

# CARNATION CULTIVATION GUIDE



**Floriculture Association Nepal (FAN)**

Battishputali-9, Kathmandu

# CARNATION

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## Preface

This is a unique technical guide book on the sector of cut flowers. In this field of cut flower production in Nepal entrepreneur had not any significant guideline text book to get start cut flower production. Although it is not a complete scientific information. In the cultivation procedure grower have collected many types of information, the sources of information sometimes from books, internets, technical guidelines or in the form of knowledge by experiences. Floriculture Association Nepal collected all these information and makes the form of a booklet. In this process, our farmers group, technical advisers and officials have contribute valuable information, guidelines and effort. This is a consolidated form of it. Our main aim is to make easier form of cultivation practice to a new grower and make easier to the growers who are already involved.



This is our first practice. It may various types' shortcomings. But our main aim is to make encourage for every technical persons as well as experiences farmers to collect those types of information and share to each other. This is why, we want to share our technical expertise to others and aim all the farmers who are involve in this sector can produce quality, quantity and continuity.

As a high value crop, lack of few technical information growers bears huge losses. This is our bitter fact. Our cultivation practice is not proper scientific as our crop needed. So, every one needed to know as more scientific way, if no, they should have turn on the appropriate practice. Otherwise product should not competitive and market should not pay as our investment.

For the publication Ministry of Agriculture Development has financial support for publication. Besides this the important part is collection of technical information. From the joint co-operation we came on this point. In coming days we expect valuable suggests and comments from technical exporters as well as farmers and growers which may help to correct ourselves and moderate it on the proper direction.

We appreciate and thanks for Ministry of Agriculture Development, technical advisers, growers and our members for their kind co-operation.

**Lok Nath Gaire**

President

Floriculture Association Nepal (FAN)



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## Introduction

*Dianthus Caryophyllus*, more commonly known as Pink, is the branch of large family (Caryophyllaceae) which is more closely connected with our modern flower, and is a native of Southern Europe." There is a large number of members of this Carnation family, which the botanists call "the natural order Caryophyllaceae," and their relationship is based upon the botanical similarity of their flowers, stems and leaves. There are said to be about sixty genera and eleven hundred distinct species, a species being the true wild original type. Some of these "types," because of their nobility and natural beauty, were taken into gardens ages ago and under the fostering hand of the owners of the gardens they gradually became improved. Such was and has been the case with the types (or species) called *Dianthus Caryophyllus*, parent of all the Carnations; *Dianthus plumarius*, parent of the hardy Garden Pinks; *Dianthus barbatus*, parent of the whole race of Sweet Williams; and so on. The *Dios anthos* (*Dios*, God; *anthos*, a flower, the *Dianthus* or Divine Flower) is also from the ancient Greek. The name might also be translated as "Jove's flower," Jove being the chief divinity of the ancients. On the other hand, the English name, Carnation is of doubtful meaning but generally understood to have been applied to distinguish a deep red color (Dick, 1915).

Carnation is an excellent and one of the most important commercial cut flower. In Nepal, it ranks the third most important cut flower (Pun, 2004). Carnation can be successfully grown in mild temperature (not more than 30°C). It has been accepted as an important competitive product for export in the international market (FAN, 2007).

While most Carnations are perennials, there are some annual varieties. Carnations are also called by their Latin name: "*Dianthus*". To gardeners, they are also sometimes referred to as "Pinks". They are popular as boutonnières, in corsages, bouquets, and in a wide range of floral arrangements. Carnations grow 18" to 24" tall, and produce a spicy clove-like fragrance. Long lasting blooms grow on straight, strong stems. The most common colors are white, red, and pink. Carnations are easy to grow (The Flower Expert, 2013).

Carnations grow 18" to 24" tall, and produce a spicy clove like fragrance. There are over 300 species of Carnations, and hundreds more of hybrid varieties. Though each hybrid comes in a different color, white, pink and red are the most common ones. Carnations come as annual, biennial and perennial varieties. Carnations can be planted in flowerbeds, borders, rock gardens and

even containers like pots. Carnations will flower well into fall if they are guarded against harsh weather. Carnations are one of the flowers with the longest vase life, lasting up to 2-3 weeks. Though growing Carnations does not require much labor, some factors are to be considered while growing them (The flower expert, 2013).

### Flower meanings

It symbolizes pride and beauty. A red carnation symbolizes love, pride and admiration; a pink carnation symbolizes the love of a woman or a mother; a purple carnation symbolizes capriciousness; a yellow carnation symbolizes disdain, rejection or disappointment; while a white carnation symbolizes innocence and pure love. A striped carnation conveys refusal (Flower Council of Holland, 2013).

### Economic value

Carnations are excellent for cut flowers, bedding, pots, borders, edging and rock gardens. Due to its excellent keeping quality, wide range of forms, ability to withstand long distance transportation and remarkably ability to rehydrate after continuous shipping (KF, 2013).

Climate of Nepal gives relative advantage over India to produce carnation of international quality especially during summer season (Yanai et al., 2007). Owing to comparative advantage, it could be expected to export carnation cut flower in the future (Shrestha, 2003; Tamang, 2006).

### Growing structures

Most of the perpetual carnations are commercially grown under protection. These require sufficient light and proper ventilation. Therefore, the design and orientation of the greenhouse are of great importance. The greenhouse should have the ridge, true north and south, the plants being grown in beds running in the same direction with beds 1-1.2m wide, path 60cm towards the side wall and in between the beds to assist working and ensure adequate air movement. Poly greenhouse fitted with fan and pad system can bring down the temperature by 8-10°C. However, top ridge and side ventilation also give good fresh air exchange and lower the temperature. The portable tunnel 3m x 1.5m x 1.5m are useful for protecting the open crop during rainy season to save from heavy rains and during winter to increase the growing temperature (UOU, 2011).

## Varieties

The Carnation varieties can be divided into two groups (KF, 2013):

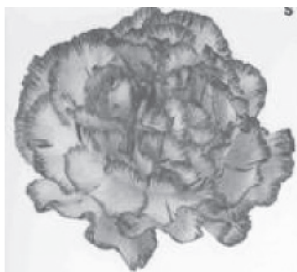
- **Standard variety:** It has single large flower on an individual stem. It is the popular type of flower for the purpose of cut flower.
- **Spray variety:** It has several shorter branches with smaller flower on each branch with short stem

### Standard types

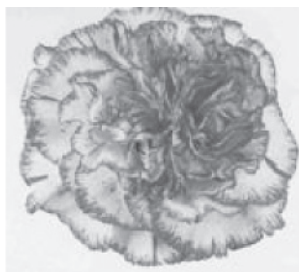
Killer, Malaga, Delphi, Madame Colette, Varna, Solar, Lady Green are some of the popular standard types. Some other varieties like Pink Dona, Tundra, White Tundra etc. are also cultivated.



PINK DONA



TUNDRA



WHITE TUNDRA

Source: TNAU, 2013

### Spray types

Estimade, Indira, Vera, Durago, Amore, Kiss Siga are some of the popular spray types.

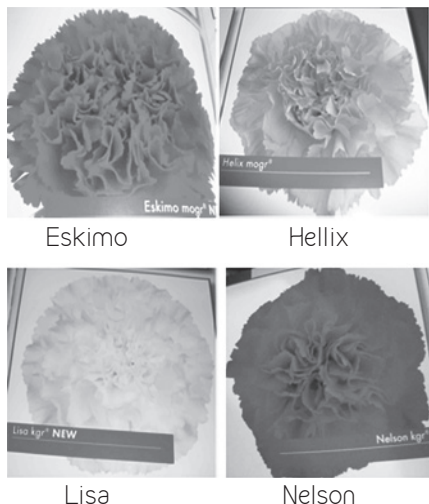


Spray types

Source: TNAU, 2013

Some varieties grown in Nepal are:

Red flower	White flower	Yellow	Pink flower
Corsa, Nelson, Pamploma, Eskimo	White liberty, Lisa, Hydra	Salamanca, Corona, Liberty, Helix (orange)	Alergo, Pink nelson



Source: Kooij and Zonen, 2007

### Soil and climate

Carnation 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 up to 40 cm as carnation roots go as deep as 25 to 30 cm. So, well drained and red loamy soil with the pH of 5.5-6.5 is most suitable. Temperature should be within the range of 25°C- 27°C. 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 temperature especially during flowering results in abnormal flower opening and calyx splitting, ideal day and night temperature is given below:

Growing condition: Day temperature 20-25°C or up to 28

Night temperature 10-15 or up to 16-18°C

Critical photoperiod 13 hours

RH 50-60%

The carnation is a facultative long day plant, which means that they form the flowers faster during long days than in short days. Carnation requires high levels of light to produce high quality flowers.

### Shed house

Following points should be considered (KF, 2013):

- The land should be levelled
- Shed house height 5 to 6.5 meter
- Length: North-South is better
- Polythene thickness: 200 microns



- Distance between two adjoining poly houses should be minimum 4 meter
- Sufficient ventilation space is required on top and sides

## Soil preparation

Sandy loam soil having pH around 6.5 is good for carnation cultivation and is good. Being a perennial crop having 3 years productive life, it is better to sterilize the soil. Sterilization can easily be done either by solarization or by the treatment of Formalin. For the solarization, soil should be covered with white plastic after well preparation of soil, for a week to kill the germs, insects and other microorganism. It needs long sunny days for early solarization. With the chemical, 4 liters formalin (40%) diluted in 400 liters of water and then completely wet the prepared bed. Then, the soil should be covered by plastic sheets for 2 weeks. After treating the soil, there is need of heavy irrigation or flood once a time to leach the chemicals.



## Bed layout

Normally, the beds are 0.8-1 meter wide and the path is 50 cm. In order to prevent the crop from being washed away or for proper drainage, the beds have to be raised 20-25 cm.

## Propagation

**By seeds:** Seeds can be sowed, 1/8 inch deep in a well-drained mix. Space seeds 12" apart. Make sure the compost is moist but not wet. Firm soil over seed and mist spray occasionally and keep it moist. The seeds will germinate in 2 to 3 weeks.

Seed Rate: 400 to 500 gm/ha (MAIB, 2011).

**By cuttings:** Cuttings taken from the terminal growth can also be used to propagate Carnations. The cuttings, varying from four to six inches long are taken and the basal leaves of at least two to three nodes are removed. The cuttings are then inserted in pure sand. The lower leaves must not touch the surface. Cuttings become ready for transplantation in 25 to 30 days. This method is preferably used in case of perennial Carnations.



*Cutting preparation and rooting*

**By division:** Carnations can also be grown by division through which we can rejuvenate older plants. Dig up an entire clump, and either pull it apart using your hands to separate the plant segments, or use two gardening forks inserted in the center of the clump, to gently pry the plant apart. Replant each new division as you would a new perennial or annual, and water it in very well.

**Plantlets/suckers** can be used for planting. The terminal cuttings of 5-10 cm are treated with NAA at 500 ppm for 5 minutes to induce rooting. Cuttings are dipped in Carbendazim 2g/lit solution.

Raised beds at 3 feet width and 45 cm height are formed at 45 cm interval and planting is done on top of the bed at 15 x 15 cm spacing. The cuttings normally develop good root system within 21 days (TNAU, 2013).

## Planting

A spacing of 20cm x 20cm is preferable and even wider spacing, can be used. Distance between the rows of 20cm allows 5 lines in 1m wide beds. Approximately 9350 plants or cuttings /ropani may be planted. Air movement between the plants and spray penetration is improved with wide spacing 30cm x 30cm under ordinary conditions (UOU, 2011).

Planting schedule is very important to regulate the flower production. Under controlled, greenhouse conditions, carnation could be planted round the year. Approximately 150-180 days are required from planting to flower under open conditions. However, under protected conditions, its flowers can be obtained within 120-150 days depending up on the season.



*Planting method in carnation*

## Netting and support material

Carnation crop has the tendency to bend unless supported properly. Hence the crop needs support while growing. Good support material is metallic wire woven with nylon mesh. At every two meters the wire should be supported with poles. The poles at both the ends of bed should be strong. Metallic wire is tied around the bed along the length with the support from supporting poles. Across the bed, nylon wires are woven like net. For an optimum support, an increasing width of the meshes can be used. Bottom net can be of 10x10cm, then two nets of 12.5x12.5cm and the upper most can be 15x15cm.

*5 steps of nets on the pole is practiced*

- 1st : 7\*7cm, height 12 cm from the soil level (named as planting net).
- 2nd and 3rd : Above first netting, nets are to be kept in the height of 15 cm
- 4th and 5th : Height of 18 cm



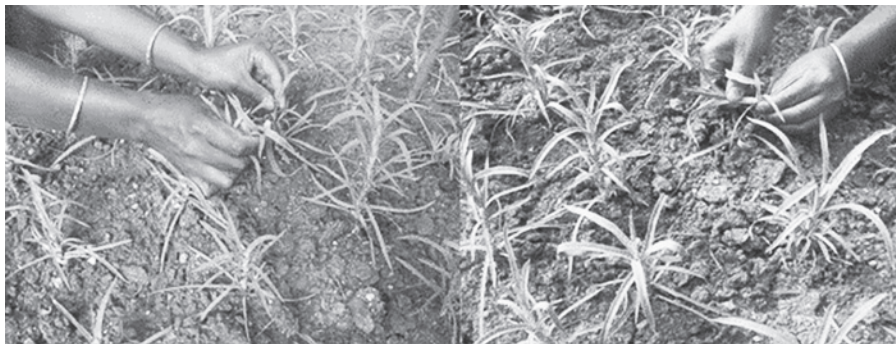
*Netting practice in carnation*

*Source: TNAU, 2013*

## **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, the main stem produces a crown flower.

Pinching is necessary for two times. It is done to develop good production of carnation flowers. Generally first pinching is done at 25-30 days after planting at the 8th pair of leaves. It helps to proliferate side shoots, generally 4-5 shoots. Second pinching is done on new side shoots at the 5th node. Pinching whole plant in a single day is not suitable, there may be stress problem. Generally second pinching is done 60-70 days after planting (Maharjan, 2006). Actually, pinching refers to breaking the tip and encouraging growth of side shoots. Depending upon the need of crop spread a) single, b) one and half and c) double pinches are given. Ideal time for pinching is morning. When the plant attains 6 nodes, the first pinch is given. This is referred as 'single pinch'. This would give rise to six lateral shoots. With a 'one and half pinch', 2-3 of these lateral shoots are pinched again. For the 'double pinch', all the lateral shoots are pinched off.

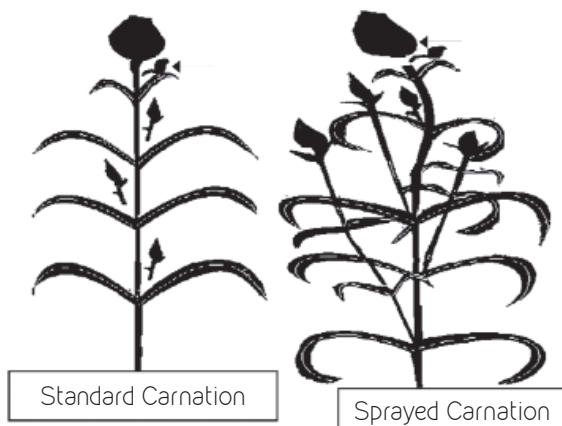


*Pinching in Carnation*

*Source: TNAU, 2013*

## **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 called disbudding. Disbudding refers to removal of side buds so that the central/terminal bud receives maximum food for the full development. In standard carnations, side buds should be removed where as in spray carnations, the terminal bud has to be removed.



Source: KF, 2013

## Deshooting:

Deshooting is also practiced to remove unwanted weak shoots (MAIB, 2011).

## Water

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 (3 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. When a carnation crop is in full growth and healthy, it absorbs 6 to 7 liters of water per m<sup>2</sup> day.

However, carnations do not require much water, except in the hot months. You must be careful not to make the soil too wet which can produce yellow foliage. You must spray water on the plants instead of splashing.

## Fertilization

It is most important to soil analysis before planting. Maharjan (2006) reported that for qualitative production, fertilizers are to be applied 2-3 times per week. The important fertilizers and nutrients viz. DAP (Diammonium Phosphate), Urea, oil cake, potash, Calcium Nitrate, Magnesium, Boron and Iron are important for carnation. Basic fertilizer required for carnation plants per week per square meter (soluble in 10 liters of water) are as follows:



Nutrients	Planting to pinching(gm)	Pinching to blooming(gm)	During blooming(gm)
DAP	6.66	6.10	6.6
Urea or oil cake	2	2.2	2.5
Potasm	2	3.10	3.4
Borax		1	1
Magnesium phosphate	2.5	2.5	2.5
Calcium Nitrate (apply separately)	5	8	10

### Manure

Peat is an excellent organic matter that can be added when growing Carnations. Pulverized and decomposed pine bark and well-rotted cow manure also serve as good manure. A prior soil analysis may help in deciding the kind of manure. A soil rich in manure or well-fed with nitrogen is not suited to the carnation. It may cause heavy vegetative growth, fewer blooms or even lead to the splitting of the calyx (green cup like structure that holds the petals) (The Flower Expert, 2013).

### Growth regulators

There is a pronounced effect of growth regulators on flower production and regulation in carnation. Spraying of GA3 (100ppm) twice at first pinch and when axillary shoots are 8-10cm in length, produce early flowering with long stems. However, application of BA (50ppm) at monthly intervals increases yield of cuttings (UOU, 2011).

### Supplementary lighting

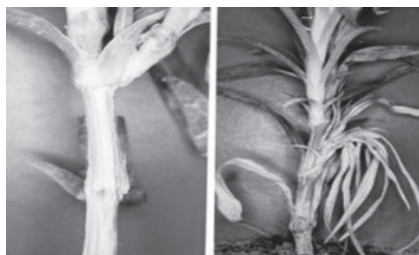
It is very effective for increasing stem length, flower size and early flower production and should be given with 100 W incandescent bulbs hung at 1.5 above beds at 1m spacing during November-January from dusk to dawn when light intensities are poor (UOU, 2011).

### Pests and diseases

Diseases

#### Fusarium wilt:

The disease caused by *Fusarium oxysporum* is one of the most serious diseases of carnation. *Source: TNAU, 2013*



*Symptoms* : Wilting of foliage, often only on a few branches followed by death. Rotting of the stem is on 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.

**Management:**

- 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 Rhidomil @ 2g/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.

**Management:**

- 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 @ 2g/lit) before planting.
- If disease develops remove infected plants and apply Rhidomil or Benomyl @ 2g/lit as a soil drenching.

**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.

**Management:**

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

### 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 decreased

Use: Omite 1ml/lit

#### 2) 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.

Use: Pride 0.4gm/lit or Rogor 2ml/lit

#### 3) 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.

Use: Pride 0.4gm/lit or Rogor 2ml/lit

### Deficiency and disorder

Calyx-splitting is a major disorder in carnation. As the flower bud opens and petals approach their full size, the calyx may split down either half or completely. Calyx-splitting occurs in many carnation cultivars, due to low temperature ( $<10^{\circ}\text{C}$ ) during the growth of flower bud and an extra whorl of petals is developed inside the calyx. But the calyx is not able to contain these extra petals or petaloids and splits. Low nitrogen, high ammonical nitrogen or low boron levels also enhance calyx-splitting. Some considerations are:

#### 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

Flower starts after 4 months of planting and continues up to one and half years. Standard carnation flowers are harvested when the outer petals unfold nearly perpendicular to the stem. Spray types are harvested when two flowers open and the remaining buds show color. Daily harvest is made leaving bottom 5 nodes of stalk to facilitate side shoot development (TNAU, 2013).

## Grading

Just after harvesting, the flowers must be graded and bunched properly. Various standardized grades based on stem length, flower diameter, and physical condition of flower like stem sturdiness, free from diseases and insects, sleepiness, stem cracks, slabside, bullhead and calyx splitting should be considered while grading carnations. Each grade is bunched in a lot of 25 stems. About 600 stems of carnation weigh approximately 22kg.

## Post harvest treatment

After harvest, the flower stems have to be trimmed at the base and should be immediately placed in a bucket of preservative solution of warm and deionized water. A good preservative solution for carnations should be acidic (pH 4.5) with 2-5% sucrose and a biocide not phytotoxic to carnations. After keeping in preservative solution for 2 to 4 hours, flowers should be placed in a refrigerated room at 0-2°C for 12-24 hours. The flowers can be stored for two to four weeks before marketing. For this, the flowers have to be packed in cartons lined with polyethylene film. These cartons should have sufficient vent holes. The full cartons should be pre-cooled without lid. The plastic is then loosely folded on top of the stems and the lid is closed. These cartons are stored in cool chambers designed to maintained 0°C with good air circulation and a constant relative humidity of 90-95% (TNAU, 2013).

Carnation flowers are highly sensitive to ethylene. The flowers after harvesting and grading should be pulsed with 10% sucrose + 1mm STS for 8-10hr before transportation to increase storability and vase life of cut carnations. After pulsing, the flowers should be stored at 2°-4°C temperature and 95% relative humidity in water with a nutritive solution. This is necessary to prevent sleepiness in cut carnations (UOU, 2011).

Citric acid can also be added to water to make the pH 4.5 to 5 and 5 mg of Sodium hypochlorite is added to 1 litre of water. Cut flower stalk is soaked in this solution for 4- 5 hours to improve vase life.

## Packaging and transportation

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 98x30x12cm. Generally 300 flowers are packed per box.

It is also reported that Carnations are packed in corrugated cardboard boxes. About 800 carnations are packed in a standard-sized carton (122cm x 50cm x 30cm). The boxes should be well insulated. Bunches of 25 flowers are then packed in these boxes with one half of the total number of bundles oriented on each end of the container. Newspaper layers are placed between the layers to maintain high humidity and then when the container is filled, an insulated layer of paper is put across the box to cover the flowers completely. Transportation should be done in a refrigerated van at 2°-4°C temperature to maintain the cool chain up to cargo. However, for local markets it should be done by buses and vans during night hours (UOU, 2011).

## Yield

Generally yield is about 200 flowers per square meter or 20 plants per square meter (KF, 2013) but in Nepalese context, it was found as below:

Production of carnation cut flowers from 6000 plants in 2060/61

Months	Max. Temp (Av.)	Min. Temp (Av.)	Av. rain (Day/ month)	Production
Shrawan (July-Aug.)	28	20	14	1193
Bhadra (Aug-Sept)	27.5	19	10	5006
Ashoj (Sept-Oct)	26.5	15.5	5	9397
Kartik (Oct-Nov)	24.5	10.5	1	8401
Marga (Nov-Dec)	21.5	5.5	0	6961
Poush (Dec-Jan)	19	2.5	1	5787
Magh (Jan-Feb)	19.5	3	1	4405
Falgun (Feb-Mar)	23	6	1	8338
Chaitra (Mar-April)	26.5	9.5	2	9292
Baisakh (April-May)	28.5	13.5	5	14939
Jestha (May-June)	28.5	17.5	8	6295



Ashad (June-July)	28	19.5	12	10986
<b>Total</b>				91000
<b>Av. stick per day</b>				249
<b>Total production per plant per year</b>				15.2

*Source: Maharjan, 2006*

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## Photo Gallery



Bed Preparation



Plantation





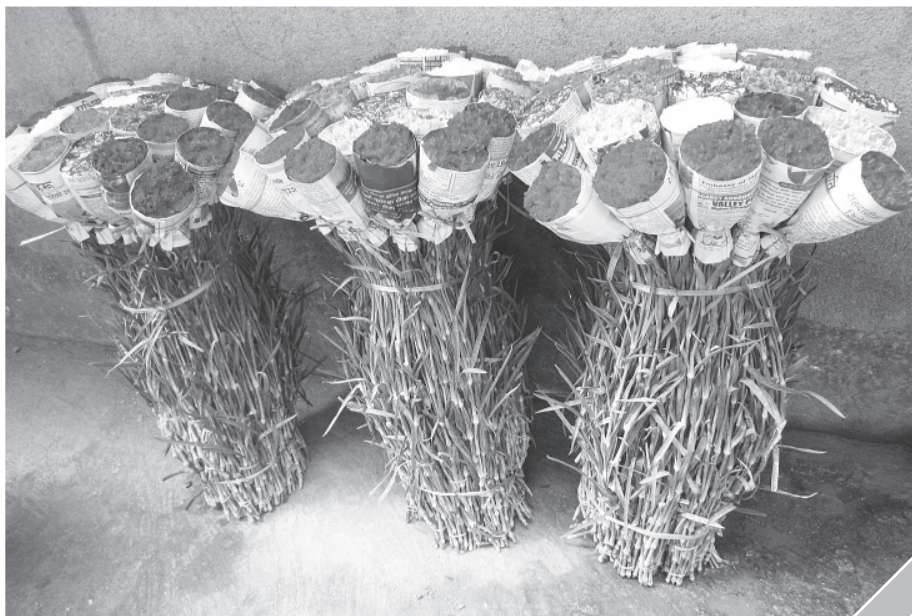
Growing Carnation



Pinching Bud



Harvesting



Packing and Ready for sale





## Floriculture Association Nepal (FAN)

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