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# Carnation Cultivation in Polyhouse

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## INTRODUCTION

The carnation plant, or *Dianthus caryophyllus* L., is one of the world's most significant commercial cut flowers, especially when cultivated in protected cultivation structures such as polyhouses. The popularity of the carnation flower is widespread, with flower enthusiasts in homes and markets alike finding it attractive due to its wide color selection, aesthetic appearance, long vase life, and high transportability. Because of these characteristics, carnations are the preferred flower for bouquet arrangements, decorations, and export. With polyhouse cultivation, the growth conditions can be optimized to ensure uniform growth, high-quality flower production, and round-the-clock production. The science of carnation cultivation is highly developed, with floriculture research and development activities carried out by the Indian Council of Agricultural Research, among other organizations, to improve the variety, fertigation, and protected cultivation technology to improve productivity and profitability.

### Advantages of Polyhouse Cultivation

The advantages of polyhouse farming for carnations are numerous, including the benefits of growing the crop throughout the year, providing uninterrupted supply to the market, regardless of the season. Polyhouse farming also provides the advantage of protecting the crop from harsh weather conditions, including heavy rains, frost, strong winds, and extreme temperatures, which could otherwise cause the flower buds to spoil.

With the polyhouse, the temperature and humidity levels can be optimized to provide the best conditions for plant growth, allowing the carnation to grow in its ideal conditions. Polyhouse farming also provides the advantage of reduced pest and disease pressure, since the polyhouse prevents the entry of insects and diseases into the farm. Additionally, the carnation flower produced in the polyhouse is uniform, with large flower sizes and deeper colors, which is ideal for export. These characteristics provide the farmer with high productivity, quality, and better market price, making polyhouse farming one of the most profitable methods for carnation farming.

**Climate requirement**

"Carnations thrive in cool to moderate humidity. Hence, creating a suitable climatic condition is essential for their proper growth. In a controlled environment, it is recommended to maintain a temperature between 20°C to 25°C during the daytime to ensure proper growth and strong flower stalks. During nights, a cooler temperature between 10°C to 15°C is necessary to ensure proper formation of buds and flowers. Also, it is necessary to maintain a humidity level between 60% to 70% to reduce transpiration loss and minimize the risk of diseases.

Light is also a critical factor in carnations. Too little or too much light is not desirable. Carnations require just enough light to facilitate photosynthesis and to induce flower buds and open flowers. Too much light can result in abnormal flower shapes and colors and reduce their longevity. Too little light can impede flower formation and reduce their growth. Hence, it is necessary to maintain a proper microclimate inside the polyhouse.

The polyhouse used for carnations should be strong and suitable for creating a proper microclimate. The cover is usually made of UV-stabilized polyethylene film. This film is transparent to allow sufficient sunlight to penetrate and reach the plants. However, it also protects the plants from UV rays and harsh weather conditions. Proper ventilation is also necessary to ensure proper temperature control and to prevent stagnation of humidity.

The use of shade nets with 30 to 50 percent opacity is also necessary to regulate the amount of sunlight entering the polyhouse and to prevent heat stress during hot days. Drip irrigation is also necessary to ensure proper watering and to supply nutrients to the plants. The use of raised beds is also necessary to ensure proper aeration and root development.

To ensure proper climatic conditions throughout the year, it is necessary to install modern climatic equipment such as foggers, exhaust fans, and cooling pads."

**Soil and Growing Media**

Carnations require a growing medium that is capable of draining water properly and is also porous and nutrient-rich, as these plants are highly susceptible to waterlogging and poor aeration. The traditional composition of the growing medium is equal parts of soil, sand, and organic matter such as farmyard manure and cocopeat (1:1:1). This composition is ideal as it controls the moisture level and also ensures that excess water is drained out properly, while providing the necessary nutrients required for the growth of the plant.

The ideal pH range for carnations is between 6.0 and 6.5, which is ideal for the availability of nutrients and absorption of the roots of the plant. The electrical conductivity level should be maintained below 1.0 mS/cm, as high levels of electrical conductivity can prove to be harmful to the roots of the plant and affect the quality of the blooms.

Prior to this, the growing medium must be sterilized to free the medium of pathogens, nematodes, and weed seeds. This may be done by solarization or the use of chemical sterilants. A well-prepared medium will provide a healthy root environment for the development of vigorous plant growth and high-quality flowers.

**Varieties**

Selecting the most suitable variety of carnations is an important decision in the field of commercial floriculture. Different varieties of carnations differ in flower size, color, stem height, and yields. In the case of commercial carnations, the main two species of carnations are the standard carnations and the spray carnations. Standard carnations bear one flower

at the end of the stem, making them suitable for cut flower arrangements. Some of the most popular varieties of standard carnations include Master, White Sim, and Domingo. These are popular for their long stems, color, and flower quality.

On the other hand, spray carnations bear multiple flowers at the end of a single stem. These flowers are most suitable for flower arrangements. Some of the most popular varieties of spray carnations include Rony, Tanga, and Chabaud.

**Propagation and Planting**

**Planting Material**

Carnations are propagated vegetatively using terminal cuttings from healthy and disease-free mother plants. This method is important for uniform growth in plants, flower quality in terms of size and color, and yield. For planting, rooted cuttings are used because they establish quickly in the soil and minimize seedling mortality. They also promote early flowering. For planting, certified and virus-free planting material must be used. This planting material must be obtained from reliable sources.

**Planting Time**

In polyhouse conditions, carnations can be planted at any time of the year. This is because temperature and humidity conditions can be controlled. However, planting in mild weather conditions is best for optimal growth and early root development. Extreme temperatures must be avoided for optimal growth.

**Spacing**

Spacing is important for healthy growth in plants, for light penetration into the crop canopy, and for ease of intercultural operations in the crop. For standard varieties of carnations, planting is done at 20 x 20 cm. However, for spray varieties, closer spacing is required due to their smaller size. Spacing for spray varieties is 15 x 15 cm. Plant density varies between 25 and 36 plants/m2 depending on the variety and spacing used.

Balanced nutrition is a pre-requisite for the development of high yields with excellent quality of blooms in a protected environment. In the case of polyhouses, the most commonly used technique for the efficient use of nutrients by the crops is fertigation. The nutrient solution comprises a combination of nitrogen at 150 to 200 ppm, phosphorus at 50 to 60 ppm, potassium at 200 to 250 ppm, calcium at about 150 ppm, and magnesium at about 50 ppm. Nitrogen promotes the development of the plant, stem growth, and flower development. Phosphorus promotes the development of the root system and flower development. Potassium increases the size of the flower.

Apart from the three major nutrients, calcium, and magnesium, other secondary nutrients include iron, zinc, manganese, and boron, which are supplemented weekly in small quantities to prevent deficiencies and maintain the nutrient balance. The pH of the nutrient solution also needs to be maintained at a level of 5.5 to 6.5, as this pH level is most suitable for nutrient uptake by the plants.

**Irrigation Management**

Irrigation management is an essential practice in the successful cultivation of carnations in protected environments due to their sensitivity to moisture stress and waterlogging. Drip irrigation is the preferred method of irrigation since it provides water directly to the roots of the plants in controlled and uniform amounts, thus avoiding water wastage and foliage wetting that may lead to infection.

It is also important to avoid overwatering since it may lead to reduced oxygen availability in the root system, which may cause root rot and fungal infections. The frequency of irrigation should also not be based on predetermined intervals but should instead be controlled according to seasonal conditions, growth stage of the plants, and moisture levels in the medium. For instance, in periods of high temperatures and in light medium, irrigation may be required more frequently than in periods of low temperatures and in heavy medium.

**Training and Pruning**

**Pinching**

Pinching is one of the critical cultural activities in carnation production. This process involves

removing the growing apex of the plant. This process enhances the production of flowering stems and gives the plant a better shape. Single pinching is done when one wants the plants to flower early. This allows for rapid production of flowering stems. On the contrary, double pinching is done when one wants more stems produced in one plant. This enhances more production of flowers in one plant

**Staking and Netting**

Carnation plants have long and slender stems that are liable to breakage or bending. This calls for support for the stems. A support net or plastic mesh is laid across the plants. This support is laid in three or four layers depending on how tall the plants have grown. This support allows the stems to grow in an upright direction. This allows for more production of straight stems that are marketable.

**Growth Regulation**

Plant growth regulators are significant in improving flower quality and uniformity in commercial carnation production. Gibberellic acid, $GA_3$, is usually applied to stimulate stem growth, which is essential in ensuring that the stems are long enough to meet commercial and export requirements. Growth retardants may also be applied to control vigorous growth in carnations.

It is essential to ensure that these chemicals are applied in the recommended concentrations and growth stages to avoid abnormalities in the plants, such as distorted flowers, weak stems, and delayed flowering. When applied correctly, these chemicals improve flower synchronization and increase flower bud size.

**Pest and Disease Management**

**Major Pests**

Carnation is affected by various insect pests, such as aphids, thrips, and red spider mites, which suck sap from the plants and affect their vigor and flower quality. These pests are also known to transmit viral infections in carnations, which necessitate their control. The application of yellow and blue sticky traps is essential in controlling these pests in carnations using an integrated management approach. Biological control using mites and parasites is also effective in managing these pests in commercial carnation production. Chemical control using insecticides is recommended when pest populations are above economic threshold levels to avoid resistance and environmental degradation.

**Major Diseases**

Diseases that affect carnations include Fusarium wilt, rust, and Botrytis blight, which affect the vigor of the plants, flower quality, and flower stems, respectively. Fusarium wilt is characterized by yellowing and wilting of the leaves, rust is characterized by the formation of rust pustules on the leaves, and Botrytis blight is characterized by flower rot in humid conditions. These three factors are controlled using preventive measures such as soil sterilization, ventilation, and maintaining optimum humidity levels in the greenhouse environment. It is also essential to uproot and destroy diseased plants to control the spread of these three factors in commercial carnation production. Fungicidal sprays may also be applied in these cases to control the three factors in commercial carnation production. It is essential to adopt Integrated Pest Management in commercial carnation production to ensure sustainability and minimize the use of chemicals in these farms.

**Harvesting**

To ensure the maximum vase life and marketability, the flowers of the carnation plant should be harvested at the right stage of maturity. The right stage to pick the flowers is when the outer petals are fully developed, and the inner petals are still not fully open, indicating the flowers will open gradually after picking. The flowers should be harvested during the early morning or late evening hours when the temperatures are cool and the plants are well hydrated.

Cut stems meant for export should be between 45-60 cm in length, straight, and without defects. The cut flowers should be immediately placed in water with a preservative solution to maintain their freshness and prevent them from wilting.

**Yield**

In the case of the scientific cultivation of the carnation under polyhouses, the yield can be very high compared to open field cultivation. The normal variety of the carnation can yield about

250-300 stems per square meter per year, and the spray variety can yield about 300-400 stems per square meter per year. The performance of the yield will depend on various factors, and the optimal conditions inside the polyhouse will play a very important role in maximizing the yield and maintaining the quality of the flowers throughout the year.

**Post-Harvest Handling**

Proper post-harvest handling is important for maintaining the freshness and quality of carnation flowers. After harvesting, the lower leaves must be removed from the stems to minimize transpiration and decay. The flowers must be graded depending on the length of the stems, flower size, and quality. Pre-cooling at 2–4°C is recommended for slowing down respiration and postponing senescence. This would increase the shelf life of the flowers. The flowers must be packed in corrugated boxes that protect them against mechanical injury. Proper handling would increase the vase life of carnations for two to three weeks. This would make them suitable for transporting over long distances.

**Economic Benefits**

Growing carnations in polyhouse technology is considered one of the profitable floriculture ventures due to their high market value and demand for exports. The flowers produced in controlled environments are of high quality and would fetch a high price in the market. The continuous production cycle would provide a steady income for growers rather than seasonal earnings.

Although initial investment for polyhouse construction and infrastructure is relatively high, the returns are substantially greater than those obtained from open-field flower cultivation because of higher yields, superior quality, and reduced losses. Efficient resource utilization, precise fertigation, and controlled climate management further enhance profitability and sustainability.

## CONCLUSION

Carnation cultivation under polyhouse conditions represents a highly scientific and commercially viable floriculture system that integrates advanced production technologies with precise crop management. Adoption of improved varieties, accurate fertigation schedules, environmental control, training techniques, and integrated pest management enables growers to produce premium-quality flowers consistently throughout the year.

With increasing demand for cut flowers in domestic and global markets, protected carnation cultivation offers excellent opportunities for farmers, entrepreneurs, and agribusiness ventures. Continued technological innovation, research support, and skill development will further strengthen this sector, making carnation production a profitable and sustainable component of modern floriculture.