



A KUMAR – FLORIST (HOLLAND) JOINT VENTURE

A large, detailed, grayscale image of a carnation flower occupies the central and lower portions of the page. The petals are densely packed and have a ruffled, scalloped edge. The word 'Carnation' is written across the flower in a large, elegant, white cursive script. To the right of the main word, the word 'Manual' is written in a smaller, white, sans-serif font.

Carnation Manual

CARNATION CULTIVATION INTRODUCTION

Carnation is one of the most important cut flowers of the world. Carnations are grown in almost every climate. In temperate zones mostly in glasshouses, in sub tropic areas, in plastic and glasshouses as well as in open air and in tropic areas more or less shaded. Carnation belongs to the family *Caryophyllaceae*, the genus *Dianthus* and species *caryophyllus*.

The carnation varieties can be divided into two main groups:

1. Standard varieties :

The standard carnation has one large flower on an individual stem. It was the first type of carnations used for large scale production.

2. Spray varieties :

The spray carnation has several shorter branches with smaller flower on each branch. These varieties were developed less than 50 years ago in United States.

IMPORTANCE AND USES

Carnations are excellent for cut flowers, bedding, pots, borders, edging and rock gardens. Due to it's excellent keeping quality, wide range of forms, ability to withstand long distance transportation and remarkable ability to rehydrate after continuous shipping. Carnation is preferred by growers to rose and chrysanthemums in several flower exporting countries.

Although cut carnations are sold in the western countries all the year round, they are in particular demand for the Valentine's day, Easter, Mother's day and Christmas.

India too has the potential for growing good quality carnation. Places having cool climate like Shimala, Kulu, Manali, Kalimpong, Ooty Kodaikanal, Bangalore, Pune, Nasik, etc. are most suitable areas for the production of cut flowers, which may also be exported to Europe.

Soil : Carnations can be successfully grown in any type of soil but the soil should be well drained and be in good physical condition. Soil must be worked upto 40 cm as carnation roots go as deep as 25 to 30 cm. The ideal soil pH is between 5.5 and 6.5. The optimum EC during vegetative stage is 1.2 mS/cm. and during generative stage is 1.5 to 1.7 mS/cm.

A rich sandy loam or loamy sand is considered to be the most ideal soil for successful production of carnation. Soils with higher amount of clay or silt should be amended by incorporating organic matter or compost.

It is indispensable to sterilize the soil to keep pace with problem of *Fusarium* and nematodes (usually with Methyl Bromide). Before planting, soil sample should be analyzed with respect of main and trace elements to advice on basic fertilization.

GENERAL DISINFECTION OF SOIL

Before plantation of Carnation, disinfection of soil is absolutely necessary. In particular, the fungus *Phytophthora* is a menace to Carnation. The various methods of sterilization are :

1. **Steam** : Not feasible for Indian conditions.
2. **Solarization** : Cover the soil with plastic for 6 - 8 weeks. Sunrays will heat up the soil, which will kill most fungi.
3. **Chemical** :

A. Hydrogen Peroxide (H₂O₂) with Silver

Procedure:

- Wet the beds with irrigation water of neutral pH & EC less than 0.5 mS/cm.
- In irrigation water; mix hydrogen peroxide with silver at the rate of 35 ml per liter of water (3.5% solution). Since this product is highly reactive and has an oxidizing agent; do not mix any other chemical with this.
- Apply this solution uniformly over moist beds using the spout. Use 1 liter water for 1 m² area.
- No need to cover the soil. Just leave the soil as it is and after 4 to 6 hours the crop can be planted.

Advantages of hydrogen peroxide with silver:

1. Very easy and safe to use without any hazardous effect on human health.
2. Economical.
3. Eco friendly and does not produce any phyto toxic effects on plants.
4. Plantation can be carried out 4 to 6 hours after fumigation.
5. Destroys almost any fungal, bacterial and viral presence as well as larva and eggs of the insects in soil.
6. Stable in wide range of temperature and pH.

B. Formalin @ 7.5 - 10 lit/100 m². This pure chemical should be diluted

10 times in water and then sprayed/drenched on beds and then cover with plastic for 7 days. Then flush the soil approximately with 100 lit. of water per m² to drain the traces. After sterilizing and subsequent washing out of the soil it is advised to wait for 2 weeks before plantation for 'vapsa' (field capacity) condition.

C. Methyl Bromide : (25 - 30 gm/m²)

D. Basamid (Dazomet) : (30 - 40 gm/m²)

CLIMATE

- 1. Temperature** : Temperature is the major factor that influences the growth and flowering of carnation. Best quality carnations are produced in areas having high light intensity during winter and at the same time the temperatures during summer months are mild. In case of carnation growing, moderate temperatures are preferred. Temperature at night is very important for quality. The difference between day and night temperature should be big enough and the night temperature low enough to grow carnations of best quality. Higher day and night temperatures especially during flowering results in abnormal flower opening and calyx splitting. Ideal day and night temperature is 28^oC and 16 to 18^oC, respectively.
- 2. Light** : The carnation is a facultative long day plant, which means that they form the flowers faster during long days than in short days. Carnations require high levels to produce high quality flowers. Cyclic lighting from dusk to dawn increases the flower fresh weight and the strength of flower stalk. The photoperiod is more important factor than light intensity in flowering, which influences the lateral shoot development and flowering in carnation. Carnation handles lot of light i.e. upto 50,000 lux.
- 3. Humidity** : At the initial stages of growth and development, humidity should be maintained around 80 to 85 per cent. Whereas at full growth stage it should be 60 to 65 per cent. Hot and humid climate is not suitable for carnation cultivation.
- 4. Optimum CO₂ concentration** : Should be around 800 to 1000 ppm.

GREENHOUSE FOR COMMERCIAL CULTIVATION

1. Criteria for site selection :

- a. The land should be leveled.
- b. No wind breaks or multi storied structures present upto 30 meters.
- c. Good connectivity to nearest market
- d. Electricity at the site and no high tension electricity wire upto 5 meters

e. Availability of good quality of water

2. Specification for greenhouse :

a. Height : 5 to 6.5 m

b. Length : North - South

c. Gutter direction : North - South

d. Polythene thickness : 200 microns

e. Vent opening : Along the wind direction

f. Distance between two adjoining polyhouses should be minimum 4 m.

3. Sufficient ventilation space is required on top and sides.

4. To protect the plants from the rain in the monsoons, without affecting the air circulation side curtains should be kept open in slanting position.

5. To control light intensity and solar radiation, white shade net (50%) is used. Approximately 50,000 lux light intensity is required on the plant level.

6. Greenhouse operation:

a. Open side curtains from 7 am to 6 pm in summer and rainy seasons, whereas open from 9 am to 5 pm in winter, to facilitate maximum air circulation.

b. Top shade net opening and closing:

- During cloudy climate keep open, otherwise close from 10 am to 4 pm.

- During cold nights close the shade net.

- In summer close from 9.30 am to 5 pm.

c. Wash top of plastic with clean water monthly.

d. Always maintain hygiene and sanitation inside as well as outside polyhouse.

e. Test water and soil sample for EC and pH periodically.

7. Apply white wash to east, west and north sides of greenhouse to protect plants from bright light intensity during summer season.

SUPPORT MATERIAL, BED LAYOUT AND IRRIGATION SYSTEMS

Support System :

The carnation crop needs to be supported with 4 or 5 layers of support material. Good support material is essential for the success of the cultivation. If the crop is not supported well enough, it will collapse. This will result in bent stems and a stagnation of the crop development. Good support material is metal wire. Minimum at every 3 meters, the wires

should be supported with poles. The poles at the beginning and the end of each bed should be strong enough and be cast in concrete.

For an optimal support of the crop an increasing width of the meshes may be used e.g. the bottom net 7.5 X 7.5 cm, then one net of 10 X 10 cm and two nets of 12.5 X 12.5 cm. Distance between first three nets should be 10 cm and between 3rd and 4th net 20 cm. Usually, 36 plants per net m² (= per m² of bed) and about 20 plants per gross m² (per m² of greenhouse) are planted. Please stick to this plant density. More plants per m² will just give a higher production in the first flush, afterwards this advantage disappears and more problems with disease will occur.

Bed layout :

Normally, the beds are 0.8 meter wide and the path is 50 cm. In order to prevent the crop from being washed away, the carnations are cultivated on raised beds. The beds have to be raised 20 to 25 cm to achieve improved drainage. To create favorable growing conditions a good quantity of organic matter along with basal dose of NPK fertilizer should be applied and mixed into the soil.

Bed Material Composition :

Material	Clay soil	Silty loam soil
Red soil	55 %	60 %
Sand	15 %	10 %
FYM	30 %	30 %
Rice husk	4 kg/m ²	2.5 kg/m ²

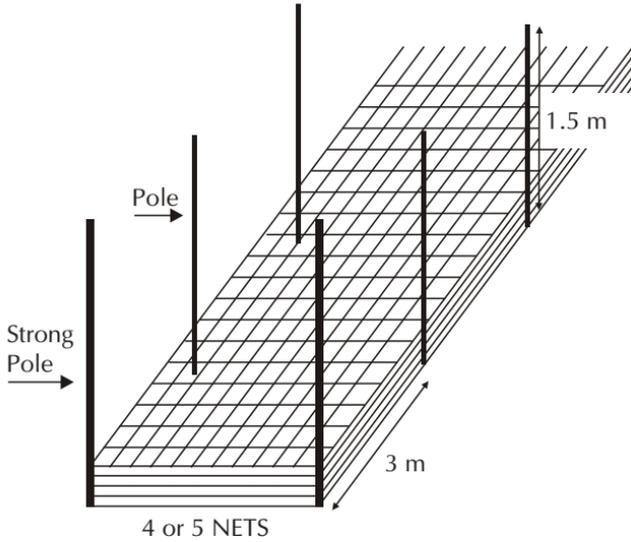
Basal organic dose :

Neem cake (@1kg/m²) should be applied after fumigation, at the time of bed preparation as preventive against nematodes.

Irrigation system :

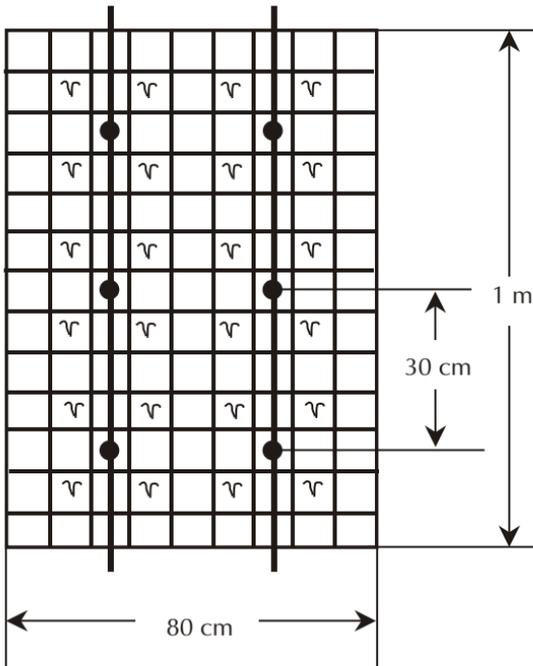
During the first three weeks after planting you will need overhead sprinklers to prevent young plants from drying out. Afterwards, it is possible to gradually change to drip irrigation (2 tubes per bed). The water needs to be filtered with a sand filter to prevent obstruction of the drip tubes. Make sure that there is sufficient supply of good quality water. To ensure even distribution of water the drippers should be placed at a distance of 30 cm with 2 lph discharge. When a carnation crop is fully grown and healthy; it absorbs 6 to 7 liters of water per m² per day.

Support Material : (Front & Side View)



The size of the strong side pole (angle) 40 x 5 mm
 The size of the middle pole (angle) 25 x 3 mm

Bed Lay-Out : Plant Diagram (Top View)



CULTIVATION

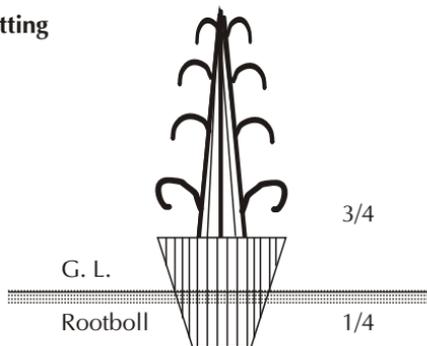
Planting:

It is vital that the cuttings get a good start :

- Check the EC and pH of the soil after application of basal dose and before plantation. EC should be less than 1mS/cm
- Be ready; get the soil prepared in good time. Moisten the planting substrate evenly. Shallow planting is essential in tropical areas. Put the netting on the beds before planting. Ideal conditions for planting- warm, humid and fairly bright day.
- **Do not actually 'plant' the cuttings, make a small depression with your fingers or knuckles and 'stand' the cuttings as shallow as possible.** Do not firm it in and do not move soil or peat around the base of the cutting. After planting, the white perlite in the root ball should still be visible.

Make sure that the staff is properly instructed and check regularly. Prevent the cuttings from drying out just after planting. Depending on weather conditions; you may need to start giving overhead watering for 5 minutes. Do not water too much during the first week. Maintain high air humidity. Spray the path as well, not just the plants. During intense sunshine it is necessary to shade the plants slightly, until new roots are visible. Aim to get them growing as quickly as possible.

Carnation Cutting



Thumb rules to curb initial mortality and produce a healthy crop thereafter:

1. Fumigation procedure is absolutely necessary to prevent the infestation of soil borne diseases.
2. After the application of the basal dose, the soil pH and EC should be tested. Ensure that the soil and water EC and pH are well within the prescribed limits.
3. The FYM added into the beds should be completely decomposed and uniformly mixed.

4. Do not give any top showering. Practice only surface watering and avoid splashing water onto foliage. If overhead irrigation is necessary, do it early in the morning when plants will dry quickly.
5. Provide ample ventilation and air movement inside the greenhouse to prevent moisture from condensing on the foliage.
6. Never close the side curtains.
7. Follow the 21 day schedule which essentially includes preventive fungicides and insecticides, in addition to the chemicals that enhance the root development and establishment of the plant.
8. Do not delay pinching operation. Carry out pinching after 2 weeks on the 5th leaf pair.

Pinching :

Pinching is an important cultural operation in the successful production of top quality carnations. After planting, the cutting continues to grow a main stem. If left unpinched, this main stem produces a “Crown flower”.



Pinching is an important operation in Carnation which involves removal of the bud-head of the main stem at an early stage. This allows the side shoots to develop. These shoots produce the first flush. Pinching involves breaking out the head of the cutting by bending; leaving 6 pairs of leaves (internodes). The easiest time to break the top of the cutting is in the morning when the cutting is still fresh and fully turgid. The plants are usually pinched for the first time about 3 weeks after planting. Immediately after pinching it is good to make a spray treatment with Captaf or Bavistin (1.5gm/lit).

Disbudding :

The practice of removing undesirable immature flower buds to provide either a small number of large flowers or large number of small flowers is



Standard Carnation



Spray Carnation

called disbudding. Only the central terminal bud is removed in case of spray carnations to encourage lateral flower buds to develop. Identifying which bud to remove often confuses the beginner. Identification is easiest at an early stage, when the terminal bud is just showing some first color. From standard carnations, the side buds have to be removed to give main flower a chance to develop. Care must be taken to avoid any injury to the main stem.

Crop handling :

It is very important to raise the nets at the right time. Raising too soon makes picking very difficult. Raising too late allows the crop to fall to one side. Once this happens, stems bend and crop losses are inevitable. Watch the crop carefully and raise the nets a little at a time. Netting is a priority job, even when you are much occupied in the middle of a flush. Shoots growing into the path have to be tucked back into the netting. If not, it will reduce your production. It is advisable to maintain 5 to 6 strong shoots per cutting for good quality of the flower. Extra shoots should be removed.

GENERAL FERTIGATION SCHEDULE

1. Make a soil analysis before planting.
2. If there are no big excesses or shortness, apply a base dressing to the soil per 100m² of :

2.0 kg	- Biozyme granules
2.5 kg	- 12:61:0
3.75 kg	- 16:8:24
2.2 kg	- Ca(NO ₃) ₂
2.5 kg	- MgSO ₄
0.250 kg	- Borax

3. Right after planting : 3 weeks clean water (no fertilizers). The roots are not able yet to absorb any nutrition.
4. Fertilization from 4th week onwards till 8th week: (Per 100 m² per day)
Every Monday, Wednesday and Friday,

100 gm	- 19:19:19
54 gm	- 0:52:34
36 gm	- 13:0:45
36 gm	- MgNO ₃
18 gm	- Borax
15 gm	- Fertilon Combi - II

Every Tuesday, Thursday and Saturday,

154 gm - $\text{Ca}(\text{NO}_3)_2$

Nitrogen stimulates the vegetative growth, growth of young shoots. The ideal water EC during vegetative growth should be around 1.2 mS/cm.

- Note that small amount on a frequent basis is better than large amounts of fertilizers. Try to give something every day.
- Fertilization from 8th week onwards till 12th week: (Per 100 m² per day).

Every Monday, Wednesday and Friday,

100 gm - 19:19:19

25 gm - 0:52:34

128 gm - 13:0:45

36 gm - MgNO_3

18 gm - Borax

15 gm - Fertilon Combi - II

Every Tuesday, Thursday and Saturday,

113 gm - $\text{Ca}(\text{NO}_3)_2$

- If possible, have the soil analyzed every 2 or 3 months to decide whether it is necessary to change the fertilization schedule.
- Fertilization from 12th week onwards till end of flush: (Per 100 m² per day).

Every Monday, Wednesday and Friday,

116 gm - 19:19:19

48 gm - 0:52:34

215 gm - 13:0:45

29 gm - Borax

15 gm - Fertilon Combi - II

Every Tuesday, Thursday and Saturday,

113 gm - $\text{Ca}(\text{NO}_3)_2$

Note: Above mentioned fertilizer dose is for acidic soil (pH < 7).

The ideal water EC during generative growth should be around 1.6 mS/cm.

Continue with the above until the end of the first flower production peak.

Then clean water for 1 full week, no fertilizers. Wash the soil and get rid of excess nutrients.

- For re-growth of new shoots, Nitrogen is required. Start fertilizing again as given in No. 4. Then see in what stage most of the plants are: vegetative growth or bud development, more nitrogen or more potash.

METHOD OF GIVING FERTIGATION:

Fertigation should be given early in the morning at 6 am for better utilization by the plants. Take recommended quantity of fertilizers and dissolve them in sufficient quantity of water. If pH of plain water to be used is on higher side then lower it to 6 to 6.5 by using acid. It should be added to the water atleast 12 hours before use. It is necessary to give fertilizers with recommended quantity of water to maintain EC of soil. Hence, operate drip system for recommended period of time. After every fertigation, open flush valve to drain off water from laterals and sub mains. Periodically clean the fertigation system to avoid any type of malfunctioning.

DISEASES, PESTS AND DISORDERS:

Prevention is always better than having to cure a crop. Cleanliness, hygiene and the environment are just as important as the prevention, spraying program, which you need to execute weekly. It is important to realize that disease start in a very small way. Most favourable conditions for fungi are moisture and high humidity. Any moisture on foliage, stems or flowers will allow fungal spores to develop. Good pest and disease control can be obtained by maintaining a routine preventive spraying program. Sprays under relatively slow drying condition, late afternoon or early morning are best.

Never spray plants that are weakened by intense sunshine. Plants must at all time be sufficiently turgid.

Diseases :

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

***Fusarium* wilt :**

The disease caused by *Fusarium oxysporum* 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.

C.M.

- The best control measures are soil sterilization or chemical fumigation of the soil, use of pathogen free plants and general sanitation in the greenhouse.

- Rogue and destroy diseased plants to reduce the source of infection.
- Benomyl or Ridomil @ 2gm/lit of water drenching.

Butt rot - *Rhizoctonia solani* :

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 differ in that no internal brown streaking is observed.

C. M.

- Plant material derived from pathogen tested stock into fumigated soil.
- Relative resistance of carnation to *R. solani* was increased by good air circulation, good drainage, shallow planting of cuttings and a low or medium fertility level.
- Incidence of the disease was reduced by drenching with fungicide (Bavistin or Benomyl @ 2gm/lit) before planting.
- If disease develops remove infected plants and apply Ridomil or Benomyl @ 2gm/lit as a soil drenching.

Rust - *Uromyces dianthii* :

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

C. M.

- Avoid wet foliage.
- Rogue infected plants.
- Maintain a regular preventive spray program using Mancozeb @ 1.5 gm/lit, Zineb @ 1 gm/lit and Sulphur @ 1 gm/lit.

Grey mould - *Botrytis cinerea* :

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. The disease is favored by high humidity.

C. M.

- Reduce humidity, maintain good ventilation and hygiene practices.

- Avoid injuring flowers.
- Rovral @ 0.5 gm/lit or Benlate @ 1.5 gm/lit is registered for control of *Botrytis* on carnations.

Stem and root rot - *Phytophthora spp.* :

Withering and yellowing of foliage, leaf death, external browning of stems and internal browning at nodes. Stem and root rot may be present. Wet conditions, over watering and badly drained soils favor developments of the disease.

C. M.

- Avoid over watering and poorly drained soils.
- Drenching with Benomyl @ 2 gm/lit or Rovral (0.5 gm/lit).
- Drench with Thiram @ 3 gm/lit.

***Alternaria* leaf spots :**

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

C. M.

- Avoid excessive moisture in crops. Spray with Zineb @ 1 gm/lit, Mancozeb @ 1.5 gm/lit, Hexaconazole @ 1ml/lit, Propiconazole @ 1ml/lit.

Fairy ring spots - *Cladosporium echinulatum*

Whitish tan coloured spots upto 5 mm in diameter surrounded by a narrow red purple margin. Black pin-head sized spore masses occur in concentric rings on the surface of the spots. The disease occurs on the leaves, stems and calyces.

C. M.

- Spray with Mancozeb @ 1.5 gm/lit and Sulphur @ 1 gm/lit.

Carnation mottle virus (CMV):

CMV is the most common virus detected in carnation. Usually infected plants are symptom less, however some cultivars can show a mottling pattern on the leaves. It reduces flower quality and production and may cause inconsistent color integrity in the petals. CMV has no known vector and is highly infectious.

C. M.

Prevention is the only option, as viral disease can't be controlled by chemicals. Use plants derived from pathogen tested stock and maintain strict hygiene practices to minimize the disease.

Pests :

1) Red Spider Mite - *Tetranychus urticae*

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

2) Aphids - *Myzus persicae*

Symptoms : 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 tabaci*

Symptoms : 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) Bud Borer

Symptoms : 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.

5) Root Knot Nematode - *Meloidogyne spp.*

Symptoms : Stunted growth of plants with galls or knot like swellings of various sizes on roots. Leaves are yellow in severe infestations.

PEST CONTROL IN CARNATION

Pests	Suggested Chemicals for Control	Concentration per lit.
Thrips	Regent (Fipronil)	1.5 ml
	Confidor (Imidacloprid)	0.5 ml
	Nuvan (Dichlorvos) + Nuvacvon (Monocrotophos)	1.5 ml + 2 ml
	Rogor (Dimethoate)	2 ml
	Pride (Acetamiprid)	0.4 gm
	Calnova + Calpaste	0.5 ml + 2 gm
	Actra (Thimethoxan)	0.5 gm
Red Mites	Pure Water Spray	-----

Pests	Suggested Chemicals for Control	Concentration per lit.
	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
Bud borer	Proclaim (Emamectin benzoate)	0.2 gm
	Thimet (Phorate) (S)	10 gm/m ²
	Decis (Deltamethrin)	0.5 ml
	Avaunt (Indoxacarb)	0.5 ml
	Larvin (Thiodicarb)	0.4 gm
Nematode	Neem cake	1 kg/m ²
	Metacid (Methyl parathion)	2 ml
	Benlate (Benomyl)	3 gm
	Hydrogen peroxide with Silver (D)	3 ml
	Nematoguard (<i>Pcealomyces</i>)	5 gm

Note:

(D) Drenching @ 50 - 100 ml/plant

(S) Soil application around plant

PHYTOTOXIC EFFECT OF SOME CHEMICALS

Some of the pesticides used for the control of pests and diseases in carnation have phytotoxic effects on one or more varieties. Please note that several pesticides damage the wax layer and that gives the leaves and stems a bad appearance. Always read the directions for use at the packing and in case of application of a new product, first execute a trial spraying.

Note :

- Methomyl : (e.g. Lannate) may cause damage.
- Vertimec : may damage the wax layer.
- Parathion : to be used at most a few times because of damaging of wax layer.
- Dienochlor : (e.g. Pentac) may damage the wax layer.
- Carbofuran : (e.g. Orthene) causes arrest of growth if frequently used.
- Thiophanate methyl : (e.g. Topsin M) spraying this over standard carnations causes damage.

Care to be taken while spraying of pesticides, fungicides and fertilizers for better results.

- 1) pH of the solution should be between 6 to 6.5. It is maintained by acid treatment to water 12 hours before spray.
- 2) Use solution immediately after preparation.
- 3) Do not store mixture for more than 2 hours after preparation.
- 4) Smaller droplet size helps to cover maximum leaf surface area.
- 5) It is recommended to add spray adjuvant like Apsa 80 @ 5 ml/15 lit. of water to enhance the performance of pesticides & fertilizers and also help the solution to penetrate deeper.
- 6) Test water and soil sample for EC & pH periodically.
- 7) Operation of greenhouse is very important to maintain suitable conditions inside the polyhouse.

Disorders:

Boron deficiency :

Excessive calyx splitting [the petals are deprived of their support which result into bending down of petals thus, the regularity of shape and structure of the flower are destroyed]. As the bud opens and the petals approach their full size calyx may split down either half or completely.

- Brittle stems, cracking off near a leaf joint when getting mature or easy stem breakage while harvesting the flowers.
- Note that high potash levels can induce boron deficiency.
- The remedy lies in keeping a good balance of nutrients and avoiding over fertilization.

Harvesting of flower :

- Harvesting stage: Just elongation of petals out side the calyx.
- The best place of cutting stem is the area where leaves are well spaced and where at least 2 axillary shoots appear.
- The best time of harvesting is in the morning. The cut given on the stem should be smooth to avoid injury to flower stem or to the mother plant.
- Stems are usually cut with a sharp knife. Cutting is faster when both hands can be used, one to cut and the other to hold and remove the flower stem.
- In the production period flowers should be cut every two days.

- As soon as the flowers are harvested they should be kept in water or preservative solution (commercial bleach/Sodium Hypochlorite @ 7 - 10 ml or Citric acid + Ascorbic acid @ 5ml each/lit of water) for at least 4 hrs.

Handling :

Do not expose the harvested flowers to very high temperatures (keep them out of direct sunshine). Avoid harvesting during the heat of the day as much as possible. During picking periodically collect the cut flowers and remove them to a cooler place. Handle them carefully.

Conditioning of flower :

The conditioning of flowers; after grading and bunching increases the post harvest life of flowers. The stem ends after bunching should be trimmed and placed in a preservative solution. The recommended temperature for the cold store is 5°C to 8°C.

GRADING AND PACKING : (Quality standards for flowers)

- Stems should not be damaged by pest, disease or handling, chemical deposit should be unobstructive.
- Flower should be at a uniform stage of development within the box, not immature or over mature.
- Flowers must be cut at opening stage appropriate to time of year.
- The main stem should be of sufficient strength so that the flower can be held upright with little bending.

A range of polythene, polypropylene and paper sleeves is available. A good quality sleeves should protect the bunch from damage and enhance the appearance. Perforated sleeves are generally used. Remember to cool flowers before sleeving.

Use good quality box, pack firmly, fill the box completely, but keep the heads away from the end of the box.

Packing :

After grading and treatment with a flower preservative, the flowers are packed in bunches and sleeved in plastic sleeves or paper sleeves, according to the demand of the buyer. The standard carnations are packed in a bunch of 20 flowers and spray carnations of 10 flowers. Box used for packing is of size 98 X 30 X 12 cm. Generally 300 flowers are packed per box.

Good flower is :

- Stem length : 80 cm
Bud size : 8 to 10 cm circumference

Duration of the crop : 24 months

First flowering : 3.5 to 4 months after plantation

Yield : 200 flowers/m². (20 plants/m².)

WATER AND SOIL SAMPLE COLLECTION

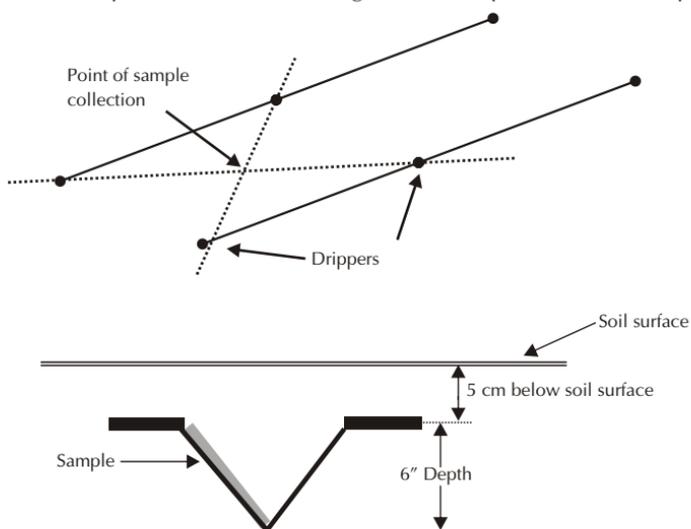
1. WATER SAMPLE:

- For tube well or open well, pump out some water and then collect sample in clean and chemical free plastic or glass bottle.
- For river or lake, collect sample at a distance from the bed so that the sediment particles do not enter in the sample.
- Ensure that the sample should reach the analysis laboratory within 2 days from collection.

2. SOIL SAMPLE:

For existing plot, it is necessary to take samples from 3 to 8 spots depending on the area.

- Stop fertigation for 2 days.
- Remove upper 5 cm layer of soil from these spots.
- Make a V-shaped hole (as shown in figure) of 6" depth in between drippers.



- Scrap soil from slope of hole and this will be a sample from that spot. Similarly take samples from all spots and mix together.
 - Then air dry this sample under shade and then take some sample as a representative sample of the plot. Ensure that the sample should reach the analysis laboratory within 2 days from collection.
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Safety guidelines while handling agricultural chemicals:

Farm chemicals include Insecticides, Fungicides and various other chemicals, which are hazardous and can cause grievous injuries, if not taken proper precautions while handling. The hazards can include burns due to the corrosive nature of the chemicals, inhalation of the dust or fumes or residual effect due to improper hygiene after the use of the chemical. Following are some vital points:

1. The pesticides and other related chemicals should be stored under lock and key in a separate, dry, well ventilated room.
2. Access to children, unauthorised persons and farm animals should be strictly denied.
3. A First-Aid Kit should always be available.
4. Use different set of clothing while handling the chemicals.
5. Read the safety instructions mentioned on the container, before opening the container.
6. Use face mask, eye protecting gears as well as hand gloves while using the chemicals.
7. In case, any corrosive chemical has come in contact with skin or come in contact with eyes, immediately wash under running cold water tap, followed by seeking medical help.
8. Seek immediate medical attention if the chemical has been ingested.
9. The used and empty containers should be safely disposed.



A KUMAR – FLORIST (HOLLAND) JOINT VENTURE

An ISO 9001:2008 Company

S. No. 178, Kirtane Baug, Mundhwa Road, Magarpatta, Hadapsar, Pune - 411 036. India.

Tel : +91-20-2689 0422 / 2689 0615 Fax : +91-20-2689 0681 E-mail : info@kfbioplants.com

CIN : U01122MH1997PTC106620

www.kfbioplants.com