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Ready Reckoner on Cultivation of Gladiolus

ICAR Research Complex for Goa

(Indian Council of Agricultural Research)

Old Goa - 403 402, Goa, India.

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Dr. Safeena S.A
Dr. M. Thangam
Dr. S. Priya Devi
Dr. A.R.Desai
Dr. V.Arunachalam
Dr. Mathala Juliet Gupta
Dr. N. P. Singh

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Published by:
Dr. Narendra Pratap Singh
Director
ICAR Research Complex for Goa
Ela, Old Goa – 403 402.

Fax : 0832-2285649
Phone : 0832-2284678, 2284679
E-mail : director@icargoa.res.in
Website : http://www.icargoa.res.in

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Technical assistance: Sidharth K.Marathe and Ms. Anabel Rita Alphonso

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गोवा के लिए भा. कृ. अनु . प . का अनुसंधान परिसर
(भारतीय कृषि अनुसंधान परिषद)
ICAR Research Complex for Goa
(Indian Council of Agricultural Research)
Old Goa - 403 402
Tel.: 0832-2284677/678/679
Fax: 0832-2285649
Email: director@icargoa.res.in

FOREWORD

डॉ. एन. पी. सिंह
निदेशक
Dr. N. P. Singh
Director

Floriculture is increasingly regarded as a viable diversification from the traditional field crops because of higher returns per unit area. Flowers are intricately entwined in the social fabric of our nation and no function is complete without flowers. Indian floriculture industry has recently witnessed commendable changes which have transformed it from a hobbyist activity to a commercial enterprise. Indian floriculture industry has been shifting from traditional flowers to cut flowers for export purposes. The area under flowers has crossed to 2.32 lakh hectares during 2012-'13 which is concentrated mostly in Tamil Nadu, Andhra Pradesh, Maharashtra, West Bengal, Karnataka, Kerala, Himachal Pradesh and Uttarakhand with a production of 1729.21 thousand MT of loose flowers and 76731.85 million of cut flowers. The country has exported 27,121.88 MT of floriculture products to the world for the worth of Rs. 423.46 crores in 2012-'13. Floriculture products mainly consist of cut flowers, pot plants, cut foliage, seeds bulbs, tubers, rooted cuttings and dried flowers or leaves. The important floricultural crops in the cut flower trade are rose, carnation, chrysanthemum, gladiolus, gypsophila, orchids, anthuriums, tulips, lilies etc.

Gladiolus is one of the most important bulbous plants in flower trade and is valued for its beautiful flower spikes. The flowers have brilliant colours, attractive shapes, varying sizes and excellent keeping quality. It is ideal for both garden and floral decoration. The florets open in sequence and hence it has good keeping quality of cut spike. Three important factors for a successful floriculture venture viz., favourable climatic conditions for growing of wide range of flower and foliage plants, sustained domestic as well as export demand for flower crops with good transport facility and ready support from the Government and policy makers to make the floriculture a profitable venture are very much available in the state of Goa.

ICAR Research Complex for Goa has played an important role in the promotion of gladiolus cultivation in Goa. The institute has also played an important role in the improvement of the livelihood of the farmers under the TSP (Tribal Supply Plan) by supplying corms of improved varieties of gladiolus. In this endeavour, ICAR is publishing a technical bulletin entitled **"Ready Reckoner on Cultivation of Gladiolus"** authored by Dr. Safeena S.A, Dr. M. Thangam, Dr. S. Priya Devi, Dr. A.R.Desai, Dr. V.Arunachalam, Dr. Mathala Juliet Gupta and Dr. N. P. Singh. This bulletin includes information on the classification, soil and climate, varieties, propagation, planting, nutritional requirements, irrigation, cultural practices, curing of spike, vase life, plant protection, harvesting, storage of corms and yield of Gladiolus. This would be of immense use to flower crop growing farmers of Goa. I congratulate the authors for their efforts in compiling and bringing out this technical bulletin on gladiolus.

(Narendra Pratap Singh)
Director

PREFACE

Flowers are closely associated with mankind from the dawn of civilization. Flowers, the crowning beauty of God's creation, are an inseparable part of human joy and sorrow. Floriculture is a lucrative enterprise having an edge over other horticulture and field crops. Gladiolus is one of nature's most beautiful creations and is an important flower crop, grown commercially in many parts of the world. It belongs to the family Iridaceae and genus Gladiolus. It is favoured for its attractive flowers, which grow on long spikes and open sequentially resulting in good keeping quality of the cut flower. It can be grown in any type of soil provided it is well drained. For its good performance, it prefers a sandy loam soil, rich in organic matter. Earlier gladiolus was considered as a crop for temperate regions and its cultivation was restricted to the hilly areas, particularly in the north eastern region, which still continue to supply the planting material to most parts of the country. However, with improved agronomic techniques and better management, the cultivation of gladiolus has increased throughout the country.

ICAR Research Complex for Goa has played an important role in the research work on gladiolus. The institute has also been instrumental in generating awareness and interest among the farmers of Goa in order to increase the cultivation of Gladiolus in the state while simultaneously improving the livelihood of the farmers. There is a need to publish a brief bulletin covering important aspects of the cultivation of gladiolus in Goa. Hence, a sincere attempt has been made here, to compile the information on various aspects of gladiolus cultivation viz., classification, soil and climate, varieties, propagation, planting, nutritional requirements, irrigation, cultural practices, curing of spike, vase life, plant protection, harvesting, storage of corms and yield. With this background, this technical bulletin titled 'Ready Reckoner on cultivation of Gladiolus' is being published as a result of the research work carried out at ICAR and with the hope that it serves as a precise guide cum reference to all those dealing with this crop.

The authors wish to express their sincere thanks and gratitude to Dr. N. P. Singh, Director, ICAR Research Complex for Goa for permitting us to publish this technical bulletin with the financial support from the Tribal Sub Plan (TSP), Govt. of India. Authors are also greatly indebted to the Director for his support and constant encouragement throughout the course of the publication of this bulletin.

Authors

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Introduction

Gladiolus (*Gladiolus hortensis* L.), the queen of bulbous flowers, belonging to the family *Iridaceae* and subfamily Ixoideae, is one of the most popular ornamental bulbous plants grown commercially for its fascinating flowers in many parts of the world. It is one of the most important ornamental crops having a pivotal place as cut flower both in the domestic as well as the international market. Gladiolus was introduced into cultivation towards the end of the sixteenth century. Most of the wild species (approximately 300) of gladioli have their centre of origin in Africa, particularly in and around South Africa, but a few species are also from the Mediterranean and adjoining areas of Europe. Ploidy in the genus ranges from diploid (2n = 30) to dedecaploid (2n = 12x = 180). The genus was named by Tournefort and this generic name is derived from the latin word 'gladius' meaning 'sword' on account of the sword – like shape of its foliage. Popularity of this crop as a cut flower is increasing day by day because of its keeping quality and inexhaustive range of colours of the spikes. This Gladiolus is a slender herbaceous perennial with sword shaped phyllode leaves, grown both for gardens and floral decorations. From the commercial point of view, mainly, it is very important due to its majestic flower spikes having florets of varying shapes, sizes, colours and excellent keeping quality. Gladioli grow from rounded, symmetrical corms that are enveloped in several layers of brownish, fibrous tunics. Their stems are generally unbranched, producing 1 to 9 narrow, sword-shaped, longitudinal grooved leaves, enclosed in a sheath. The lowest leaf is shortened to a cataphyll. The leaf blades can be plane or cruciform in cross section. The flower spikes are large and one-sided with bisexual flowers, each subtended by 2 leathery, green bracts. These flowers are variously coloured, pink to reddish or light purple with white, contrasting markings, or white to cream or orange to red. Gladiolus is relatively easy to grow and is ideal for bedding and exhibition. The flowers are used in flower arrangement, in bouquets and for indoor decorations. It is gaining popularity in India as one of the main decorative flower. Demand of its cut flower for bouquet and other floral arrangement is increasing day by day due to its long vase-life and economic value.

Classification

A. Horticultural Classification

There are four types of gladioli based on the size and shape of the flowers. For horticultural purposes, gladioli are grouped as follows

Large flowered (Grandavensis) Hybrids:

The large flowered gladiolus is more suited for garden display than floral decorations with triangular overlapping florets. The flower spikes grows to a height of 120 to 150 cm, are strong and erect, with florets of 10 to 15 cm across, closely arranged, triangular and symmetrical flowers and flowers late in the season

Primulinus

Primulinus gladiolus has slender spikes with separate wide florets arranged in a zig-zag pattern. They bear hooded flowers which are smaller in size. The spike grows to a height of 100 cm and bears florets of 5 to 10 cm across. It is a mid- season flowering type.

Miniatures

Miniature gladiolus, popularly known as 'Pixiola', are the daintiest, with upper petal slightly hooded and smaller florets having frilled or ruffled petals These are preferred for forcing under glass or for growing in pots or bowls. Colvillea, Nanus, Byzantinus, Gradis and Tristis are some of the popular cultivars in this category. The spike grows to a height of 60 to 100 cm, with florets of 5 to 7.5 cm across, good for cutting and early flowering type. They include butterfly hybrids which possess spikes up to 36 cm in length. Edges of the petals are often frilled and ruffled with individual florets about 6 cm in diameter, having most distinctive throat markings.

Peacock Hybrids

These are good for cutting, dwarf in height, multi coloured sorts with reflexed petals

Star flowered

These types bear flat star – like flowers, a race raised by Unwins of Cambridge, England

B. Commercial Classification

For commercial purposes, gladiolus are classified on the basis of spike length and floret number. These classifications are given below

Classification of Gladiolus on the Basis of Spike Length and Floret Number

Grade	Spike Length (cm)	Minimum Floret Number
Fancy	>107 cm	16
Special	>96 cm to ≤ 107 cm	15
Standard	>81 cm to ≤ 96 cm	12
Utility	≤ 81 cm	10

C. Classification of Gladiolus based on the size of the floret

Depending on the size of the floret, gladiolus are classified as follows

Type	Floret size (cm)
Miniature	<6.4 cm
Small	≥6.4 cm to <8.9 cm
Decorative	≥8.9 cm to < 11.4 cm
Standard or Large	≥11.4 cm to <14.0 cm
Giant	>14.0 cm

D. Classification of Gladiolus on the basis of colour

White, yellow, orange, salmon, pink, red rose, lavender, violet, smokes, tan and brown. In each colour pale, light and medium deep, etc. are also considered.

Soil and Climate:

Gladiolus prefer sunny situation and hence site selected for gladiolus planting should be sunny protected from stormy winds, by wind breaks or hedge. They will not do well if planted close to trees, shrubs, buildings and in low, poorly drained places. Well drained fertile loamy to sandy loam soil with the pH of 6.5-7 is highly preferred for gladiolus cultivation. Highly acidic and alkaline soils should be avoided. Clay soil is not suitable for gladiolus cultivation. Adding sand to make it porous can amend light clay soil. Water logged, heavy sticky soil will result in decaying of corms as well as delay in growth of plants. Therefore heavy soil should be supplied with sand, decomposed leaves and organic manure. Thorough incorporation of these materials into the soil and judicious cultural practices will improve the physical texture of the soil. Organic matter should be incorporated into sandy soils by heavy application of manure. The added organic matter will help in retention of moisture and prevent leaching of fertilisers. It produces bigger size flowers in areas with moderate humidity.

Favourable temperature range for growing gladiolus is between 27°C and 30°C.

Varieties

There are different varieties of gladiolus like Arka Gold, Darshan, Arka Amar, Arka Naveen, KumKum, KKL 1, Pusa Srijana, Pusa Unnati, Pusa Manmohak, Pusa Red Valentine, Pusa Vidushi, Pusa Gunjan, Pusa Bindiya, Pusa Subhangini, Nazrana , Jester, Novalux, American Beauty, Red Ginger, Summer pearl, Charms Glow, Tiger frame etc.

Description for some of the popular varieties of Gladiolus is given below.

Arka Amar: This variety is released by IIHR, Bangalore. Florets are pink in colour with white blotch. It produces 30.24 spikes /m^2 / crop season. It is high yielding and cut flower has a vase life of 8.5 days.

Arka Gold: This variety is released by IIHR, Bangalore. Florets are Yellow in colour with red blotch. It produces 24.80 spikes /m^2 / crop season. It comes to flowering 74 days after planting.

Arka Naveen: This variety is released by IIHR, Bangalore. Florets are purple with pale yellow blotch, wavy tepals. It produces 27.68 spikes /m^2 / crop season. Cut flower vase life is 9 days.

Archana: This variety is released by NBRI, Lucknow. It is a cross between G. Psittacinus 'Sylvia' x G. 'Friendship'. The spike is branched with a mean spike length of 80cm. The petals have a central white streak with the throat blotched with prime rose yellow. There are 16-18 florets/spike.

Aarti: This variety is released by IIHR, Bangalore. It is a cross between 'Shriley' and 'Melody'. It is a midseason variety requiring 70 days for flowering. Spikes are attractive and 93cm long. The florets are light orange with red and yellow blotch and red spots. There are 12-13 florets per spike. Cut flower life is 6 days.

Apsara: This variety is released by IIHR, Bangalore. It is a hybrid from the cross between "Black Jack' x 'Friendship'. It is an early flowering


Pusa Shubham


Darshan


Arka Gold


Arka Amar


Arka Naveen


Pusa kiran

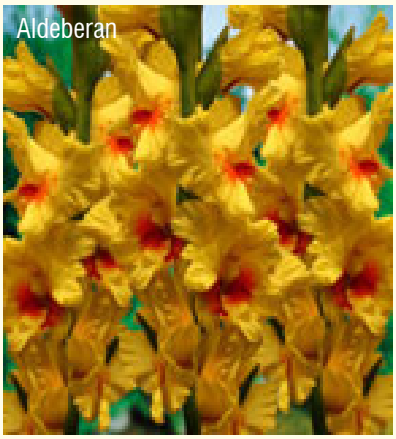

Jacksonville gold


Friendship


White goddess


Novalux


Jester


Aldeberan


Pusa Red valentine


Pusa Manmohak


Pusa Vidushi


Pusa Srijana


Pusa Unnati

variety, which flowers in 55 days after planting. The spikes are strong, dazling and 117cm long. The florets are purple with tight yellow flecks in the throat. There are 18 florets per spike. Cut flower life is for 8 days.

Aldebaran: It is an exotic variety having a mean spike length of 62cm. The petals are Straw Yellow in colour with throat blotched with Signal red colour. There are 12-14 florets per spike.

Basant Bhar: This variety is released by NBRI, Lucknow. It is a seedling produced by selfing G. 'Tunias Challenge'. Mean spike length is 50cm. The florets are Empire Yellow with throats speckled magenta. There are 14 florets/spike.

Friendship: It is an exotic variety having a branched spike with a mean length of 75cm. The upper outer lower petal and inner upper two petals towards the apex are dawn pink in colour. There are 18-20 florets per spike.

Gazel: This variety is released by NBRI, Lucknow. It is a seedling produced by selfing G. 'White Friendship'. Mean spike length is 35cm. The florets are Fuchsine pink with darker tips and linear shading while the throat is persian yellow. There are 14-18 florets/spike.

Grock: It is an exotic variety having a mean spike length of 72cm. The florets are oriental blue in colour with throat blotched violet purple and ruby red. There are 16-18 florets per spike.

Jacksonville Gold: It is an exotic variety having a mean spike length of 68cm. The florets are empire yellow in colour. There are 14-16 florets per spike.

Jwala: This variety is released by NBRI, Lucknow. It is a seedling produced by selfing G. psittacinus hybrid. The spikes are branched with a mean spike length of 65cm. The florets are Vermilion with sparingly spread long liner streaks of Vermilion. There are 14-18 florets per spike.

Manhar: This variety is released by NBRI, Lucknow. It is a cross

between G. 'Friendship' x G. 'tristis'. The spikes are one sided with a mean spike length 60 cm. The florets are Primrose Yellow and the tips of outer three petals are splashed with Tyrian Rose. There are 14-18 florets per spike.

Manisha: This variety is released by NBRI, Lucknow. It is a cross between G. 'Friendship' x G. 'tristis'. The spikes are one sided with a mean spike length 60cm. The florets are white with outer three petals splashed with Tyrian Rose colour more towards margins. There are 14-16 florets per spike.

Manmohan: This variety is released by NBRI, Lucknow. It is a cross between G. 'Friendship' x G. 'tristis'. The spikes are one sided with a mean spike length 80 cm. The florets are Primrose Yellow having irregular splashes of Orchid Purple colour at the tips of outer three petals. There are 14-16 florets per spike.

Mohini: This variety is released by NBRI, Lucknow. It is a cross between G. 'Friendship' x G. 'tristis'. The spikes are one sided with a mean spike length 60cm. The florets are white with outer three and inner upper petal heavily splashed with Tyrian Rose and lower inner two sparsely splashed with the same colour. There are 12-14 florets per spike.

Mukta: This variety is released by NBRI, Lucknow. It is a cross between G. 'Friendship' x G. 'tristis'. The spikes are one sided with a mean spike length 70cm. The florets are Sulphur Yellow with splashes of Orchid purple in irregular fashion. There are 12-15 loosely arranged florets per spike.

Meera: This variety is released by IIHR, Bangalore. It is from a cross between 'G.P.I' x 'Friendship'. It is an early flowering variety, which flowers in 58 days after planting. The spikes are robust, bewitching and 106cm long. The florets are snow white in colour. There are 18 florets per spike. Cut flower life is for 8 days. Ideal for cut flower and display purposes.

Phule Prerna: This variety is released from MPKV, Rahuri. It has variable pink shades on the dull

white coloured petals. It is an early flowering variety. Flower stocks are longer. There are 16 florets per spike. It produces 250 cormels per plant. Spike length 117 cm. Rachis length 60 cm. It produces 1.65 lakhs spikes per hectare. It has longer vase life (10 days). Less susceptible to wilt disease.

Pitambar: This variety is released by NBRI, Lucknow. It is a cross between G. 'Friendship' x G. 'tristis'. The spikes are branched with a mean spike length 64 cm. The florets are Uranium Green towards edge with throats having a streak of Orchid purple colour. There are 15-16 overlapping florets per spike.

Poonam: This variety is released by IIHR, Bangalore. It is from a cross between 'Geliber Herald' x 'R.N. 121'. It is a mid-season cultivar, which flowers in 61 days of planting. The spikes are 98 cm long. The florets are light yellow in colour. There are 17 florets per spike. Cut flower life is for 7 days. It is tolerant to Fusarium wilt disease.

Pusa Unnati: It is a gladiolus hybrid released from Indian Agricultural Research Institute, New Delhi. It is a cross between Berlew × Heady Wine (Tall). This attains a height of 158.66 cm and produced spikes having spike length of 141.00 cm and rachis length of 71.00 cm.

Pusa Manmohak: This variety is released from Indian Agricultural Research Institute, New Delhi. It is a selection among the progeny obtained from the cross of Mayur ×Hunting Song. It is a mid-maturing variety flowering in about 100-105 days and duration of flowering ranges from 20-25 days. The florets are saffron red with thin whitish stripes on the throat of two oppositely placed lower tepals. Spikes are more than 93 cm in length with good rachis length (>55 cm) and 19-21 numbers of florets per spike.

Pusa Srijana: It is a gladiolus hybrid released from Indian Agricultural Research Institute, New Delhi. It is a cross between Berlew × Heady Wine. Pusa Srijana attains a height of 103.22 cm having spike length of

85.25 cm, rachis length of 49.55 cm with 16.66 number of florets/spike.

Pusa Red Valentine: This variety is released from Indian Agricultural Research Institute, New Delhi. It is a selection among the open pollinated population of the variety Regency. It flowers in about 95 days. Spikes are straight and long with good rachis length (about 50- 55 cm) and have close arrangement of 18-19 florets on each spike. Florets are brick or blood red in colour with sun ray like small lines on the lower tepals which make them more attractive.

Pusa Vidushi: This variety is released from Indian Agricultural Research Institute, New Delhi. It is a selection among the progeny obtained from the cross of Melody x Berlew. It is an early and mid-maturing variety, first florets open in 80-85 days after planting. Spikes are straight with good rachis length and have 15-16 florets per spike. The florets are arranged compactly on the spike. At a time about 5-6 florets remain open which enhance the beauty of spikes when kept in vases. Florets are purplish white in colour with grey purple spots on base of the throat.

Sapna: This variety is released by IIHR, Bangalore. It is a hybrid from the cross 'Green Woodpecker x 'Friendship'. It is an early flowering variety, which flowers in 60 days after planting. The spikes are strong, magnificent and 83cm long. The florets are light yellow in colour with greenish yellow blotch and light red tinge on margins. There are 17 compact florets per spike. Cut flowers last for 8 days in vase. It is moderately tolerant to Fusarium wilt disease.

Shobha: This variety is released by IIHR, Bangalore. It is an induced mutant of var. 'Wild Rose'. It is an early flowering variety, which flowers in 60 days after planting. The spikes are pleasing and 105cm long. The florets are light pink with creamy throat. There are 18 florets per spike. The vase life of cut flowers is for 7 days.

Shree Ganesh: This variety is released from MPKV, Rahuri. It is a FI hybrid (Sancerre x Oscor), most promising in respect of growth;

flowering and corm and cormel production. Good acceptance in the market. The unopened florets (dorsal side) are pale yellow while fully opened florets (Ventral side) are dull-white. Longer vase life. Length of spike 117 cm,produces 19 florets per spike. Colour of spike is green. Placement of florets on spike is alternate and compact. Produces 2.15 corms and 69 cormels per plant. Average yield is 2.08 lakh spikes per hectare.

Smita : It is an Indian bred late season hybrid developed from a seedling of G. 'Lavanesque'. The mean spike length is 45 cm. The florets are China Rose in colour with darker margins. There are 14-15 florets per spike.

Triloki: This variety is released by NBRI, Lucknow. It is an Indian bred late season hybrid developed by crossing G. 'Friendship' x G. 'tristis'. The spikes are one sided with a mean spike length of 75cm. The florets are China Rose in upper half portion and Primrose Yellow in the lower half. The petals have splashes of China Rose along the margins. There are 14-15 florets per spike.

White Goddess: It is an exotic variety having a branched spike with a mean spike length of 65cm. The florets are white in colour with throat blotched violet purple. There are 17-20 florets per spike.

Propagation

Gladioli are propagated by seeds, corms and cormel. In each new growing season, a new corm is produced from the mother corm. Cormels are formed at the tips of branched stolons that develop from the buds located at the base of the new corm. Gladiolus can be commercially propagated by corms of at least 4-5 cm diameter. It should be healthy and disease free. Conical shaped corms are preferred over flat ones, as it gives better flowers. Lifting of corms is carried out 6-8

weeks after harvesting of spikes. The corms should be cleaned, dipped in 0.3% Captan 50 WP for 30 min and shade-dried at an aerated place for about 15 days. Corms are then packed in crates or in net bags and should be cold-stored at 3-7°C. From cold storage, these corms should be taken out one month prior to planting and kept at ambient conditions at an aerated place. Before planting the scaly portion of the corms are to be removed and they are dipped in mancozeb 2g or carbendazim 1g/lt of solution.

Planting:

To prepare the soil for planting, it should be spaded or ploughed to a depth of 30 cm to obtain the best flowers. Land is prepared during September - October and the corms are planted up to November. Even December planting is also recommended. To encourage sprouting, the brown dry scales or the tunics are removed. The corms should be disinfected properly before planting to reduce the chances of disease infestation. For prolonging the blooming period, (a) planting of corms of different grades, (b) planting of corms at 15 to 30 days interval, (c) planting of corms at different depths (7.5, 10 and 15 cm), and (d) use of early, mid-season and late varieties, etc., are helpful. Gladiolus corms which are healthy, disease free with diameter of 4 to 5 cm should be selected and planted at a spacing of 30 x 20 cm. Shallow planting of corms is essential. The depth of planting of the corms should range from 5 to 10 cm. Deep planting of corms will result into poor production of cormels and also cause decaying of corms. Generally, the performance of high crowned corms is better than large flat corms.

Nutritional Requirements:

FYM is mixed thoroughly in the soil while preparing the field for planting corms @ 20 tonnes/ha of FYM. 120 kg N, 150 kg P_2O_5 and 150 kg K_2O per hectare is recommended, of which 60 kg N and entire dose of P_2O_5 and K_2O is applied as basal dose. The remaining N is given in two split doses, 30 and 60 days after planting. i.e. first dose at 4-6 leaf

stage and second at earthing up stage i.e. 6-8 weeks after planting.

Irrigation:

Judicious use of water is possibly the most important single factor in the production of the best gladiolus spikes. A gladiolus crop must not be allowed to suffer from water stress especially when spikes are emerging. Regular irrigation at an interval of 7 to 10 days depending upon the weather is necessary. Over watering should be avoided. Irrigation should be withheld at least 4-6 weeks before lifting of corms.

Cultural Practices:

After the corms have sprouted well, watering should be done, if necessary. When the shoots are about 20 cm high they are covered by heaping the soil up to a height of 10 to 15 cm. Earthing up is essential after 6-8 weeks of planting corms, or before the emergence of spike. This enables the plants to grow erect despite high winds and rains, and suppresses weed growth. Earthing up the soil is a must in case of light soils. These plants need staking for its satisfactory growth and if not staked may fall or break by high wind velocity. In cases where the spikes grow longer or stems are not strong enough to bear the lodging or mild stroke of wind, they are supported with about 1.5 meters strong stakes. Strings instead of stakes may be used at the time of the appearance of the spikes. Strings are stretched between the stakes along the row to provide easy and adequate support. Staking is done when the plant attains the height of 15 cm in order to provide shelter from the wind.

Curing of Spike (Harvesting):

After planting the corms, gladioli comes into bloom in two to three months, depending upon the species and variety. Early flowering varieties start flowering within 80 - 90 days, while late varieties start flowering within 100-145 days after planting. The flower spike should be cut as close to the base as possible with a sharp knife or a scissors after the first floret on the spike has opened. Later on, the other flower buds i.e. florets on the same spike will open in a sequence, slowly starting from

below and continuing upward when placed in water. While harvesting or cutting of the spike, care should be taken that at least four to six basal leaves should be retained on the plant to ensure proper development of corms and cormels. This is vital for the new corms to have good flowers in the following year. For the internal market, flower spikes are cut when 1-2 lower most florets on the spike have opened and for the external market, when the colour has fully developed in mature unopened buds. Immediately after cutting, the spike should be immersed (upto 15 cm from base) in a bucket containing water.

Vase life

The various aspects of quality parameters of gladiolus cut flowers are their keeping quality, straight strong stems free from side shoots, uniformly spread florets with a specified number per spike, turgid florets facing in one direction, colour, freshness, foliage with proper length and free from damage, dust and spray residues, absence of insects, disease and bruising injury. Gladiolus

spikes are generally harvested with relatively few florets showing colour. Vase-life of gladiolus spikes varies from 5-10 days, depending upon the cultivar and room temperature. About 2.5 cm long basal ends of the spikes should be cut off and the spikes placed in acidic solution having pH between 3-3.5 to increase the shelf life. Spikes can also be kept in floral preservatives containing sucrose,8-HQC etc for enhancing the vase life.

Plant protection

Pests

Aphids, thrips, cut worms, loopers, grubs and nematodes are the common insect pests of gladiolus.

Cut worms *(Agrotis segetum)*

Grown up clay coloured larvae cut the plants at ground level. Plants are vulnerable to attack, up to the 3 leaf

stage. Cut worms also damage the underground corms and developing spikes. Plouging during summer exposes pupae to predators. Poison bait consisting of carbaryl or malathion at 0.1% in wheat bran and molasses in the field control the larvae.

Bulb mite *(Rhizoglyphus echinopus)*

This slow moving mite is about 0.5 mm long, globular, and yellow-white with brownish legs. Infested corms produce stunted plants with yellow and distorted leaves. Early infestations are found around the basal plate of the old corm. Roots are destroyed first and stems are attacked later. Corms can be completely destroyed by the combined action of the mites and micro-organisms that invade the damaged tissue. Hot water treatment will kill the mites, but good sanitation is very important when digging up, storing, or planting out corms.

Aphids

Several species of aphids like *Aphis craccivora, Aphis gossypii* and *Macrosiphum gossypii* attack gladiolus. They suck the sap from

tender shoots and produce flowers of low quality. They also transmit viral diseases. Aphids are slow moving, and plump bodied insects. The colour varies with the species and green yellow, pink, brown and black forms occur. Malathion (0.1 per cent) spray checks the infestation.

Thrips (*Taeniothrips simplex*)

Yellow coloured nymphs and black adults damage leaves and spikes by rasping tissues and sucking the sap. Affected leaves and spikes develop silver streaks, turn brown, get

deformed and dry when the attack is severe. Corms in storage are also attacked by thrips. Infested corms are sticky, get shrivelled and produce weak plants. Spray Acephate 0.1% 2-3 times at 10 days interval or spraying contact insecticides like Rogor, Metacid, Malathion etc. along with systemic insecticides like Thimet or Furadan to control thrips.

Loopers (*Trichoplusia ni and Pseudoplusia includens*)

They cause damage by feeding on the leaves. Dimethoate (Rogor) (0.2 per cent) spray controls them.

Grubs and beetles (*Altica sp.*, *Mylabris phalerata* and *Mylabris postulata*)

They attack leaves and flowers. They make holes on the leaves and feed on the petals of flowers destroying their floral beauty. Malathion (0.05 per cent) spray is effective in controlling them.

Nematodes (*Meloidogyne incognita* and *Trichodorus sp.*)

They cause damage to corms and roots of gladioli. Hot water treatment of corms and soil fumigants are remedial measures for them.

Diseases

Gladioli are infected by several fungal, bacterial and viral diseases. Gladiolus is highly susceptible to fungal diseases like wilt, corm rot, dry rot or neck rot, curvularia blight, storage rot, septoria leaf spot etc..

Fusarium corm rot or wilt *(Fusarium oxysporum f.sp. gladioli)*

It is a destructive disease of gladiolus. Fusarium attacks the corms causing fusarium corm rot. It attacks the vascular regions of the roots, corms and leaf bases. The initial symptom is yellowing of older leaves, whereas the inner leaves remain green. Spikes develop dark green colour and petals also develop a dark colour. In the advanced stages of the infection, the plants show wilting. Corms when cut open show

brown spots or streaks usually at the base. Rotting of corms, yellowing of leaves and distortion of leaves, stems and flowers, bending and cupping of leaf stalks and gradual yellowing and dying of foliage are the characteristic symptoms of the disease. In order to control the disease, it is advisable to destroy the infected corms from the field and to spray systemic fungicide like Bavistin on the soil as well as on the plants in the affected field. It is also suggested to treat the corms in a solution of Bavistin prior to planting in the field. Proper curing, crop rotation, Bavistin (0.2 per cent) spray and use of resistant varieties are remedial measures for the disease.

Leaf and flower blight *(Curvularia trifoli, C.eragrostidis)*

In warm and humid weather, round, irregular or elongated black and brown lesions develop on the corms. Leaves from cormels become curled and twisted at the apical region. Oval brown spots appear on the young leaves and later on spreads to stems and spikes which is caused by Curvularia fungus. Dark brown blotches appear on the stem. Proper curing and storing of corms and spraying with mancozeb 0.2 per cent weekly or with an interval of 10 days are effective for controlling the disease.

Neck rot or dry rot (*Stromatinia gladioli*)

Stromatinia causes neck rot, stunting the growth of the plant and forming brown or black spots on the corms. It causes premature yellowing of leaves. Later, leaves turn brown from the tips downward and decay at the basal region. Affected corms develop small, round and dark lesions which coalesce, forming an irregular area. Hot water treatments of cormels and spraying with Bavistin (0.2 per cent)or Captan (0.2 per cent) are effective in controlling neck rot.

Storage rot (*Penicillium gladioli*)

Treatment with Benomyl (0.2 per cent) and proper curing of the corms

are controlling measures for storage rot

Septoria Leaf spot (*Septoria gladioli*)

It appears as small, circular brown or purple brown spots with reddish centres. Affected corms show water-soaked circular brown to black lesions covered by scales. Use of copper oxychloride (0.3 per cent) or foliar application of Carbendazim @ 1 g/l or Mancozeb @ 2 g/l is recommended to control leaf spot

Core or corm rot (*Botrytis gladiorum*)

Affected corms become dark brown and soft and covered with a white mouldy growth. Infected leaves produce greying brown centres covered with masses of grey spores. Infection may spread inward through the leaf bases and cause stem rot. Vascular bundles show discoloration. Removal and destruction of the diseased plant parts and spraying with Maneb (0.2 per cent) are controlling measures for the disease.

Stemphyllum leaf blight (*Stemphyllum sp.*)

It produces small, circular yellow lesions with reddish centres on the leaves. Spots may coalesce to form irregular patches. In severe cases, all the above ground parts dry during flowering. Mancozeb (0.2 per cent) or copper oxychloride (0.3 per cent) spray control the infection.

Bacterial scab, blight and spots:

Dip the corms in 1:100 Mercuric chloride solution for 12 hours before planting.

Scale and neck rot (*Pseudomonas gladioli*)

It is the most important bacterial disease of gladiolus. It appears as small, circular reddish brown spots on the leaves which become dark at a later stage. The leaves may rot at the collar region.

Root-knot Nematodes (*Meloidogyne spp.*)

Gladiolus is also attacked by root-knot nematode causing wilting of the plants, stunted growth, yellowing of leaves and heavy galling on roots. Use nematode free planting material. Hot water treatment of corms at 57.8^{o}C for 30 minutes. Intercropping or crop rotation with marigold. Apply Furadan granules @ 8-10 q / acre or Carbofuran/Phorate (1g/m^{2}).

Harvesting and Storage of Corms:

Lifting of Corms and Cormels

After harvesting of flowers or spikes , plants are twisted down to ground level for allowing the corms to mature. Once the spikes are cut out, the leaves begin to turn yellow. Plenty of moisture, followed by a dry period, before lifting ensure the formation of large corms. Gradually the water supply is reduced till the leaves get dried naturally. After 3 - 4 weeks corms and cormels are lifted from the ground. Corms are matured when 25% cormels have become brown which generally take 30 to 45 days from flowering when the leaves also start yellowing. Corms and cormels should be dug out with the help of a spade. Soil should be dug deep in order to take out all the cormels. The corms are checked for any disease infection and the affected corms are discarded.

Storage of corms in perforated plastic trays

Curing

Curing is one of the essential post harvest operations for successful storage of corms. After lifting and removing the adhering soil, the corms and cormels of each cultivar are kept in trays in a shady but well ventilated place for about a fortnight. For curing, the layers of corms should not exceed three, which may be cured for five weeks at 21°C.

Cleaning, Grading and Storage

After the corms are fully cured, these are cleaned and diseased ones discarded. The old withered corms are taken out and cleaned. Treating the corms with 0.2% Captan 15 days before storage or dusting with 5% Cythione dust and Dithane M-45 protects them from insects, pests and diseases during storage. After cleaning, the corms and cormels are graded in different grade-sizes. The corms are stored in perforated trays in a well-ventilated cool and dark room with temperatures

not exceeding 27°C. Being smaller in size, the cormels are stored in plastic trays having fine perforations. It is advisable to keep on turning corms and cormels periodically, for preventing their rotting due to poor aeration. The corms are periodically checked during storage and the decaying ones are removed. The cormels of exotic cultivar vary considerably in respect of hardiness, depending upon their size. The small sized cormels (<0.5cm diameter) are fairly hardy and may be stored at room temperature, without decay. However, the large ones (>0.5cm dia.) of exotic cultivar require low temperature during storage and should be kept in cold storage. To avoid chances of mixing, the cormels are packed in hessian cloth bags before putting them in perforated trays for keeping them in the cold storage. Like corms, the cormels should also be taken out of the cold storage in the first week of October and kept at room temperature for a week before planting them in the ground.

Yield:

The yield of flower spikes and corms in gladiolus depends on variety, corm size, planting density and management practices. Gladiolus planted at a spacing of 30 x 20 cm yields approximately 1,50,000 marketable spikes per hectare. Additional income can be obtained from the sale of corms.

For further reading.....
Anon (2014). Accomplishments : Floriculture and Landscaping. http://www.iari.res.in/
Anon (2001). Gladiolus varieties. http://www.nhb.gov.in/flowers/gladiolus
Anon (2014). Gladiolus (Gladiolus spp). http://agritech.tnau.ac.in/horticulture/horti.html
Anon (2014). Varieties / Hybrids. http://www.iihr.res.in/varieties
S.K.Bhattacharjee and L.C. De. (2010)., Advanced Commercial Floriculture. Aavishkar Publishers, Distributors, Jaipur.
Sheela V.L. (2008). Flowers for trade. New India Publishing Agency, New Delhi

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