the best. Here, 2 or 3 of the lateral shoots are pinched again at 2 well developed pairs of leaves. This results in a bigger production. The best time for pinching is during the morning hours when plants are fresh, turgid and easier to break.

Netting

Carnation plants cannot stand on their own. Hence, they need adequate support. The size of the squares of the nets must be 7.5 x 7.5 cm. Distances between the nets should be in this manner:

- First net: 12 cm above soil followed by
- Second net: 12 cm higher followed by
- Other nets: each 15 cm higher.

Disbudding

Standard carnations will have to be disbudded, which is the removal of side buds. While doing this job, the leaves of the stem must not get damaged or removed, as this will cause the bending of the main bud. If disbudding is done at an early stage and all buds and side shoots are removed from the entire stem, the quality of the stem will improve.

Irrigation and humidity

Irrigation in carnation cultivation may be most difficult part even for the most experienced growers. The following points to be considered:

- Watering in small lots is best.
- On sunny days, watering can be done 2 or 3 times a day.
- Plants should never dry out, but also must not be kept too wet.

Relative humidity should be kept 65% or more. In order to maintain optimum humidity, ventilation of the greenhouse should be well balanced.

Fertigation Schedule:

After Planting			
Week Number		**Fertiliser**	**Quantity (gm/ sq.mt.)**
4		19:19:19 NPK	8-9
5		11:52:00 / 12:61:00 MAP	18-20
6		19:19:19 NPK	8-9
7		Calcium Nitrate	5
		Magnesium Sulphate	3
		Micronutrients	0.5
		Borax	0.3
Vegetative Stage			
8-16	Schedule for Monday and Thursday	Calcium Nitrate	1.5
		Micronutriets	0.25
		Potassium Nitrate	1.0
	Schedule for Tuesday and Friday	Mono potassium phosphate	1.5
		Magnesium Sulphate	1.0
		Borax	0.5
Production Stage			
16 onwards	Schedule for Monday and Thursday	Calcium Nitrate	2.5
		Micronutriets	0.5
		Potassium Nitrate	1.5
		Mono potassium phosphate	2.5

	Schedule for Tuesday and Friday	Magnesium Sulphate	2.5
		Potassium Nitrate	1.5
		Borax	1.0

Harvesting

Harvesting should be done in the morning hours. Generally, harvesting is done just above the first layer of net. If harvesting is too deep, it will take much more time till the next flush. On the other hand, if harvesting is too high, too many shoots will develop, which will reduce the quality in the next flush.

For picking the flowers, giving a smooth cut with a small sharp knife is better than using a pair of scissors. Usage of knife is cleaner and causes less damage to the plant. The problem with scissors is that it may cut other young shoots and leaves of the plant instead of only the flower stem.

Cleaning of the crop

At the end of a flush, it is quite possible that the plant would still contain weak and bent shoots. In this case, it is better to remove them, else the plants will continue to grow on these weak shoots instead of sprouting new strong shoots.

Post harvest care

For better handling of the harvested flowers, put them in STS solution immediately after harvesting in order to give proper pre-treatment. The use of STS (silverthiosulphate) is highly recommended. It will considerably increase the vase life of the flowers. It will also keep the flowers better during transport.

Bunching and packing

Normally carnations are bundled in bunches of 20 stems, which is the standard manner seen at the market.

Up till now, the general way of transport is the so called dry transport. The flower bunches are packed in carton boxes and transported. Packing must be firm and the box must be filled completely, keeping the heads of flowers away from the end of the box. Generally, 300 flowers are packed per box.

Diseases

The important diseases of carnation and their possible control measures are described below

1. ***Fusarium* rot *(Fusarium oxysporum)***:
   It is one of the most serious diseases of carnation.

   Symptoms:
   - Wilting of foliage, often only on a few branches followed by death.
   - Rotting of the stem below ground level with internal brown streaking extending up to stem. If pulled, the plant breaks off easily while the firm roots remain in the soil. Infected cuttings wilt and die rapidly.

   Control:
   - The best control measures are soil sterilization or chemical fumigation of the soil. Using of pathogen free plants and general sanitation in the greenhouse.
   - Destruction of diseased plants to reduce the source of infection.
   - Drenching with Benomyl or Rhidomil @ 2g/lit of water.

2. ***Rhizoctonia Solani* stem rot*:-***

Symptoms:

- Wilting and yellowing of foliage followed by death of plants.
- Butts sometimes show a brown discoloration and cracking just below soil level. The brown rot can extend up the stem.
- Fluffy, light brown fungal hyphae can sometimes be observed on the surface of the rotting tissue.

Early stages of the disease can be confused with *fusarium* wilt, but the difference is that no internal brown streaking is observed.

Control:

- Planting material should be used tested stock into fumigated soil.
- Good air circulation, good drainage, shallow planting of cuttings and a low or medium fertility level.
- Drenching with fungicide (Bavistin or Benomyl @ 2g/lit) before planting.
- If disease develops remove infected plants and apply Rhidomil or Benomyl @ 2g/lit as a soil drenching.

3. **Rust (*Uromyces dianthii):***

The disease is common under warm humid conditions. It reduces plant vigour and quality of cut flower.

Symptoms:

- Early infections appear as pale green blister like swellings, which erupt releasing reddish to dark brown powdery masses of spores. Postules can be upto 10 cm in length and occur on stems, leaves and calyces. Severely infected leaves may turn yellow and die.

Control:

- Avoid wet foliage.
- Destroy rogue infected plants.
- Maintain a regular preventive spray program using mancozeb @ 1.5g/lit, zineb @ 1g/lit and sulphur @ 1g/lit.

4. **Stem and root rot (*Phytophthora spp.):***

Wet conditions, over watering and badly drained soils favor developments of the disease

Symptoms:

- Withering and yellowing of foliage, leaf death
- External browning of stems and internal browning at nodes. Stem and root rot may be present.

Control:

- Avoid over watering and poorly drained soils.
- Drenching with Benomyl @ 2g/lit or Aliette @ 2.5 gm/lit.

5. **Grey Mould (*Botrytis cinerea):***

This disease occurs due high humidity and lack of ventilation.

Symptoms:

- Initially a wet tan colored blotch develops on petal tips and spreads rapidly through the petals to produce a fluffy gray mould. This disease can develop on cut flowers while in transit.

Control:

- Reduce humidity; maintain good ventilation and hygiene practices.
- Avoid injuring flowers.
- Rovral @ 0.5g/lit or Benlate @ 1.5g/lit is registered for control of *Botrytis* in carnations.

6. Alternaria leaf spots:

Symptoms:

- Small purple spots appear on the leaves, stems and occasionally on the flowers. These develop in to spots upto 5mm in diameter with brown center surrounded by broad purple margin.
- Spores resembling black specks develop randomly in the center of spots. Heavily infected leaves may die.
- Infected branches may get girdled, particularly at the nodes.

Control:

- Avoid excessive moisture in crops.
- Spray with Zineb @ 1g/lit, mancozeb @ 1.5g/lit, hexaconazole @ 1ml/lit, Propiconazole @ 1ml/lit

Pests

1. Red Spider Mite (*Tetranychus urticae*):

This is the most serious pest on carnations. The mites are minute red insects which feed on the undersides of the leaves, suck the sap. The leaves turn pale, withered, bronze and show severe webbing. Plant growth, crop quality, yield and vase life of carnation flowers decrease.

2. Aphids (*Myzus persicae*):

Aphids suck the sap from the leaves and disfigure the young growth. In severe attacks, they leave sticky deposits on the leaves and flower buds. Aphids can be responsible for the transmission of viruses.

3. Thrips:

Thrips also suck the sap from the leaves, causing them to turn yellow and patchy often with black specks and slight wrinkling. They also cause streaks in the flowers making them unmarketable.

4. Caterpillar:

Caterpillars are mostly a problem of the carnation bud. The eggs are laid in the buds and the larvae eat into the bud that is completely damaged.

Pest control measures

Pest	Chemical	Concentration per litre
Red Spider Mite	Wettable Sulphur	1.5 gm
	Kelthane (Dicofol)	1.5 ml
	Magister (Fenazaquin)	1 ml
	Omite (Propergite)	1 ml
	Milbeknock (Milbemectin)	0.5 ml
	Derisom	2 ml
Aphids	Proclaim Amemectim Benzoate	0.2 ml
	Thimet (Phorate) **(S)**	10 gm/sq.mt.
	Decis (Deltamethrin)	0.5 ml
	Avaunt (Indoxacarb)	0.5 ml

	Larvin (Thiodicarb)	0.4 gm
Thrips	Confidor (Imidacloprid)	0.5 ml
	Nuvan (Dichlorvos) +	1.5 ml
	Nuvacon (Monocrotophos)	2 ml
	Rogor (Dimethoate)	2 ml
	Pride (Acetamiprid)	0.4 gm
	Calnova + Calpaste	0.5 ml + 2 gm
	Actra (Thimethoxan)	0.5 gm
Caterpillar	Proclaim (Amemectin benzoate	0.2 ml
	Thimet (Phorate) **(S)**	10 gm/sq. mt.
	Decis (Deltamethrin)	0.5 ml
	Avaunt (Indoxacarb)	0.5 ml
	Larvin (Thiodicarb)	0.4 gm
	Pride (Acetamiprid)	0.4 gm
	Calnova + Calpaste	0.5 ml + 2 gm
	Actra (Thimethoxan)	0.5 gm
Nematode	Neem cake	1 kg/sq. mt.
	Suzan (Diazinon) **(D)**	2 ml
	Metacid (Methyl parathion)	2 ml
	Benlate (Benomyl)	3 gm
	Hydrogen peroxide **(D)**	7 ml
	Nematogaurd (Pcealomyces)	5 gm

General notes on chemical spraying

The pH of the spray-solution should be between 5.5 to 6.5. If the pH is much higher, the effect of the spraying will be much less. pH can be adjusted by adding some nitric acid. The temperature of the spray solution should be about 20 – 25^{o}C. If the temperature is too low, the effect is much less. The humidity in the greenhouse should be high. If the spraying is done with a low humidity the effect of spraying is very much less. The spray equipment should be right, with the right nozzles in accordance to the pressure. Enough spray solution should be used so that a proper spraying can be done. Always use a sticker or spreader in the spray solution for proper wetting.

General economics for growing Carnation flowers

Working out an exact cost-price for carnation cultivation is difficult. It depends very much on many individual situations. In general it can be said that the life time of a carnation crop is about 2 years. The numbers of flowers produced are related to the varietal character. As a rough indication of production: first year approx. 10 flowers/ plant and the second year 10 – 12 flowers/plant.