

# GLADIOLUS OR SWORD LILY



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## Gladiolus: An Introduction

Gladiolus, also known as Sword Lily has derived its name from a Latin word “Gladioli” which means sword as the leaves of the plant resemble to that of a sword. Attractive and long spikes with bright, huge and colorful flowers in various sizes in addition to long keeping quality are some of the characteristics which make it as one of the most demanding and revenue fetching commercial crop. It is an ideal cut flower crop which can be grown easily and is valued for its use in floral arrangements

### Taxonomy

Gladiolus belongs to the family Iridaceae with genus Gladiolus. Mainly propagated by corms (similar to bulbs) it is a perennial bulbous plant with one type having large flowers and the other with small miniature flowers. The genus Gladiolus has about 260 species. It has a single stem with the sword shaped leaves which are enclosed in a sheath. The spike where the flowers are borne is large and one sided. The flowers are bisexual in nature with green bracts and both the petals and sepals appear identical to each other (which are also known as tepals)

### Major Species

The wide range of colorful flowers produced by present day cultivars are developed by crosses between various species. Some of the major species for present day cultivars are: *Gladiolus aurantiacus*, *Gladiolus byzantinus*, *Gladiolus cruntenus*, *Gladiolus psittcinus* and *Gladiolus primulinus*



## **Origin and Distribution of Roses**

Most of the species of Gladiolus have originated in South Africa hence it is generally considered as centre of origin of the flower but is distributed widely in other parts viz. Tropical Africa, Asia and Europe. Out of 260 species counted so far, more than 60% are originated in South Africa whereas around 30% in Tropical African region and rest of the species in other parts of the world

## **Classification of Gladiolus**

Gladiolus is generally classified on the basis of floret width and flower colors. Gladioli are divided into five sub-classes- Giant Gladiolus has width of bottom floret not less than 20 cm, the Large Gladiolus have width ranging from 11cm to 15 cm, Medium Sized have floret width from 9cm to 15 cm, Small Gladioli have width of bottom floret ranging from 6 cm to 9 cm whereas the Miniature type Gladiolus has size less than 5 cm. Miniature Gladioli are also known as Potted Gladioli as these have less flower buds and generally grown in pots. On the basis of color and hue, the flower has various sub-classes viz. Red, Black, Rose, Lavender etc. In addition to this, the flowers are also categorized on the basis of their blooming season like Species which flowers in summers or Summer Blooming, the species which flower in winters are Winter Blooming and those species which bloom in harsh winters are Butterfly Gladiolus

## **Major Varieties of Gladiolus**

The major cultivated varieties in gladiolus are developed as a result of hybridization between various species. Some of the major cultivars widely grown for both home gardening and commercial purposes are Candyman, Prins Claus, Her Majesty, Dream's End, Friendship, Aldeberan, Eurovision, Jester, Orange Emperor, Priscilla, Red Beauty, White Beauty, Melody, Lily Blue, High Fashion, Peter Pears, Snow Princess, Tropic Seas, Watermelon Pink and White Prosperity. On the basis of color the table presents some of the major cultivars of Gladiolus which are on demand and cultivated commercially by various florists

### Commercial Varieties of Gladiolus

Color	Major Varieties on Demand
<b>White Colored</b>	Moon Frost, Mighty Mite, Super Star, Snow Dust, White Friendship, White Oak, Cotton Blossom, White Prosperity
<b>Yellow Colored</b>	Chinese Lantern, Fatima, Morning Sun, Lime Light, Royal Gold, Sweet Fairy
<b>Orange Colored</b>	Coral Seas, Tangerine, Orange Beauty, Orange Emperor, Peter Pears
<b>Pink Colored</b>	Dawn Pink, Friendship, Kimberly, Priscilla
<b>Red Colored</b>	Oscar, Delicious, Red Beauty
<b>Rose Colored</b>	American Beauty, Royal Brocade, Upper Crust
<b>Purple and Lavender Colored</b>	Purple Giant, Purple Moth, Elegance, Shalimar, Magic Lavender
<b>Violet Colored</b>	Her Majesty, Tropic Seas, Lily Blue, Blue Mist
<b>Cream Colored</b>	Dew Drop, Lady Bountiful, Pale Moon
<b>Green Colored</b>	Oasis, Green Giant

## Major Uses of Gladiolus

**As a Cut Flower:** Gladiolus is one of the beautiful cut flowers which have huge demand in international market due to their long vase life, attractive colors and round the year availability. The flower generally lasts up to 6 to 10 days in a vase however treatment with suitable preservatives elongate the life as well as prices of flowers in the market

**Corms and Cormels:** Corms and cormels are propagating material for the flower both of which are actually underground stems. When the plant completes its life cycle up to the maximum, these underground stems are dug out of the soil and with proper post harvest practices, packed and sold in the market. Selling corms and cormels are also one of the sources of earning income. This propagating material can also be stored for next time planting

**As an Antimicrobial Agent:** Corms are also used as an antimicrobial agent. The extract of corms possesses antimicrobial properties and help in recovering from various uro-genital and gastrointestinal problems

**As Food:** In some of African countries, the corms are consumed as edible food by the people

**Other Uses:** In African countries, the corms of Gladiolus are used to treat Diarrhea, coughs and colds, dysentery and constipation. The flowers are also used in ceremonies and funerals in China

## Growing Practices for Gladiolus

Like other cut flowers, Gladiolus has also the same cultivation practices which should be followed with high priority and failure of which results in complete crop loss if grown commercially. The crop is a perennial plant where flowers grow on spikes. The flower is known to fetch a good amount of returns as compared to other cut flowers due to demands of its varied ranges of colors in the market



## **Climatic Requirements**

***Sunlight:*** The location to plant Gladiolus should have proper sunlight where the flower blooms to its full size and brightness. The flower stalk has sturdy growth under the sun. In contrast to this, the shady location obstructs the quality of flowers. In addition to sunny location, the site should be far from strong winds. Although the crop can be grown either as short day or long day flowered but the quality of flowers in long day conditions is comparably better

***Temperature and Humidity:*** The crop grows well in mild climate where temperature is one of the major quality contributing factors. The optimum temperature for proper growth of Gladiolus along with its vegetative growth ranges between 10 to 25 degree Celsius and the night temperature should not be more than 16 degree Celsius. With relatively high humid conditions, the crop is also able to tolerate high temperature up to 40 degree Celsius

***Rainfall and Altitude:*** The crop requires sufficient rainfall for its blooms to grow to maximum. It can be grown in the altitude of 2500 m and equally in plains also

***Soil Requirements:*** Well- drained fertile soil with good water holding capacity is the ideal soil conditions for a quality yield of Gladiolus flowers. The pH of the soil should range from 6 to 7. Soil with pH less than 5 should be amended with lime. Sandy loam soil with a good amount of organic matter is preferred by most of the gardeners. To minimize the incidence of pests, it is advised to grow the crop in the soil where Gladiolus is not planted before. Sterilization also helps in overcoming such barriers



***Site Selection:*** The main pre-requisites for a quality yield of Gladiolus are its climatic requirements. The major parameters for selecting the site in case of commercial cultivation of the crop are discussed here

**Location:** The site should be sunny, have proper air circulation with no strong winds. It is generally recommended to plant the crop in the land where it has not been planted before else select the land where it is not planted for last six years. Accordingly, the site should be far away from traffic and pollution but have good metallic connectivity in order to transport the packaged produces for sale. The location should be installed with proper irrigation facility, in order to save time and labor. It is advisable to sterilize the soil to eliminate harmful biological organisms from the soil

**Ease of Marketing:** The location should be equipped with storage, post harvest and packaging chambers as well as transportation means. This will reduce the post harvest loss of crop and help in generating more income

**Field Preparation:** For the selected location having heavy soil, the corms are grown in raised beds whereas no such operation is required with light soils. Sand can also be mixed to improve aeration in such soils. The field is prepared by deep plowing up to 45 to 60 cm and levelling the land. The soil is advised to be dug up to 30 centimeters to make the corms. Care should be taken to remove or break all the clods and afterwards, well and rotten farm yard manure is mixed with the soil uniformly. Too much amount of decomposed manure is also not recommended as it results in lean and tall spikes. For home gardening purposes, Gladiolus can be grown in pots where the soil mixture should contain soil, decomposed manure and sand in recommended proportion of 2:4:1 respectively

**Propagation:** Gladiolus is propagated by corms which can be used for next year plantings also. Cormels are miniature corms attached to the large corms and are generally planted along with corms. However it takes two to three continuous plantings for the production of desirable blooms from the same. Propagation by seeds is practiced to obtain hybrid cultivars of gladiolus. A corm is a swollen underground stem that is a storage organ for some plants in order to survive in adverse winter conditions, summer drought and heat. Corm is usually enveloped by leaves that form its skin and help to protect the corm from attack of insects and water loss. It is generally distinguished from a bulb having a solid mass when cut into halves whereas a bulb is composed of layers

**Planting Season:** Planting season depends on the other climatic conditions (place of origin, temperature, soil) of the locations. In plains, the ideal season of planting is September to October however it is spring in case of hills just after the frosty season is over generally in March to April. In mild areas, the corms are planted in June and flowers are harvested in August

**Planting Method:** Gladiolus is a three month crop which takes around 70 to 90 days from planting to harvesting. Planting is done in two ways. As discussed earlier, it is recommended to plant the corms in raised beds when the soil is heavy and generally stores water for long or high rainfall areas (that result in rotting of corms) and for light soils, flat beds are preferred. Corms having a diameter range of 5 to 10 cm are planted to get a good quality crop that can be used from market sale to exhibition purposes. Before planting the corms, soaking them in a fungicidal solution such as Captan at the rate of 2 milliliter in a liter of water for 30 minutes helps disinfecting them. These are then planted immediately in the soil. Prior to planting, the corms which are kept in cold storage for a longer duration are kept in dark and warm place to break the dormancy and allow these to swell and sprout. The corms are also covered with black polythene to facilitate sprouting

**Planting Space:** The planting space between two corms should not be less than 15 to 25 centimeters in a row and the two rows are recommended to be 30 to 45 centimeters apart to carry out intercultural operation

**Planting Depth:** The planting depth depends upon size of corms, type of soil, planting season and location. Large sized corms are planted deep as compared to smaller ones. Some of the gardeners prefer the depth of planting to be four time that of the size of corm. Deep planting is also advised in light soils. However the ideal depth of planting is 5 centimeter. After planting the corms are covered with soil



**Fertilizer and Irrigation:** The food materials reserved by the corms can supply enough of nutrients to the plant for their growth for few weeks. It is recommended to not give heavy doses of nutrients to the plant. Fully decomposed farm yard manure which should also have leaf mould is best. In some places, nitrogenous and phosphate fertilizers are applied at the time of field preparation. The fertilizers should be mixed with the soil uniformly. In a hectare of land, 120 kg of Phosphate as well as 200 kg of nitrogenous fertilizers are added to the soil. After the emergence of third leaf from the plant, 80 kg of Nitrogen is again applied to enhance vegetative growth of the plant. A good amount of water is consumed by the crop during its entire growth period which is always advised to be done in the early morning hours. Watering is not preferred during rainy season. In summers, irrigation is done once in a week while it is sufficient to water once in 10 days during winter season

**Mulching:** Mulching is done to take care of plant during winter season. The purpose of this operation is to keep the soil moist by cutting down the evaporation from the surface, in addition to minimize the growth of weeds around the plant and prevention of freezing which results in corms damage. Generally mulch of about 5 to 7 centimeter is used to cover the outside areas of Gladiolus. Mulches such as grass, pine needles or bark and straw are suggested for Gladiolus. It is done when the temperature starts coming down. The mulch is removed after the winter season is over to expose the soil as the onset of spring season helps in producing new shoots. The plant gives rise to weak and pale shoots if the mulching material is not removed on time. It will also become a reason for the diseases and pests to grow if not dumped away from the main land as the mulched material becomes source of pests to generate

**Staking:** Staking is an important practice in gladiolus plantation to prevent the spikes from break and fall due to strong winds. A strong stake of bamboo stick is used and is dug next to the corm during the planting time only. Utmost care should be taken not to damage the corms with stake. However plants are not staked when grown closely. Staking is also not required for cultivars of miniature and butterfly type gladiolus

**Earthing Up:** This first earthing is done when the corms start sprouting. The purpose of this operation is to keep the plant erect and straight. Second time, this operation is done when the plant grows up to a height of 25 centimeter. It is mostly practiced in locations where the soil is heavy

## **Harvesting**

**Time of Harvesting:** Since Gladiolus is known for its spike which has long vase life. For gladiolus to be sold in market, in order to fetch more prices, proper time of harvesting the spike should be known. The spike is ready to harvest when the last flower from the bottom of the stalk starts showing color however cutting also depends on distance of the location from the market. When the flowers are to be sold to nearby markets, spikes are cut when lowest 2 to 3 florets start showing color while in case of distant markets, the spike is cut when the lowest floret of the spike starts showing color rest of the flower buds remaining tight. The spike should always remain in straight position to prevent them from bending. Early morning or night is proper time to harvest the spikes to transport them to distant markets

**Proper Way to Harvest the Spike:** A sharp knife is used to cut the spike so that it gets saved from injury. This is important to know the proper method of harvesting the spike as it is also one of the parameters which help in growth of corms and flowers. The spikes after harvesting should be kept in a bucket containing water to retain its moisture and removing field heat

**Corms:** Corms are harvested during October to November in hills and April to May in plains since it takes about 7 months for the corm to be ready to harvest. The corms are dug once the plant completes its life or when blooming is finished and mostly killed by winter adversity. Also when the corms start turning brown is another sign to harvest the corm. The leaves also start turning yellow and There should be some portion of stem along with dug corms. The soil is then removed from the corms and stored for next season. In addition to corms, there are several cormels the large sizes of which are also stored as they also become ready to harvest in two to three years

**Yield:** The yield of Gladiolus depends on variety planted, density of planting, and size of corm as well as management practices followed during the whole life cycle of the crop. If all the crop management practices are religiously followed, then from in a hectare a crop planted with the density of 30 centimeter X 20 centimeter will yield about 0.15 Million spikes. In addition to spikes, the corms also fetch good amount during sale season where the yield reaches up to 0.35 Million corms

### **Important Point to be Noted**

1. Harvesting indices must be known for proper post harvesting practices
2. Spikes during harvesting should be least injured
3. Exacting timing of lifting the corms and cormels should be taken care of
4. Removal of infected, rotten and damaged corms and cormels is necessary to avoid further spreading
5. The corms should be stored according to their sizes and hardness. These should not be freezed
6. Use of perforated plastic trays and jute or hessian bags for storing and avoiding mixing of cormels
7. Before planting, the stored corms or cormels should be exposed or few days in at room temperature

### **Pest Management**

Like other cut flower crops, Gladiolus is also attacked by various pests if not properly managed. Sometime the attack of pests is so severe which lead to complete loss of crop especially in case of diseases. Hence one should follow recommended practices to prevent pest incidence. Some of the pests and their management practices are discussed in the book

### **Weed Management**

Weed is an undesirable grass which grows with the main crop and competes for nutrients and water. Weed also competes for space and takes away essential nutrients and thus affects the quality and yield of the crop. These unwanted grasses that grows with the main crop also affect the quality of Gladiolus crop hence proper management before the onset is required to get rid of weeds

## Weed Management Practices

Mulch helps in preventing the growth of weeds around the plant and helps the plant to utilize the growth and development sources. Planting space should not be less than 30 to 45 centimeters to ease the intercultural operations and also prevents the plant to compete for space. Regular weeding and hoeing is required as and when weeds are seen. First weeding is required to be done after three weeks of planting corms and second before application of nitrogenous fertilizers. Chemical control of weeds is done by application of Glyphosate or Paraquat one or two weeks before planting

## Insect Management

Because of its brightness and varied ranges of colors, the plant gets easily attracted by insects where there are many insects which either suck the cell sap from leaves or flowers or chew away the plant parts thus contribute in crop loss if not managed timely and with proper practices. Some of the common insects that affect the crop are discussed in this section of the book

**Thrips:** Thrips are very minute insects that feed on plant parts and suck the cell sap from leaves, flowers and also cause damage to corms. This results in white silvery patches on leaves and distorted flowers with yellow patches. The damaging stage of this insect is nymph. The dark colored varieties are mostly affected which is clearly visible. Corms are also affected by thrips as the insect enters the corms and feed on it if the plant is left on field for longer duration. Thrips can be controlled by dusting with Carbaryl, keeping low temperature during storage of corms and removing affected plant parts

**Spider Mites:** This is a very minute pest which is not clearly visible to the naked eyes. It sucks the leaves of plant and distorts them. Spider mite is a serious problem if not managed at their earlier stages of incidence. Application of Kelthane at the rate of 3 to 4 milliliter in 10 liters of water controls the incidence effectively. Also the cultural practice to apply water forcefully on the attacked surfaces of leaves control the further spread

**Aphids:** Aphids are sucking insects that suck the cell sap from shoots, leaves and flowers and discolor the surface. The plants affected by aphids become weak and produce deformed flowers. This also results in infection of Sooty mould disease. The chemical treatment to control the insect is application of dimethoate at the rate of 3 milliliter per 10 liter of water

**Bud Worm:** Bud worms also affect the crop in some regions. Caterpillar stage is the damaging stage in Bud worm which feed on the leaves, and flower buds of the plant and make holes. Removal of the affected portions and regular hoeing controls the incidence of Bud Worm

**Painted Apple Moth:** The damaging stage of Apple moth is its larvae or caterpillar. This stage feeds on plant parts for food and distorts and deforms the plant completely leaving no portion unfed. This insect is generally active throughout the year. Removing affected plant parts and application of Dimethoate at the rate of 3 milliliter in 10 liter of water effectively control the pest incidence

### **Disease Management**

Like insects, the crop is also affected by diseases and result is complete loss if timely management is not done. Mostly the fungal diseases infect the crop which is discussed in details in this section

**Fusarium Yellow or Wilt:** Fusarium wilt is one of the most serious diseases in Gladiolus that affects the plant including corms. The disease infection is identified by yellowing of older leaves (initially one sided which extends to another side also) and stunting. The disease also spreads up to the corms that start from blackening of bases of roots. The plant ultimately becomes brown and dies. The incidence is seen when humidity is high. Uprooting and burning of the affected parts control the disease spread

**Corm Rot (Hard Rot):** The symptoms of the infection are identified by the leaves with brown or purple spots which are circular in appearances. The fungus also affects the corms which produce the symptoms of hard rot with brown to black rotten areas. The infected plant parts including corms should be thrown away immediately as the spread of this disease is very fast

**Dry Rot (Scelerotenia):** The disease spreads when soil moisture is very high mostly in heavy soils that have poor drainage. The infected plant parts are leaves, stem, roots and corms. The infection discolors the plant completely and in corms there are sunken black or brown spots. The disease is controlled by following cultural practices on regular basis. Application of Benlate fungicide is also beneficial

**Botrytis Leaf Spot:** The major symptoms in the plants affected by Botrytis Leaf spot are small and brown centers that have defined boundaries on the leaves. Gradually the stem and corms also get affected. Spraying Benlate at the rate of 1 gram in one liter of water or soaking the corms in same amount before storage and planting are some of the control methods of this disease

**Stemphyllum Leaf Spot:** The disease results in yellowing and failure to blooming in Gladiolus and under high infestation the plant completely distorts and dies. There are small and rounded yellow spots on leaf surfaces which extend towards the tip of the leaf. The dead and diseased plants are removed and burnt completely to prevent the spread

**Neck Rot (Scab):** Neck rot is a bacterial disease which infects mostly in heavy soils which are poorly drained. The leaves show the symptoms of tiny and reddish brown dots which are numerous

on the bases of leaves.

Oozing is also seen on

leaves and corms also

show the symptoms like sunken spots which are circular in appearances.

The disease mostly occurs when the environment conditions are hu-



mid. Crop rotation is advised in the areas having this disease. In addition, regular cultural practices are also required

## Post Harvest Management

**Spikes:** For commercial purposes, it is very important to concentrate on post harvest management as quality of the spike decides how much prices the produce will fetch. Since Gladiolus is very perishable crop which losses its value if the produce is not handled properly. The spikes after harvesting at their desired stage are dipped in water. The life of the spikes is elongated when these are treated with flower preservatives. Other than harvesting time and use of preservatives, there are certain other technologies which help in increasing the shelf life of the flower

**Harvesting Stage:** The proper time of harvesting is already discussed in earlier section (Harvesting and Yield). Care should be taken to avoid water loss from the spikes

**Use of Preservatives:** To keep the spikes fresh until these reach to the end customers and to increase the vase life, Silver Nitrate Solution is considered to be very effective. Other solutions which are also used for the same purpose are ethylene inhibitors, mineral salts, solution of Hydroxyquinoline Sulphate and Sucrose

**Pulsing Solution:** Pulsing solution are generally used for the flowers which are to be transported to long distances, enhancing bud opening and increasing vase life of the produce. Pulsing solutions of Silver Thiosulphate or Silver Nitrate, Calcium Chloride, and Calcium Nitrate are greatly used by commercial growers

**Packaging:** The spikes are wrapped in polythene sheets and packed in Corrugated Fiber Boxes. Generally box sizes of 1.1m X2.5mX0.1m sizes are used for packaging

**Cold Storage of Spikes:** Spikes are kept in cold storage chambers mainly for long distance transportation. The already pulsed spikes of gladiolus are stored in cold chambers at a temperature of 4 degree Celsius for 6 days

*Ethylene Inhibitors-* Ethylene is required by plants for ripening. In Gladiolus it is required to stimulate flowering hence to inhibit the flowering for some duration to increase the vase life (by reducing the secretion of ethylene); inhibitors like Aminoxyacetic Acid (AOA), Sucrose Solution are used to treat the spikes

**Corms:** It is already discussed in harvesting section about the time and method of digging corms from the ground. The corms along with cormels should be dug with the help of a spade. As some of the cormels grow deep under the soil hence in order to dig out all of them, soil should be dug to an extent of maximum depth but care should be taken not to injure the corms and cormels with the blade of spade. In this section, all the processes regarding post harvest management of corms is discussed. All the corms where signs of infection are found should be discarded from the lot. This will help in preventing spread of the diseases in other corms

**Curing of Corms:** The corms and cormels after removing all the soil (process of Cleaning) and infected ones are cured which is an essential practice before storing them for longer duration. It is done by spreading the corms and cormels separately in trays and kept under shade for about 2 to 3 weeks. The temperature should be in the range of 60 to 70 degree Celsius

#### **Important Points in Curing**

1. Each variety should be cured separately
2. There should not be any particle of soil left outside the corms and cormels
3. The place should be well ventilated and dry in addition to proper shade
4. The old and infected corms and cormels should be removed before the process starts

#### **Grading of Corms**

The corms and cormels which are cured separately (variety) are then graded according to different grade sizes. It is also one of the important post harvest practices for Gladiolus as the storage temperature of some of the exotic varieties varies on the basis of sizes

**Storing Corms:** For storing Gladiolus corms, there are certain criteria for storage chamber. The chamber or room should be dark and ventilated where the temperature should not go beyond room temperature (27 degree Celsius). The cormels on the other hand should be kept on plastic perforated trays and stored. Some of the cormels due to poor ventilation also decay hence turning the corms on regular basis and removing the rotten ones is necessary. Some of the varieties (especially exotic) are stored taking care of their sizes and hardness. The larger sized are stored in cold storage chambers whereas the cormels which have comparatively small size can be stored at room temperature but care should be taken to avoid mixing. In order to prevent rotting, corms and cormels are sometimes soaked in fungicides like Benlate at the rate of 1 milliliter in a liter of water or Captan at the rate of 2 milliliter in a liter of water

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