



**TRAINING MANUAL
ON
ENTREPRENEURSHIP DEVELOPMENT
THROUGH COMMERCIAL CUT
FLOWER PRODUCTION**

By
Dr. Madhumita Choudhury Talukdar
Ms. Sutrishna Bordoloi



**DEPARTMENT OF HORTICULTURE
COLLEGE OF AGRICULTURE
ASSAM AGRICULTURAL UNIVERSITY
JORHAT – 785 013**

N^o HEP

**TRAINING MANUAL
ON
ENTREPRENEURSHIP DEVELOPMENT
THROUGH COMMERCIAL
CUT FLOWER PRODUCTION**

By
Dr. Madhumita Choudhury Talukdar
Ms. Sutrishna Bordoloi



**DEPARTMENT OF HORTICULTURE
COLLEGE OF AGRICULTURE
ASSAM AGRICULTURAL UNIVERSITY
JORHAT – 785 013**

TRAINING MANUAL ON ENTREPRENEURSHIP DEVELOPMENT THROUGH
COMMERCIAL CUT FLOWER PRODUCTION: A training manual prepared by Department
of Horticulture and Published by IDP, NAHEP, Assam Agricultural University, Jorhat-13,
Assam.

Publisher :
IDP, NAHEP
Assam Agricultural University
Jorhat-13

First Edition : May, 2021

© Department of Horticulture
Assam Agricultural University

Printed at :
AAYAN'S World, Jorhat, Ph : 9854193113

Dr. Bidyut C. Deka
Vice Chancellor



ASSAM AGRICULTURAL UNIVERSITY
JORHAT-785013, ASSAM (INDIA)

(Recipient of Sardar Patel Outstanding Institution Award)

Foreword

I am happy to note that a training manual on “Entrepreneurship Development through Commercial Cut Flower Production” has been prepared by Dr. Madhumita Choudhury Talukdar and Ms. Sutrishna Bordoloi, Department of Horticulture for the benefit of the stakeholders including students. The manual encompasses important commercial flower crops currently grown in the state.

I sincerely believe that this manual will help our students to develop expertise and skill to become entrepreneurs in flower production and business.


(Bidyut C. Deka)

Preface

The cut flower production is the most important area of commercial floriculture. It has become essential to train our UG students on various aspects of commercial cut flower production including seed / planting material, cultivation practices, biotic and abiotic stress management, harvesting and post harvest management so that they could develop the required knowledge and skill to produce quality flowers with high yield. In view of the above, the training manual on “Entrepreneurship in commercial cut flower production” has been designed for use in the training programmers under NAHEP. The important commercial flower crops of Assam and NE India have been included and efforts have been made to include various aspects of each commercial crop like seed / planting material, cultivation practices, crop management, harvesting, post harvest management etc.

I sincerely hope that the training manual will be helpful in conducting the scheduled training under NAHEP and encourage our UG students to engage in floral business as successful entrepreneurs.

May, 2021

Madhumita
25.5.2021

Madhumita Choudhury Talukdar
Professor
Department of Horticulture
Assam Agricultural University
Jorhat 785013

CONTENTS

• Commercial cultivation of Marigold	1
• Commercial cut flower production of Tuberose	5
• Commercial cut flower production of Gladiolus	10
• Commercial cut flower production of Gerbera	14
• Commercial cut flower production of Chrysanthemum	19
• Commercial cut flower production of Orchid	27
• Commercial cut flower production of Anthurium	36

COMMERCIAL CULTIVATION OF MARIGOLD

(*Tagetes species*)

Marigold belonging to the Asteraceae family is one of the most important flowers that are commercially grown in Assam. It is very easy to cultivate and have wide adaptability to different soil and climatic condition. The habit of free flowering, wide range of color, attractive shape and size, short duration and good keeping quality have made this flower very popular among the growers for garden display as well as commercial cultivation.

The flowers are very much suitable for garland as loose flower. It is also suitable as a bedding plant, and is also ideal for newly planted shrubberies to provide color and fill the space. French marigold is ideal for rockery, edging, hanging baskets and window boxes. The leaves of marigold contain some medicinal properties. The essential oil present in the flowers is used in the perfumery industries.

Field preparation and planting:

The soil should be prepared well, 4 kg well decomposed FYM/ m² area should be incorporated in the soil. The application of excess manure causes more vegetative growth resulting less flowers. The quality of the blooms also deteriorated. At the time of transplanting, the seedling should bear at least 3-4 true leaves. Very old, thin and lanky seedlings should be discarded. After planting, the soil is pressed well around the root zone to avoid air pocket and light irrigation is provided. The corresponding transplanting time for rainy, winter and summer season is mid July, mid October and Feb- March respectively.

The spacing varies according to the cultivars. For most of the cultivars of African marigold, spacing of 45 cm x 45 cm and French marigold a spacing of 20 cm x 20 cm is suitable for Assam condition.

Seeds can also be sown directly in permanent beds and thinned out after germination.

Types of Marigold:

Marigolds are broadly divided into two groups, namely African marigold and French marigold.

African marigold (*Tagetes erecta*): The plant is hardy, about 90cm tall, erect and branched. Leaves are pinnately divided. Flowers are single to fully double and large size of year round production globular heads. Flower colour varies from lemon yellow to yellow, golden yellow to orange. Some important cultivars of these groups are Pusa Narangi Genda, Giant Double African, Hajo Local Golden Glow, Cupid, Pot of Gold, Glitters, Guinea Gold, Seracole (summer Marigold) and hybrid var. Inca etc.

French marigold (*Tagetes patula*): The plants are compact, 30-35cm tall. Foliage is dark green with reddish stem. Leaves are pinnately divided. Flowers are single or double. The flower colours are varied from yellow to mahogany red. Some important cultivars in this group are – Harmony, Rusty Red, Sun Old, Star of India, Flame Spray etc.

Recently some interspecific hybrids between African and French marigold have been developed. The plants are intermediate in character, medium tall (about 60cm) with double flower measuring 5-7cm across and in colour combination of red to orange. Example: Nugget.

Propagation:

Cuttings:

About 6-10 cm long cuttings are made from the apical portion of the shoot. The basal portion is treated with growth promoting hormones. Cuttings are planted in sand and vermiculite and kept in shade. Light frequent watering is done and cutting usually takes 2-3 weeks to produce sufficient roots.

Seeds:

For raising seedlings, seeds are sown in pots, seed boxes or in raised nursery beds. Nursery beds are thoroughly prepared and should be sterilized by application of 4% formaldehyde. Boric acid should be dusted on the beds to avoid the ants carrying away the seeds. Seeds should be sown thinly and covered with a thin layer of a mixture of soil and sand. For entire period, the bed should be kept moist. The seedling should be pricked when they are 2-5cm tall, after about a month these are transplanted.

Maturing and fertilization:

The effect of N& P is significantly more on growth, yield and flowering of marigold. In both African and French marigold maximum plant growth and flowering is observed with the application of 10:10:10 NPK/m².

Interculture:

If pinching is done early, large number of auxiliary shoots arise resulting bushy plant with more number of uniform flowers. Generally, pinching is done 40 days after transplanting to get a higher flower yield.

Weeds are regularly removed otherwise it results a heavy loss of flower yield. Staking is also done, if necessary. Bamboo stakes are preferable for this purpose. Drainage of excess water is necessary during rainy season.

Irrigation:

At all stages of vegetative growth and during flower production, sufficient amount of moisture in the soil is essential. Moisture stress at any stage of development adversely affects normal growth and flowering.

During the summer and winter months, frequent irrigation at the intervals of 4-5 days required. However, during rainy season irrigation is required at a much longer intervals depending upon the availability of rainfall.

Intercropping:

Different winter season vegetables such as spinach, beet and coriander, french bean, cabbage etc. can be grown successfully as intercrop with marigold.

Harvesting and yield:

Marigold flowers are plucked when they have attained the full size. Plucking of flowers should be done in cool hours of the day either in morning or evening. Field should be irrigated before plucking, so that flower keeps well for longer period after harvest. Plucking is done easily by hand. Flower stalks are hollow and break easily when twisted between thumb and fingers. Plucked flowers are loosely packed in bamboo baskets for carrying to the market.

The average yield of French Marigold is 8-12 tones/ ha and African Marigold is 12- 20 tones/ha.

Disease and Pests:

Disease:

Damping off: It is a very serious disease at the seedling stage. Necrotic spots are developed causing the death of the seedlings. Sometime the roots are also damaged. Proper drainage and drenching of soil with Brassicol helps in controlling the disease

Leaf and flower blight (*Alternaria dianthi*)

Low temperature coupled with cloudy weather and continuous drizzling for more than 2 days have a significant role for the epidemiology of leaf and flower blight of both African and French marigold. Necessary prophylactic measures should be adopted in anticipation of such weather conditions. Three spraying with Mancozeb @ 2.5g/litre at 10 days interval will manage the disease.

Routine spraying of Mancozeb @ 2.5g/litre at 30, 40 and 50 days after transplanting will effectively protect the African and French marigold crops from the disease.

Pests:

Red Spider Mite: It is a very small insect attack the plants during flowering Spraying of Kelthane (2 ml/lit of water proves effective against this insect.

Hairy Caterpillar and Leaf Hopper: They damage the leaves by feeding and rolling of leaves. These can be controlled by spraying of Kalthene 2 ml/lit of water.

Economics of production:

Total cost of cultivation (Rs/ha) (Y1): 1,50,000.00

Yield (t/ha): 14.32

Gross return (Rs/ha) (Y2): 5,87,120.00

Net return: (Rs/ha) (Y3):4,37,120.00

Benefit cost ratio (Y3/Y1): 2.91

Note:

1. Yield of loose flower is calculated on the basis of net cropped area.
2. Out of total number of flowers 10% of it is considered as unsold due to different environmental and handling factors.
3. Sale price of loose flower: Rs. 41,000.00 per ton of flower



Marigold cuttings



Cultivar: Seracole



Marigold cultivation



Marigold Harvesting



Harvested Marigold



Garland making

COMMERCIAL CUT FLOWER PRODUCTION OF TUBEROSE (*Polianthes tuberosa*)

Tuberose (*Polianthes tuberosa*) belongs to the family Amaryllidaceae is an important bulbous ornamental plant, which are used for cut flowers and loose flowers. The flowers remain fresh for a long time and can withstand long distance transportation. The loose flowers are used for making garlands, floral ornaments and decoration. The long flower spikes are excellent as cut flowers for table decorations and bouquet making. They are also excellent source for extraction of essential oil. Bulbs contain an alkaloid lycosine and possess a number of medicinal properties. It is Native of Mexico, and then spreads to other parts of the world. In India, tuberose is commercially grown in Karnataka, Tamil Nadu, Maharashtra and West Bengal and Assam. In Assam, tuberose is commercially cultivated mainly in Hajo of Kamrup district and sporadically in other places.

Land Preparation

The site should be sunny with good drainage facilities. Land has to be thoroughly ploughed 2-3 times during February –March and soil has to be brought to a fine tilth. Suitable soil for tuberose is loam and sandy loam having a pH range of 6.5 – 7.5 with good aeration and drainage. Soil should be rich in organic matter and retain sufficient moisture for proper growth. Tuberose is grown in tropics and sub-tropics. Commercial cultivation is mainly confined to warm & humid areas with temperature range of 20-35 °C.

Selection of cultivars and planting material:

Cultivars: There are mainly two popular types in commercial cultivation

Single: In this type flowers have only one row of corolla segments and are more fragrant than other types. Example- Calcutta Single, Mexican Single. Guwahati single s Phule Rajani. There are two hybrid viz. Shingar and Prajwal. (Released by IIHR). Hybrids yield 40% higher flower yield than local varieties. A gamma ray induced variety, Rajat Rekha has been released by NBRI, Lucknow.

Double: In this type, flowers have more than three rows of corolla segments and flowers are less fragrant used for decoration in vases. e.g. Calcutta Double, Mexican Double. There are two hybrids viz. Suvasini and Vaibhav Yield is 25% higher flower yield than the local double type. A gamma ray induced variety, Suvama Rekha was released by NBRI, Lucknow. Bulbs should be stored for 4-6 weeks before planting. Size of the bulb should be more than 2.5 cm diameter (30-35 g wt) with a spindle shape.

Collection of planting material

Planting material should be collected from well known nursery with known variety

Preparation of planting materials:

Tuberose is mainly propagated vegetatively through bulbs. It is essential to select good planting material for obtaining higher yield and good quality flower. After harvesting of bulb, it should be stored for 4-6 weeks. It is better to avoid fresh bulb, as it will result more vegetative growth. The size of the bulbs plays an important role in growth and production of flowers and

bulbs. Optimum bulb size is 2.5-3.0 cm diameter for planting. Although large bulbs causes slight delay in sprouting, results in early flowering, higher yield of spike and loose flower. Clumps are cleaned; bulblets are separated and graded before planting. The bulbs are treated with fungicides like Bavistin / Indophil M-45, 1.5 g /lit water for half an hour.

Planting of bulbs:

The planting time varies from place to place depending on climatic conditions. Time of planting in plains is February/March/ and in hills April-May. Raised beds of 20 to 25 cm should be prepared for planting of tuberose bulb. Depending on the size of the bulb depth of planting varies. Larger size bulbs are planted more deeply as compared to smaller bulbs. Therefore, depth of planting varies from 3-10cm from the soil surface. Plant growth, yield, quality, bulb production is markedly influenced by depth of planting. Spacing may be 30 x 30 or 30 x 20 or 25x 25cm. For high density planting 20 x 20 cm spacing can be used, thus accommodating about 90,000; 1,50,000; 1,60,000 and 2,50,000 bulb/ha.

Fertilizer Application

Depending on soil type and climatic conditions, the nutrient requirements of the crop vary from place to place. It is very essential to get soil tested before planting for PH and for the available nutrient content for both major and minor nutrients. Application of 3-4kg FYM/m² during the time of land preparation and 40:20:40 g NPK per m² should be applied before planting. Out of this half of N and full dose of P₂O₅ and K₂O should be applied and other half of N should be applied after 45 day of planting of bulb. Application of boron is also important for quality flower production and yield.

Mulching:

To reduce weed growth and conserve moisture, mulching can be practised in tuberose cultivation. Black polythene mulch of 50 micron can be used as a mulching material before planting. Some holes are prepared in the specific spacing and bulbs are planted in the holes. Mulching increases yield and flower quality. Winter months are lean period for tuberose but mulching helps in enhancing flower production throughout the year.

Interculture and aftercare: After sprouting, the plants are to be irrigated. It is important to do earthing up and weeding regularly so that growth and production of the crop is not affected. Removal of weed helps in reducing competition for nutrients with the main crop. Earthing up will also helps in loosening the soil and improves the soil aeration. Pre-planting application of atrazine at 3.0 kg a.i per hectare also reduces weed population.

Regulation of Flowering:

Regulation of flowering is an important consideration in commercial flower cultivation. To obtain continuous flowering throughout the year, staggered planting at 10-15 days interval is required.

Irrigation: Proper irrigation for the purpose of supply regular moisture is essential for the growth and development of tuberose plant. The available soil moisture is essential for the growth and flowering. The frequency of irrigation is also dependent on soil type, stage of growth and weather conditions. It is better to irrigate before planting and avoid further irrigation till bulb development. Irrigation should be done once in a week during the period of dry season. During summer irrigation will depend on the rainfall, thus depending on rainfall, irrigation can be done once in 10dys interval.

Interculture and aftercare: After sprouting, the plants are to be irrigated. It is important to do earthing up and weeding regularly so that growth and production of the crop is not

affected. Removal of weeds helps in reducing competition for nutrients. Earthing up will also help in loosening the soil and improves the soil aeration.

Plant protection: There are no serious pest and diseases.

Insects:

Among the insects Aphids, Thrips and caterpillars become problematic. Aphids damage the flower buds and growing points and the thrips feed on leaves, flower stalk and flowers by sucking the sap.

In severe infestation the inflorescence is malformed.

Control: Application of malathion 0.1% is effective for aphids and thrips.

Diseases:

Stem rot: Stem rot is caused by sclerotium is an important disease in tuberose cultivation. Mycelial growth on leaves at or near the soil is the initial symptom. The infected spot lose green color due to rotting which gradually extend and cover the whole leaf. Further the leaves get detached and fall on the soil surface.

Control: Dipping of bulbs in Captan (0.3% for 30 minutes before planting followed by drenching soil also with Captan (0.3%) @ 10 l/m² at monthly interval for three months is recommended. Alternatively, bulbs before planting are dipped in Trichoderma viride(10g/l) followed by soil application of Trichoderma viride(100g/m²) mixed with 1kg FYM at the time of planting is recommended.

Leaf Blight: For management of leaf blight of tuberose, spraying of Chlorothalonil or Iprodione+ Carbendazim (Quintal) @ 0.2% or Carbendazim (0.1%) at 10 days interval is recommended.

Ratooning:

Fresh planting should be done after 3 years. But for quality flower production replanting is done every year. Regular and frequent weeding should be done. Half dose of recommended fertilizer should be applied during the 2nd year and 3rd year of the ratoon crop.

Intercropping:

Intercropping with vegetables like carrot, French bean, Pea can be done and growing of tuberose in-between guava plantation is also beneficial.

Harvesting and post harvest handling:

Harvesting for local market should be done when half of the florets open in spike and for distant market ideal stage for cutting spike is when first pair of flowers are open. Harvesting should be done in cool hours of the morning or evening. Loose flowers are harvested for making garlands and other floral ornaments. Immediately after harvest the spikes are kept in water.

Vase life:

Use of holding solution containing potassium permanganate (25ppm) extends vase life upto 10 days. Sucrose is very much effective in promoting the vase life of fully opened flowers.

Grading:

The flower spikes are graded according to the stalk length, length of rachis, number of flowers per spike and weight of spike. Straight and strong with uniform length are preferred. Flowers should be free from pest and diseases and completely free bruises. Florets are graded according to their sizes for loose flowers.

Packaging:

Loose flowers are packed in bamboo baskets are lined on the sides and the top with hessian cloth. Cut flowers are made into bundle containing 100 spikes. The stem portion of the bundle is wrapped with wet newspaper. Soft tissue paper or thin polythene sheets can be used for packing the entire bundle in order to avoid damage including flowers and buds. These bundles are packed in rectangular bamboo basket lined with hessian cloth or cardboard boxes or cartoons and transported.

Lifting, curing and storage of bulb:

Bulb reaches maturity at the cessation of flowering during winter. At this stage irrigation is withheld and the soil is allowed to dry. Before digging out the bulbs, the leaves become dry and the bulb attain dormancy. The leaves are then cut off at the ground level and the bulbs are dug out. The bulbs are lifted out and soils removed from it. These bulbs are stored in protected shady place for 4-6 weeks at 11-27°C temperature. After 6 weeks these bulbs are separated by hand. The bulbs are then graded in size and ready for planting for the next season.

Selling of cut flower in local market:

The produced cut flowers are marketed in the local market. The vendors of flower shops used to come to purchase and carry cut flowers to their shops.

Economics of production:

- i) Total cost of cultivation (Rs/ha) (Y1) : 5,68,596.00
- ii) Gross return from spike (Rs/ha) :
10% lost of flower due to environmental & handling factors $3,50,000 \times \frac{10}{100} = 35,000$
Therefore, total spike yield = 3,50,000 - 35,000 = 3,15,000
Gross return = 3,15,000 x 8 = 25,20,000.00
- iii) Gross return from bulb (Rs/ha):
5% bulb is unsold due to different factors $10,000 \times \frac{5}{100} = 500$
Therefore, total bulb yield = 10000 - 500 = 9500
Gross return bulb = 9500 x 2 = 19000
- iv) Total gross return (Rs/ha) (Y2) : 25,20,000.00 + 19000 = 25,29,500.00
- v) Net income (Rs/ha) (Y3=Y2-Y1): 25,29,500.00 - 5,68,596 = 19,60,904
- vi) Benefir cost ratio : (Y3/Y1): 3.44

Note : 1. Yield of spike (yield depending on the spacing, here the spacing is 30x20 cm)

i) Single variety -4 lakh/year/ha

ii) Double variety- 3lakh/year/ha

Average yield of spike = 3.5 lakh/year/ha

iii) Yield of bulb = 10 tones (10,000 kg)/year/ha

2. Out of total number of spike 10% of it is considered as unsold due to different environmental and handling factors.

3. Out of total number of bulb 5% of it is considered as unsold due to different factors.

4. Sale price of spike: Rs. 8.00 per flower.

5. Sale price of bulb : Rs. 2.00 per bulb



Tuberose



Use of black polythene for tuberose cultivation



Cultivar: Vaibhav



Cultivar Suvasini



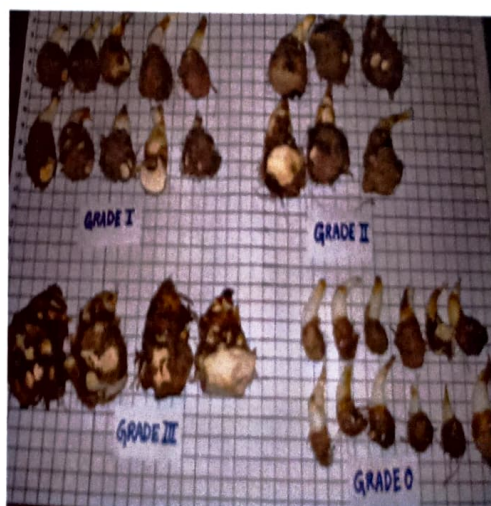
Sprinkler irrigation in tuberoses



Mulching in Tuberoses



Clumps of tuberoses bulb



Grading of tuberoses bulb

COMMERCIAL CUT FLOWER PRODUCTION OF GLADIOLUS

(*Gladiolus grandiflorus*)

Gladiolus is a bulbous ornamental plant belonging to the family Iridaceae. It becomes popular in many parts of the world due to its magnificent beauty and economic value. Gladiolus is popular for its attractive spikes having florets of large form, dazzling colours, varying sizes, long keeping quality & economic value. It is one of the major cut flowers in national and international markets. It is mainly cultivated in Karnataka, West Bengal, Maharashtra, Punjab, Haryana, Uttar Pradesh, Tamil Nadu, Jammu & Kashmir, Uttarakhand, Delhi, Sikkim and Himachal Pradesh. From commercial point of view it is the second most popular bulbous ornamental flower in the world. Gladiolus name was derived from Latin word "gladius" meaning a sword because of the sword shaped foliage. It is also known as Sword Lily or Corn Flag. It is widely used in flower arrangement, bouquets, bunches, baskets and indoor decorations. In addition to cut flower there is a huge demand of corm and cormels in the domestic as well as in the international market. The soil and climatic condition of Assam is also very much suitable for commercial cultivation of this crop. Gladiolus can withstand a wide spectrum of environment, hence it is said to be the 'Queen of Bulbous ornamental Plants'.

Land preparation:

The field should be thoroughly ploughed to a depth of 30-45cm preferably two months before planting and left as such. About two to three weeks before planting, second ploughing is done and at this time weeds are thoroughly removed. Beds preferably 1.5 meters width and length according to convenient are raised to a height of about 25-30 cm from the ground level. Well decomposed FYM @ of 4kg/m² is well incorporated in the soil at least 15-20 days before planting. Half of the recommended fertilizer mixture should be applied as basal dressing. Before planting, the corms are dehusked and clean and dipped in 0.2% solution of Bavistin for 5 minutes and dried under shade. The corm should be planted on the first fortnight of November at a depth of 5-7cm maintaining a distance of 20 cm from corm to corm and 30 cm from row to row.

Selection of Cultivars:

Though a large number of cultivars are in cultivation, the following are some important cultivars for Assam condition. They are Red Candiman, White Prosperity, Priscilla, Novalux, American Beauty, Eight Wonder, Friendship, Red sea, Suryakiran, Gold Beauty, Dhannawanty, Tiger Flame, Marallow, Poppy Tears, Her Majesty, Thunder Horn, Sunayana, Oscar, Apple Blossom, Mayor, Melody, Tithonia, Sunny Boy, Gold Dust, Bis-Bis etc.

Propagation:

Though Gladiolus can be propagated by seeds, the asexual propagation by corms and cormels is generally followed. Large size corms having an average diameter of 3-4 cm are suitable for cut flower production. However, medium and small size cormels are usually used for production of flowering grade corms in the next season. Very large size corms (more than 4 cm diameter) can be vertically split in to 2-3 sections and these should be treated with 0.2 % Bavistin solution before planting. Propagation, through tissue culture technique is also very effective to get virus free materials and rapid multiplication.

Soil and Climate:

It can be grown in a wide range of soil but the best soil is sandy to clay loam. The soils should be well drain, friable, rich in organic matter and nutrients. The pH should range between 5.5-6.5 where most of the nutrients become available to the plants.

For successful cultivation a mild climate is ideal where very hot and too cold conditions are harmful. The day temperature should range between 15-20°C. It prefers sunny situation and requires at least 80% of total sunlight for proper growth and flowering. Lack of insufficient light during winter may cause abortion of flower spikes.

Manuring and Fertilization:

The amount of fertilizer varies according to soil and climate. It also depends on cultivar, size and chemical composition of corms and cormels. Cultivar showing rapid growth and large flower spike responds more to fertilizer than those with low vigor and producing smaller plants and spikes. For Assam condition, N.P.K. should be applied in the ratio of 1:2:2@ 56g/m² in two equal split doses. One split dose should be thoroughly mixed with the soil before planting of corms and the other at 4- 6 leaves stage.

Interculture Operation:

The Intercultural operations start with the appearance of the sprouts. To facilitate sprouting initially, if necessary light watering should be done. When the shoots are about 20cm in height they are hilled up to a height of 10-15cm from both ways. This protects the plants from winds and suppresses the weed growth. Frequent weeding is done as and when necessary. When spikes grow longer and stem are not strong enough, they should be staked with about 1.5m strong stake to protect them from lodging. During staking care should be taken to avoid any damage to the underground portion. Occasional shallow hoeing starts when shoots come out of the soil and it is continued till the swelling of the spikes. Hoeing keeps down the weeds and allows constant aeration in the soil after every watering.

Irrigation:

Watering should be done at 10-12 days intervals to keep the soil moist depending on the weather condition.

Plant Growth Regulator:

Soaking the corms with GA₃ (2500 ppm) has shows the best performance on growth, flowering and corm production of gladiolus. However, Ethereal (2000 ppm) increases the number of cormels at harvest.

Harvesting and Post harvesting Handling of Spikes:

For local market, gladiolus spikes are harvested when the first pair of florets fully opened. For distant markets flowers are harvested at tight bud stage when 1-5 florets show color with at least 2 numbers of clasping leaves. The spikes should be cut with a sharp knife and immediately after cutting they should be placed in a bucket containing plain water.

Spikes are usually graded based on spikes length and number of florets per spikes as per the following groups-

Grade	Spike length(cm) (Minimum)	Number of florets
Fancy (A)	107 and above	16
Special (B)	96-107	14
Standard (C)	81-96	12
Utility (D)	81 and below	10

The graded spikes are made in to bundles of 50-100 spikes and packed in perforated and light proof card board boxes.

The stem portion of the bundle is wrapped with wet news paper. Use of tissue paper or thin polythene for wrapping of bundle loosely will protect them from damage.

Selling of cut flower in the local market:

The produced cut flowers are to be sold in the local market. The vendors of flower shops usually come to purchase and carry the cut flowers to their shops

Harvesting and storage of Corms and Cormels:

The corms and cormels get matured usually 30-45 days after spikes harvesting. At this stage, the lower leaves turn yellow and starts drying. Water is withheld and the corms and cormels are dug out with the help of a khurpi avoiding any injury. Then these are dried as such in the field. The plant is detached from the corm and cormels by secateurs. These are further dried under shade, cleaned, graded and bagged in Leno bag and stored in cold storage at 4-10°C till further planting.

Diseases and Pests:

Fusarium corm rot: (*Fusarium spp.*) During storage, corms become soft and corky with foul smell. Black spots appear on the surface on the corms.

To control this disease, proper storage of corms in thin layer and pre storage treatment with 0.3 % Captan or 0.2% Bavistin should be followed.

Wilt or collar rot: (*Fusarium oxisporum*) Most typical symptoms of the disease is the appearance of the sickle shaped leaves. Leaves become yellow and radish brown, cankers may also appear on collar region.

To control this, always healthy corms should be planted after treatment with 0.2 % Bavistin solution. Plants should not grow continuously 2-3 years in the same field.

Pests:

Cut worms are serious pests of gladiolus. Spraying of Malathion 50 E at 0.1 % at 15 days interval effectively controls cut worms.

Economics of production:

Total cost of Cultivation (Rs/ha): 808688.00

Spike (Yield/ha): 191110.00

Corm (Yield/ha): 203333.00

Gross return from spike (Rs/ha): 1337776.00

Gross return from corm (Rs/ha): 2481108.00

Total gross return (Rs/ha): 3818885.00

Net income (Rs/ha): 3010196.00

Benefit: cost ratio: 3.72

Note:

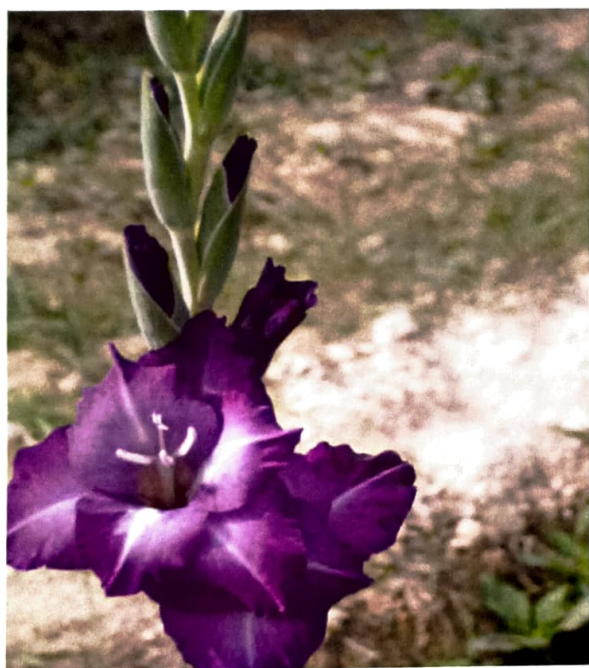
1. Yield of spike and corm is calculated on the basis of net cropped area.
2. Out of total no. of spike 10% of it is considered as unsold due to different environmental and handling factors.
3. Out of total no. of corm 5% of it is considered as unsold due to different factors.
4. Sale price of flower: Rs. 7.00 per spike (Wholesale rate)
5. Sale price of corm: Rs.10 per corm (Wholesale rate)



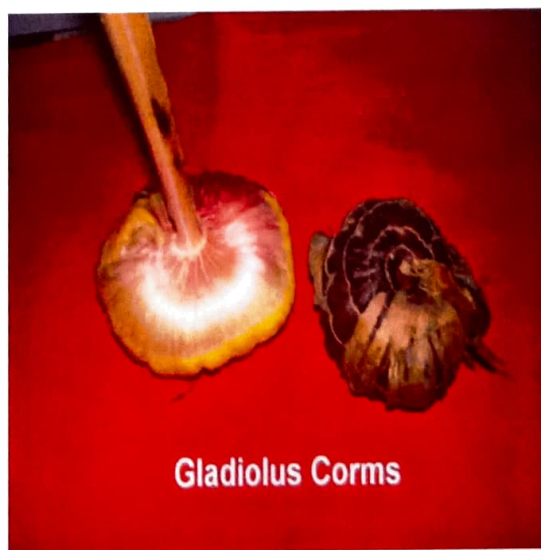
Cultivar: American Beauty



Cultivar: White prosperity



Cultivar: Her Majesty



Gladiolus Corms

COMMERCIAL CUT FLOWER PRODUCTION OF GERBERA (*Gerbera jamesonii*)

Gerbera belongs to the family Asteraceae, is a dwarf perennial herbaceous plant. It is also known as African daisy, Barberton Daisy and Transvaal Daisy. The long stalked star-like flowers are pretty and long lasting both in field condition and in vase, hence is very popular for garden decoration as well as for cut flower. It is also suitable for growing in mix borders, rock gardens and pots. Gerbera is also a valuable flower for commercial floriculture and it occupies a pride position among the top 10 cut flower of world flower trade. The flowers are hardy and withstand long distance transportation hence fetches a very good market price.

Land Preparation:

The site should be sunny with good drainage facilities. The land has to be thoroughly ploughed 2-3 times well ahead of actual planting. It is a hardy plant, can be grown in a wide range of soil except heavy clay soil, but best soil is a well drained, loam or a sandy loam rich in organic matter. The pH should be around 6-6.5 and the depth about 45-60cm. Gerbera suffer from crown rot and root rot in poorly drained soil.

Selection of Cultivars:

There are mainly two types of cultivars

General Gerbera-The following are suitable cultivars of general gerbera for Assam condition. They are— Red Gem Popular, Red Monarch, Pride of Sikkim, Evening Bells, Yellow queen, Indukumari, Orange Glim, Pink Melody etc.

Black centered Gerbera- The following are suitable cultivars of black centered gerbera for Assam condition. They are- Faith, Antibes, Batavia, Crossroad, Ruby Red, Sangria, Miracola, Piton, dalma, Florance, Rosalin, Sunway.

(Some export cultivars- Alona, Eiko, Icequeen, Kennedy, Kingdom, Julia, La, Lorca, Antinio, Sonata, Peach, Pink Frost etc.)

Propagation:

The most common method of propagation of Gerbera is by division of mother clump. The clump may be cut into small segments, each possessing a few well developed leaves and roots with the help of a sharp knife or secateurs. Very large clumps may initially be halved or quartered then these are further separated to the individual suckers. After the division is complete the foliage and the roots are trimmed back to 7-10cm in length. It is always recommended to treat the roots with fungicide solution before planting. The best time for planting in our region is Sep- Oct.

However, it can also be propagated from seeds. The gerbera seeds lose their viability within a very short period, hence must be sown immediately on maturity. The seeds need a friable, well drained soil for sowing. Seeds are sown in pans and seed boxes. The seed pans should not be allowed to dry up. Freshly harvested seed germinate in about 10 days. The seedlings are picked in 2 leaves stage. The seedlings are planted in the main field when they are sufficiently large enough. Gerbera flowers only at the end of second year when grown from seeds. However the plant produces flowers profuse only at the end of third year.

It can also be propagated from tissue culture technique very rapidly.

Planting :

To ensure good drainage gerbera are grown in raised beds in high rainfall areas. It is usually planted at a spacing of 30 cm apart within the rows and 30-35cm within the plants. The plant should never be planted deep which may cause the crown rot to develop. The crown of the plant i.e. meeting point of the leaf stalk and roots should remain above ground level. Immediately, after planting water is applied. Gerbera needs an open sunny place and will not thrive in shade.

Application of Manures and Fertilizers:

A good dose of organic manure (4kg/m^2) should be well incorporated at the time of land preparation. A fertilizer mixture of 30g N, 10g P_2O_5 , 20g K_2O / m_2 per year should be applied. $\frac{1}{2}$ of the N and entire dose of P_2O_5 and K_2O should be applied as basal dose at the time of land preparation. Remaining half of the N should be applied after 30-35 days of planting.

Mulching:

Mulching with compost, leaf mould or straw during the warmer months is beneficial for conserving moisture and checking the weed growth. However the mulch materials should not be placed very close to the plants as it may promote the crown rot. It has been observed that black polythene mulch is very suitable as a mulching material for gerbera.

Irrigation:

Light and frequent irrigation should be applied as and when necessary depending upon the weather condition.

Harvesting of the Flowers:

Usually harvesting starts 60-70 days after planting and the plant use to produce flower heavily continuously for three months. The proper stage of harvesting is depended upon the distance of the market. Usually flowers are harvested when the outer 2 whorls of disc floret are perpendicular to the stalks. Flowers should be harvested with a sharp knife and kept in plain water immediately. About 120-150 flowers/ m^2 /year are harvested from a square meter area under open condition and 180-200 flower/ m^2 / year under ploy hose in Assam condition.

Post harvest handling of Flowers:

Bushiness

An abnormality is characterized by numerous leaves, short petioles and small laminae, which give some cultivars of gerbera a bushy appearance known as bushiness. Nodes are not clearly distinguished and no internodes elongation is seen.

Stem break

It is a common post harvest disorder in cut gerberas. This is mainly caused by water imbalances. It could be ethylene controlled and associated with early senescence caused by water stress.

Yellowing and purple margin

Nitrogen deficiency causes yellowing and early senescence of leaves. Phosphorus deficiency causes pale yellow colour with purple margin. Increase in levels of nitrogen and phosphorus were found to promote development of suckers and improve flowering in gerbera.

Grading

Based on stem length and diameter, flowers are graded in A, B, C and D.

Packaging

Gerbera flower are packed in bundles of 10-15 stems together after fitting the polyethylene

cup and packed in CFB boxes.

Maintenance of the Mother Plants:

After flowering is over, during the rainy season the plot should be made free from weeds and care should be taken that no water stagnation takes place in the plot. Spray 0.1 % Bavistin at 15-20 days interval as a prophylactic measure against the incidence of any diseases. If the plot is infected by any disease it is encouraged by the high atmospheric and soil moisture during the period.

Diseases and Pests:

Diseases:

1. Sclerotium rot: It is the most serious disease of gerbera caused by the fungus *Sclerotium rolfsii*. The characteristic symptoms are the formation of water soaked patches on the collar and other lower part of the plant in contact with the soil. Plant turns yellow and gradually dies. Some brown sclerotia appear on the lower part on the stem. The disease is encouraged by the high in moisture in the soil.

It can be controlled by the application of Bavistin 0.1 % at 15 days interval

2. Blight: It is caused by *Botrytis cinerea*. The symptoms are the appearance of small black spots on ray florets. It occurs mainly due to the poor drainage, deep planting. Spraying of Benlate 0.1 % of Thiram 0.1% effectively controls the disease

3. Leaf spot: Caused by *Cercospora gerberae* and *Alternaria brassicola*. The fungi produce various types of leaf spots. Application of Zineb(0.5%) or Maneb (0.5%) reduce the infection of the disease

Pests:

1. Aphids: Can be controlled by application of Rogor 1.5 ml per lit. of water.

2. Mites: Can be controlled by Niticide 0.2%

Viral diseases: Gerbera Mosaic Virus (GMV) Vector Aphids and thrips. Leaves are reduced with molting appearance and colours of the flowers are distorted. Plants shows stunted growth

The incidence of the viral diseases can be minimized by controlling the vectors, clean cultivation, using virus free planting materials and quick removal of the infected plants.

Economics of production: General Gerbera

Total cost of cultivation (Rs/ha) (Y1): 7,00,000.00

No. of flower per ha: 19,00,000

Gross return from flower (Rs./ha) (Y2): 57,00,000

Net return (Y3=Y2-Y1) =50,00,000

5 Benefit cost ratio (Y3/Y1) = 7.14

Note:

6. Yield of flower and sucker is calculated on the basis of net cropped area.

7. Out of total no. of flower 10% of it is considered as unsold due to different environmental and handling factors.

8. Out of total no. of suckers 5% of it is considered as unsold due to different factors.

9. Sale price of flower: Rs. 3 per flower (Wholesale rate)

10. Sale price of sucker: Rs.3 per sucker (Wholesale rate)

Economics of production of Black Centered Gerbera :

Total cost of cultivation (Rs/100m²) (Y1) : 44,000.00

No. of flower per m² per year : 90

Therefore, total no. of flower per 100m² = 9000-900 = 8100 (10% is considered as unsold)

Gross return from flower (Rs/100 m²) (Y2) : 8100 x 12 = 97,200.00

No. of suckers per plant = 5

Therefore, total no. of suckers per 100 m² = 9 x 5 x 100 = 4500 - 225 = 4275 (5% unsold due to different factors)

Gross return from suckers (Rs/100 m²) = 427 x 20 = 85,500.00

Total gross return = 97,200 + 85,500 = 1,82,700

Net return (Y3-Y1) = 1,82,700 - 44,000 = 1,38,700

Benefit cost ratio (Y3/Y1) = 3.15

Note :

1. Yield of flower and sucker is calculated on the basis of net cropped area.
2. Out of total no. of flower 10% of it is considered as unsold due to the different environmental and handling factors.
3. Out of total no. of suckers 5% of it is considered as unsold due to different factors.
4. Sale of price of flower : General gerbera = Rs. 3 per flower (Wholesale rate)
Black Centered gerbera = Rs 12 per plant
5. Sale price of sucker : General gerbera = Rs. 3 per flower (Wholesale rate)
Black Centered gerbera = Rs 20 per plant



Polyhouse cultivation of Gerbera



Open cultivation of general Gerbera var.



Planting material of Gerbera (Sucker)



Cultivar: Antioes



Cultivar: Batavia



Packaging of Gerbera

COMMERCIAL CUT FLOWER PRODUCTION OF CHRYSANTHEMUM (*Dendranthema grandiflora* Tzvelev)

Chrysanthemum (*Dendranthema grandiflora* Tzvelev) is a popular and important flower crop of the world with high aesthetic appeal and its unique diversity in shape, size, color and blooming pattern. Chrysanthemum the Queen of the East is the second largest cut flower grown all over the globe and one of the most popular and commercial flower crop grown in India. The demand of this flower crop is also increasing day by day in North East India particularly in Assam. The utility and popularity of chrysanthemums have increased immensely with the introduction of the technique of year round blooming based on scientific research in the field of photoperiodism and genetics.

The chrysanthemum can be classified on the basis of architecture of the growth into two classes: standard or large flowered chrysanthemum and spray or small flowered chrysanthemum. Large flowered cultivars are grown for cut flower, for interior decoration, floral decoration and for exhibition purposes, while small flowered cultivars are grown for cut flower (filler flower), making garland, veni, religious offerings, decoration purposes, for bedding and potting purposes. When more than one seedling is planted in one pot and when the height of the plant equals to the size of the flower heads, it is called pot mum.

Cultivation of chrysanthemum requires certain important considerations. These are - selection of cultivars, time of preparation of cuttings, preparation of pot compost, land preparation, pinching, disbudding and deshooting.

Land preparation

Chrysanthemum can be cultivated in pots or in flower beds. For commercial cut flower production, it can be cultivated in beds in the open field (Spray) or inside plastic green house cum rain-shelter (Standard)

For planting in beds:

The land should be properly ploughed during July-August. Compost or dry cow dung @ 4-5 Kg / m² should be applied at the time of land preparation. In addition to manure about 400 g of lime should be applied per meter square. Before plating leaf mould is also added to the bed. Sandy loam soil is ideal for chrysanthemum. It has a shallow fibrous root system which is sensitive to water-logging. For open and poly-House conditions 20-25 cm raised beds are required

For planting in pots:

The pot mixture comprises of soil, dry cow dung, leaf mould and sand in the ratio of 1: 1: 1: ¼. This mixture should be prepared a month prior to planting. Small amount (as prescribed) of bone meal and little amount of malathion powder should be added to this mixture. This soil mixture should be kept in the form of a heap. Prior to filling of pots the mixture should be evenly spread for proper sun drying.

Under plastic Green-house

For successful flower production and quality bloom naturally ventilated poly-house

can be constructed with the help of bamboo/angle iron rod and UV stabilized polythene of 200 μ thickness such plastic green-house cum rain shelter are highly effective in heavy rainfall areas like Assam. Chrysanthemum can be grown in beds or in pots inside poly- house. Before planting the soil inside the poly-house should be sterilized by applying 2% Formalin. For growing in beds, the soil should be given a fine tilt followed by application of 4-5 Kg FYM/m² 15 days before planting.

Selection of cultivars and planting material

Selection of improved and attractive cultivars of spray (small flowered) and standard (large flowered) types plays a key role in the success of commercial cultivation of chrysanthemum. These are available in wide range of flower color, flower type and plant size. Of these some suited for cut flower production and other for outdoor planting often called Hardy mums. However, about 100 cultivars are suited for and widely grown today as flowering pot plants. Cultivar suited for pot culture today must exhibit the following characteristics

- Form a well shaped plant
- Flower quickly on relatively short stem
- Have flowers in the desired shape, size and color

Improved cultivars well adapted to the climatic condition of Assam, identified in the research conducted at Assam Agricultural University are given below:

Spray Cultivars	Flower Color	Standard Cultivars	Flower Color
Ravikiron	Red	Snow Ball	White
Gulmohar	Purple	Dignity	Red
Purple Decorative	Purple	White Cosa Grande	White
Yellow Bangla	Yellow	Diamond Jubilee	
Flirt	Red	Heather Gem	Golden yellow
Prof. Harris	Yellow	Houston	Pink
Basanti	Yellow	Silk Brocade	Yellow
Red Gold	Red	Dream Castle	Silvery purple
Charming	Chocolate	Pink Lady	Light pink
Nirod	White	Sonar Bangla	Pink
AAUCC-2	Yellow	Chandrama	Light yellow
		Robin hood	Yellow
Sadbhavana	Chocolate	White Spider	Yellow
Carnival Pride	yellow		white

Cultivars found to be especially suitable to grow in

Tray or small pots are:

Mother Terressa (White), Sadhavana (Red), AAUCC-1(Purple), AAUCC- 3 (Purple), AAUCC-4 (Bronze) and AAUCC-6 (White).

Small flowered for religious offering and garland making

Baggi, Himani, basanti, Jyostna, Kundan

Off season cultivar

April-August: Himanshu, Jalawa, Jyoty

July-August: Phuhar

Sept-October: Megami

November-December: Normal season cultivar

January-February: Jaya

February-March: Megami

No pinch, no stake variety: Guldasta, Suhag Singer, Mother Teresa, Hemanta Singar

Export Varieties: Standard- Snow Ball, Snow Don White, Bright Golden Anne, Rosalis, Paragon, Reagan Orange

Spray: BirbalSahni, Nanako, Sonali, Ravi kiron.

Criteria for selection of cultivars of standard type are larger size and attractive color and shape of flowers and enhanced blooming period and vase life for cut flower, while those for spray type are enhanced number of flowers per plant (preferably more than 100 flowers) and attractive color and shape. The spray varieties to be selected should preferably be more appealing anemone, spoon, decorative and pompon types.

Cultivation of chrysanthemum with quality planting material of these cultivars is the primary input for increased flower production. Quality planting material of chrysanthemum signifies suckers and rooted cuttings at right stage of genetically pure improved cultivars which are relatively free from insect pests and diseases.

Collection of planting material

Planting material should be collected from well known nursery with known variety especially standard and spray of different colors including those of mauve, yellow and red group are used for cut flowers which are also used for artistic flower arrangement purpose. Cultivars with erect long and sturdy stems are preferred for this purpose.

Preparation of planting materials (cuttings), time and method

Cuttings are prepared from the mother plant during the months of June to September.

The materials required for preparation of cuttings are:

Mother plant or stock plant, rooting media (builders sand), fungicide like Bavistin or Indofil M 45 or Captuf, sharp blade, hormone like, Rootex to promote early rooting of the cuttings and water in a container.

Terminal cuttings (5-7cm long) are made by making slanting cut just below the node which is to be kept in container containing water. The cut ends are then treated with hormone powder and planted in the sand. The sand should be sterilized with fungicide mentioned above by mixing 5g/l water and applying this water in the sand prior to planting of cuttings. The roots emerge and the rooted cuttings become ready after about 15 to 20 days. Delay in the preparation of cuttings (up to late September or early October) has adverse effect on the size (in case of standard or large flowered cultivars) and number (in case of spray or small flowered cultivars) of flowers. Beyond this, instead of flower production, there will be only vegetative growth.

Fertilizer Application

Chemical fertilizer:

NPK @ 30:20:20/m² is recommended for Assam. Half of urea and full dose of SSP and Mop should be applied as basal dose and other half of urea should be applied in two split doses. While MOP ½ spoon/ plant should be applied after the emergence of buds.

Liquid manure:

Application of liquid manure is essential to produce quality blooms. The method of preparation of liquid manure is as follows:

One kilogram of fresh cow dung and 250 gram of oil cake are to be mixed in 10 liters of water and should be kept for about a week. The liquid is to be stirred occasionally during these days. This liquid manure is now ready for application.

The liquid manure should be applied to the soil at the base of the plant by diluting 1 mug of liquid manure in 10 mugs of water. This should be started one month after planting and should be continued at two days interval till the stage of bud showing color.

Planting of rooted cuttings:

In the beds

In case of spray (small flowered) cultivars, the distance between rows and within a row should be maintained at 30 cm while planting rooted cuttings. In case of standard (large flowered) cultivars, the distance between rows should be 30 cm while between plants within a row should be 20 cm in open field condition or the distance between rows should be 20 cm while between plants within a row should be 15 cm under poly house condition. The beds should be adequately watered after planting of cuttings.

In the pots

Healthy rooted cutting should be selected for planting in the pots. While planting the roots should be evenly spread and the cutting should be inserted in the pot mixture with slight pressing of the base of the cutting. After planting, the cuttings should be adequately watered.

Irrigation schedule:

From the time of planting till the establishment of the seedlings, irrigation should be applied twice daily. After the establishment of the seedlings, watering should be done every day in the morning hours. Drip irrigation is preferred under green house condition.

Interculture operations:

Weeding

Weeding is necessary after 20 days of planting and occasional weeding is required throughout the cultivation.

Staking

In order to support and keep the plant upright, bamboo staking should be done. For this bamboo sticks of right length should be prepared so that when it is inserted into the soil just by the side of the plant, the top portion of the stick remains below the flower buds.

Pinching and disbudding

The standard varieties grown for exhibition require disbudding to produce large and quality bloom. This is accomplished by retaining terminal flower bud and removing all other auxiliary buds. For normal growing of standard cultivars, 3-6 flowers per plant are to be retained and for this pinching are necessary. It is done by pinching the terminal shoot 20 cm above ground level and allowed to grow 3-6 shoots by removing all the shoots (deshooting) except 3-6 shoots which will bear single flower per shoot.

In case of spray cultivars, pinching is necessary at the same height (20 cm) above the ground level. A second pinching is necessary when the shoot becomes 15 cm in length. To induce uniform flowering, terminal bud is removed and all the auxiliary buds are retained.

Regulation of flowering (Off season flowering):

The technology was developed in Department of Horticulture, Assam Agricultural University on offseason flowering of three different spray cultivars of chrysanthemum during the month of Feb-March and the rooted cuttings are planted in the pots during the month of April-May. The seedlings are exposed to the photoperiodic treatments of 14 hours (4pm to 6 am) of dark and 10 hours (6am to 4pm) of light period in the form of natural light of 54352.71 Lux. This photoperiodic treatment was found to be the best from an earlier experiment involving different treatments of dark and light period inducing flowering in off season chrysanthemum. The seedlings are given growth regulator treatments after 52 days of planting and exposed to dark treatments. The plants were grown in indigenously developed dark chamber (4.0x 1.5x 15.0m) made up of bamboo and 200 μ thick black polythene sheet during offseason and were subjected to seven growth regulator treatments viz. control, GA3 at 40ppm, 60ppm and 80ppm and CCC at 4000ppm, 5000ppm and 6000ppm. Full blooming occurs during the month of Aug-Sep. The growth regulator treatments along with photoperiod treatment are found to be very much effective for offseason flowering of chrysanthemum and to get maximum number of flowers and quality bloom.

Harvesting and post harvest handling of flowers

The correct stage of harvesting depends on the cultivar, marketing and other facilities available to the grower. The decorative types should be harvested when the petals in the center of the top-most flower are fully developed. In standards harvesting is generally done when outer ray florets ceased to elongate. Pot mums are sent to the market when flowers are about half to fully opened.

Cuttings of the flowers should be done about 10 cm above the soil and 1/3 of stems are stripped of leaves and placed immediately in water containing a biocide like silver nitrate at 25 ppm concentration. Standard chrysanthemum can also be harvested at an open stage when only a few outer ray florets unfurl. The bud opening solution is 200 ppm 8-HQC + 2 % sucrose should be used.

In distilled water chrysanthemum flower remains fresh for 15-20 days. Use of proper preservative solution throughout the period of post-harvest handling is very important to prolong the life of cut flower. Dipping of stem for a very short period 1200 – 4800 ppm silver nitrate + 2 % sucrose increase the vase life from 12 to 20 days.

Grading and Bunching

The society of American Florists has suggested the following grades for fully open standard chrysanthemum

Grade name	Fancy	Standard	short
Label color	Blue	Red	green
Minimum diameter	14cm	12cm	10cm
Minimum length	76cm	76cm	61cm

Standards and spider mums can be wrapped individually with thin wax paper to avoid bruising and entangling florets. Some growers place individual net over spider mum buds in the greenhouse

Pre-Treatments

Stems should be placed in water containing a germicide soon after harvest. Silver nitrate

provides a very satisfactory treatment but it is rarely used commercially. Bud-cut, standard chrysanthemums should be placed in a bud opening solution containing 2-3 % sucrose and germicide

Storage:

Chrysanthemum can be stored for 3-4 weeks at 0.5°C Storage at 2-3°C should exceed 2 weeks

Packaging:

Most of the standard chrysanthemum are placed in sleeves and packed in display boxes measuring 91 cm x 43 cm x 15 cm. They are placed in the boxes according to the grade. If the blooms are large and loose, a pillow made from corrugated paper should be placed under the necks of the bottom layer at each end of the box.

Transportation:

Flowers are transported from where they are produced to the markets and between markets. The flowers are commonly transported by air. Chrysanthemum is shipped from Bangalore to Bombay, Kolkata, Hyderabad and Vijaywada. The cost of transportation by air is not very high compared to costs incurred for transportation even by buses from production centers to regional markets. Kerala gets chrysanthemum from Bangalore, Coimbatore and Madurai.

Selling of cut flower in local market

The produced cut flowers will be marketed in the local market. The vendors of flower shops used to come to purchase and carry cut flowers to their shops.

Crop Protection:

Against insect pests

Sl. No	Insect pest	Symptom	Control measure
1	Aphid	Small black dot like insect, suck cell-sap of stem, stalk, buds & flower	Spraying of Rogor @ 1 ml in 1 lit of water
2	Hairy cater piller	Larvae eat away foliage leaving only the skeleton of veins	Spraying of Thiodine @ 1 ml in 1 lit of water
3	Thrips	Suck sap and leave the sucking marks on the under surface of the leaves and on buds	Spraying of Malathion 50 EC @ 1 ml in 1 lit of water
4	Pea semi-looper	Eat young leaves and secretes black excreta	Spraying of Rogor @ 1 ml in 1 lit of water

Against diseases

Sl. No.	Disease	Symptom	Control measure
1	Root rot	Appears in nursery bed. Rotting takes place in the junction of root and shoot	Disinfecting soil with Captan or Bavistin @ 1.5 g / l
2	Leaf spot	Greyish brown circular spots appear on the leaves. Leaves turn black and die.	Spraying Bavistin @ 1.5 g / l at 7 days interval
3	Virus	Stunted growth, overall reduction in plant size, foliage pale in colour, flowers may open pre maturely, red & bronze flowers often bleached.	Infected plants are to be removed and destroyed. Tools and materials used in the inter-culture operations should be used after sterization. Cuttings are to be made from virus free mother plant

Economics of Production:

Total cost of cultivation (Rs./ha): 20,00,000.00

Total number of flower: 48,80,000

Gross (Y2) return (Rs.): 1,46,40,000.00

Net return Y3= (Rs.) (Y2 - Y1): 1,26,40,000.00

Benefit : Cost Ratio : 6.32

Note

*(Cost Rs 3/spray)

*From a 100 m² poly house, 55 - 60 thousand cuttings can be produced which will be very much remunerative.



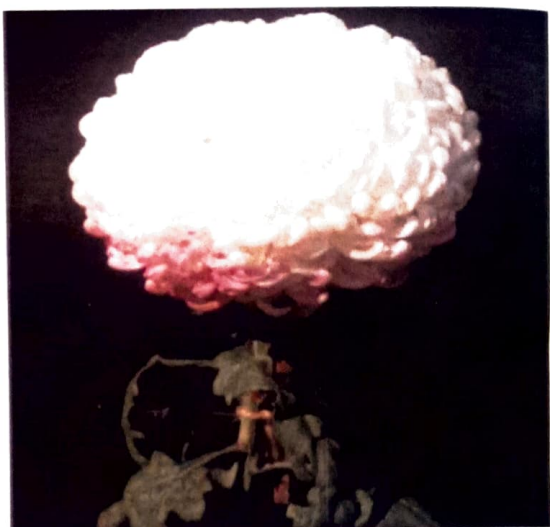
Slanting cut in the bare rooted cutting



Chrysanthemum rooted cutting



Open cultivation of spray Chrysanthemum



Standard type of Chrysanthemum
Cultivar: Snow Ball



Spray chrysanthemum



Spray chrysanthemum
Cultivar: White Spider

COMMERCIAL CUT FLOWER PRODUCTION OF ORCHID

Orchids are the most fascinating and beautiful flowers of the world. They exhibit a wide range of diversity in form, size, color, and texture. Orchids are excellent items for garden and can be grown in beds, pots, baskets, split hollows bamboo pieces, wooden logs, bamboo basket & coco husk block etc. It is an integral part of India's natural heritage, specially a treasure of Assam and N.E. States. They are most beautiful items for indoor decoration. Orchid flowers are valued for their exquisite flower and long keeping quality.

Orchids rank first in the global trade of tropical cut flower and they are 8th in the total cut flower trade in the international market. In India, the commercial cultivation of Orchids is still in rudimentary form and they are grown on small scale in some part of Kerala, Tamil Nadu, Karnataka and in north eastern parts of Kalimpong, Darjeeling, Arunachal Pradesh

The orchids are perennial herbaceous plants, which produce flowers of high ornamental values. They are mainly used as cut flowers. Beauty and fragrance apart, some hybrid orchids have the maximum vase life of 8-12 weeks. Cymbidium, an important member of this group, is one of the top ten cut flowers in the international trade. Orchids are also grown as pot plants. Some of them are valuable as medicinal plants since they are source of alkaloids. Vanillin, glycosides and related aromatic compounds are produced from the orchid *Vanilla planifolia* is a popular flavoring agent.

Orchids belong to the family Orchidaceae in the group of monocotyledon. There are about 25,000-35,000 of species and 700-800 genera. The orchid resource of India is quite rich since the country harbors about 1300 species and out of this 800 species available in North eastern region. The economy of different countries like Thailand and Singapore largely depends on the export of orchid flower to Europe and U.S.A. The orchid cut flower business has thus become a highly developed trade, both for local market and for export. Indian position in export market is alarmingly low as compared to South Asian countries like Thailand, Malaysia and Singapore, where orchid has become a multimillion dollar industry. Number of available in Assam is 400.

However, for commercial cultivation of orchid following groups are used for cut flower production.

- ♦ Dendrobium
- ♦ Cymbidium
- ♦ Paphiopedilum
- ♦ Cattleya
- ♦ Phalaenopsis
- ♦ Vanda
- ♦ Oncidium
- ♦ Arachnis
- ♦ Ascocenda
- ♦ Aranthera
- ♦ Aranda

Types of orchid:

Vegetatively orchids are divided into: Monopodial and Sympodial.

Monopodial orchid do not make separate new growth in each new season and do not have a rhizome and pseudo bulb. The single stem increases in height throughout the life period. Eg. Vanda, Rhynchostylis.

Sympodial orchid produce rhizome and develop new growth and each new growth produces its own sets of roots. Plants of this group often have more than one stem. The stems are generally thickened and bulbous and they are known as pseudo bulbs very useful device for storage of foods and water. e.g. Dendrobium, Cattleya has a determinate type of growth.

On the basis of cultural requirements orchids are classified as

- Epiphytic
- Terrestrial
- Lithophytic
- Saprophytic.

Epiphytic orchids perch themselves on tree & shrubs but they manufacture their own food from air and water. Eg. Vanda, Rhynchostylis, Dendrobium, Oncidium.

Terrestrial orchids grow on ground, with their fleshy roots in the soil and require uniform supply of water like ordinary plants. Eg. Spathoglottis and Phaius.

Saprophytic orchids are devoid of chlorophyll and grow on decayed organic matter. It has no commercial value. Eg. Neolia sp.

Lithophytic orchids generally grow on rocks and stones. Eg. Dendrobium.

Orchids are broadly classified depending on the climatic zones which they choose to grow accordingly. Three different types of orchids with different climatic zones have been recognized.

- Tropical zone (300-1800m)
- Subtropical zone (900-1800m)
- Temperate zone (1800-3500m)
- Alpine zone (3500-5000m).

Selection of orchid

For proper growth and development of orchids, certain essential requirements must be met such as

- i) Suitable temperature
- ii) Adequate water supply
- iii) Suitable humidity
- iv) Suitable light
- v) Suitable and adequate supply of mineral salt.
- vi) The choice of orchids should be made in such a way that one get flowers round the year.

For commercial cultivation, hybrid orchid like tropical orchid Sonia (purple, white and pink), Mokara, Oncidium, Aranda etc

Collection of planting material

Planting material should be collected from well known nursery with genetically pure known variety.

Growing structure:

Depending upon the area of cultivation, the growing structures can be modified to suit the

local climatic conditions. For commercial cultivation in NE region orchid cultivation can be taken up in shade net house or controlled green houses.

Shade net house:

Shade net house can be constructed by bamboo or angle iron rod or GI wires. The roof is covered by shade net of (30 – 50% shade). Provision can be made for installing overhead sprinkler. Provision for holding water below orchid stakes to maintain humidity

Controlled greenhouses:

To produce top quality blooms exclusively for export controlled greenhouses are used. But capital investment is higher in this type.

Agro climatic requirement

In nature, the orchids are found in diverse climatic condition except arid and frozen situation. However, the largest concentration occurs in tropical rain forests, monsoon forests and other tree habitats. Warm humid jungle provides congenial condition for the growth of orchid in nature. Our North eastern region and Western ghat regions of India abound in various types of orchids.

Environmental Factors:

Light:

The appropriate amount of light is necessary for proper plant growth and nutrient storage

If the leaves become very yellow, move the plant to a shadier location or sudden formation of brown blotches or orange patches particularly at the apexes of leaves. If light is too intense that can cause sunscalling. Light is the single most crucial factor for orchid plants to bloom. The appropriate amount of light is necessary for proper plant growth and nutrient storage.

Temperature

Day temperature between 16°C and 35° C and night temperatures between 10°C – 28°C are necessary for different species

Types of orchids according to temperature requirement

- The cold or cool species.
- The intermediate species
- The warm or hot species.

But most of the commercially important orchids thrive well under temperature varying from 10°C-32°C, humidity from 50%-85% light intensity 2000-6000 foot candles.

Container planting of orchid

A. For epiphytic orchids:

- i. Side Perforated Earthen ware pots
- ii. Bamboo baskets
- iii. Wooden Logs
- iv. Tree fern blocks v. cocohusk block

B. Terrestrial orchids:

- i. Soil
- ii. Ordinary earthen pots.

Growing media:

The size of the individual particles in the media affects its retention character. Small chips of a medium retain more moisture than large chunks of the above medium. The different

growing medias are:

Coconut fiber, Tree fern fiber, Charcoal, Brick pieces, Saw dust, Coconut husk block.

Growing media/ Pot mixtures: Recommended for Assam for traditional species

A. For epiphytic orchids:

In equal proportions: i. Coconut fiber (3x3 cm piece)
ii. Saw dust
iii. Charcoal pieces
iv. Brick pieces,

Moss is used as covering material.

B. For terrestrial orchids:

(a) In equal proportion: i. River sand
ii. Loamy soil
iii. Coconut fiber (3x 3cm pieces)
iv. 50% organic matter.

Moss is used as covering material.

b) In equal proportion: i. Leaf mould
ii. River sand
iii. Coconut fiber (3x3cm pieces)

Moss is used as covering material. For hybrid orchid cocohusk block is mostly used and bamboo basket with growing media as cocohusk is used.

Potting:

Proper potting with proper compost mixture has to be done for different species of orchids. Care should be taken while planting the epiphytic orchids like Vanda, Dendrobium so that aerial shoots/ keikis are not broken. Proper labeling should be done after the potting is over. The pots should be filled to about 1/3rd of their height with the suitable compost medium. The bottom of the pot/basket should be covered with crocks. Generally the roots of the plants are then covered with the potting compost and placed in the prepared pots. The old pseudo bulb should be against the edge of the pot and the youngest ones towards the center so that there will be ample space for new shoots or pseudobulbs to grow.

Monopodial orchids, such as Vanda, Renanthera or Phalaenopsis are potted similarly. But these species should be planted in the center of the pots as they do not have pseudobulbs.

For commercial purpose, orchids are grown in bed with potting compost /growing media like coconut fiber and little amount of cocopit. In addition orchid plants also can be grown in coco husk blocks.

Repotting of orchids:

The ideal time to repot an orchid is right after it finishes flowering, when it begins to produce new growth. A suitable pot is selected and orchid is divided (for sympodial orchids). The orchid is removed from the previous pot and the roots are cleaned. Then the orchid is placed in a new pot and potting mixer is added.

Nutrition:

N,P,K are necessary for plant growth, metabolism and reproduction of orchids and hence fertilizer are sold under different formulations depending on the relative concentrations of these three elements. Balanced fertilizers, those with equal proportions of N,P & K and sold under formulation 19-19-19 2gm/lit of water/week are recommended.

P such as 10-30-20 are used to promote better flowering. Fertilizers are applied only when plants are in active growth. It is advisable to water plants before fertilizing them so that the fertilizer salts are absorbed more readily by the roots and are not burned. It is more effective to fertilize at half strength with every watering than to shock the plants with full strength fertilizer very often.

Irrigation:

Good quality water is a very important requirement to grow orchid successfully. Acceptable water sources include de ionized water and rain water orchids successfully. Watering depends on the growing media/ potting media and growing conditions. Terrestrial orchids require more water than epiphytes. Generally sprinkling water twice or thrice a week is suitable for orchid.

Propagation:

There are six methods of propagation of orchids:

- Division
- Back bulbs
- Keikis
- Aerial cuttings
- Meristem or tissue culture
- Seed.

Division:

Division is the splitting of the plant into 2 or more parts each with at least three new shoot and each will produce a fully grown mostly flowering size plant that is capable of flowering the following season.

It is one of the simplest methods of producing more plants of the same variety or species. Splitting of a plant produces more shoots of the plant with better quality and new vigor. Division is carried out only in those plants where each division will have at least 3 pseudo bulbs or each division should have at least one new growth. Division is not carried out in the plants which have less than two pseudo bulbs as it will take more than 3 years to flowering.

Division of plants is done generally in the early spring just as new growth starts. This will ensure that each division has a full growing season to establish itself to flower in the following season.

Back bulbs

Back bulb propagation is a method of producing a new plant from old previously flowered pseudo bulbs. These bulbs are usually leafless or the plants produced from these bulbs take 2-3 years or more to reach flowering size.

Keikis

Keikis are the baby plants which are produced in the node of pseudobulb or along the flowering spike. A keiki is capable of producing new branches under normal condition. Keikis are generally produced by *Dendrobium* and *Phaleonopsis*, *Pulbophylum* etc

Cuttings

Aerial cuttings are very common in many of the *Dendrobiums* such as *D. nobile*. Some of the *Dendrobium* develop small plants under stressful growing conditions instead of developing flower buds. Aerial cuttings are generally taken from fully grown plant and the new plants produced from it will be true to type plant. Monopodial orchids are also propagated by cuttings because they do not produce pseudobulb or rhizomes.

because they do not produce pseudobulb or rhizomes.

Tissue culture

Meristem culture is generally used for propagation of orchids where, the meristems/apical growing buds are taken and grown in a special nutrient rich liquid. The cell mass is large enough to be split into small sections. There are then either grown into plants or the process is repeated to produce more tissues for growing. This method is often used for mass production of hybrids for commercial purposes. Tissue culture produced plants take 3-4 years to produce flowering.

Seed

This method of propagation is better suited to laboratory conditions. Orchid seed is almost like dust or lacks endosperm to sustain the growing seedling. Hence, special techniques are required to sustain it during the formative early stages of its development.

Plant protection

The pests those normally common in orchids are scale, mealy bugs, snails and aphids. Careful and frequent monitoring is to be done to check the infestation of pest. In case of appearance of any pests, appropriate insecticides are to be applied.

Aphids

Aphids are particularly visible on new growth. Aphid infestation leads to stunted growth of leaves, stems or flowers may be malformed or fail to open. The honeydew secreted by aphids in the infected plantlets harbor ants or a black fungus.

Control: Black fungus is controlled by washing off with water or mild detergent. Insecticides containing malathion, nicotine or pyrethrin is applied to control aphid. Insecticide Rogor 1ml in one lit of water is applied.

Mealy bugs

Cottony masses generally infest points of junction such as the crook between two leaves. Plants may appear stunted or shriveled. It sucks sap from stems, leaves or buds. The sticky honey dew produced as a result of infestation harbors ants or black fungus.

Control: Small infestations are removed with a cotton swab dipped in methylated spirits. In case of heavy infestation, insecticide contains malathion or nicotine is used. Malathion 1.5ml in 1 lit of water is applied.

Scales

Scales are round or oval shell in brown, white or grey in colors and are often accompanied by a sootymould. The plants may be stunted, with leaves yellowing and fall off many species of scale insect infest orchids and suck their sap.

Control: Small infestations are picked off with tweezers or a knife or swabbed with methylated spirits. Adult scales are controlled by spraying an insecticide containing malathion or monocrotophos.

Slugs and Snails

Both are legless molluscs that generally feed on foliage, buds, flowers and root tip at night. The pests lay their eggs in damp areas and in potting mixtures. The plant is punctured with ragged holes with a visible slurry trail.

Control: Pesticide bait containing metaldehyde or methiocarb is used for trapping the snails and slugs. Besides, the slugs can be hived at night into a saucer of beer to drown.

Spider mite

Normally spider mites suck sap from the undersides of leaves. Leaves are pitted or stripped

with white as a result of attack of the pest. White webbing are generally found on the underside of the leaves.

Control

The foliage can be scrubbed or rinsed with warm water to break up webs. In case of severe infestation, malathion or derris containing insecticides can be used.

Disease management:

1. Black rot: Purple blotches edged with yellow are seen on leaves or new shoots. Rotting may start downward from leaves or upward from roots or rhizomes. Black rot is caused by several types of fungi. High humidity, cool temperature or standing water is favorable for growth of these fungi. Damping off, another disease caused by fungi occurs in seedling stage. Damping off occurs most readily in community pots.

Control: Infected plants are drenched with fungicides like captan or zineb. The infected parts are cut off from the healthy tissues or the cut is sealed with fungicides. Badly diseased plants should be removed and destroyed.

2. Leaf spot: Raised/sunken spots in yellow, brown or purplish shred are found to spread over leaves. In advance stages, leaves turn yellow or brown or die. Leaf spot is generally found to occur in high humid condition. The fungi responsible for this disease thrive best under this condition or the disease is destructive especially to seedlings.

Control: Air circulation is to be increased along with reduction of humidity. Diseased leaves are cut off and the cuts are sprayed with fungicides. Weekly application of captan or systemic fungicide containing binomial /Thiophanate methyl can be prescribed.

3. Petal blight: Small brown circles often with pink edges are found to appear on petals or sepals. Petal blight or botrytis generally appears in cool, damp weather where there is inadequate air circulation. Generally old or fading flowers are attacked by these fungi.

Control: Infected blossoms are to be cut off or destroyed. Fungicides like Benlate, Captan, Thiram, Zenab or Thiophanate methyl is to be sprayed to plants.

Harvesting and Post harvest handling

This is a very important operation or the growers should have thorough knowledge about the flowering behavior of the orchids used for cut flower production. Proper time, stage or method of harvest determines the quality of the produce. In general, orchid flowers mature in 3-4 day after opening of the flower. Flowers cut prior to their maturity may wilt before reaching the wholesaler. Harvesting should be done preferably in the evening. Sterilized tools should be used for harvesting. Flowers harvested in the heat of the day can be stressed because of high temperature. When individual cymbidium and cattleya flowers are cut, the peduncle should be immediately inserted in a tube of water.

Grading

There is no standard grade for orchid flowers and their prices are fixed on the basis of size of the flowers. Both colour and size of flowers are considered for pricing in case of Cattleya. Grading is mainly done on length of the flower spike, flower number and size and arrangement of flowers on the spike. Sometimes, the number of lateral branches on the inflorescence is also considered.

Storage

Most orchid flowers are long lived on the plants. Therefore, the flowers should be harvested when necessary. The harvested flowers should be stored at 5-7°C for 10-14 days. Plastic film storage is attractive and can be stored.

Packaging

Packaging is another important aspect in the flower trade. Without proper packaging the flowers may wither or suffer mechanical injury during transit. An ideal package should be air tight, waterproof, strong enough to withstand handling and small in volume. Many ways are followed to pack orchid flowers. Cymbidium spikes are often packed 100 flowers to a box. Standard florist boxes are used for the packing of cattleya flowers. Hawaiian Dendrobium is packed in 4 dozen sprays per box. Keeping of wet cotton at the cut end of the flower stem, which is wrapped with a polythene wrapper and tie with a twist tie or a rubber band, which will help to maintain humidity.

Transportation

Orchid flowers are placed flatly in shallow boxes and transport them either by hand or vehicle for local market and by air to distant market. When travel by a vehicle, keep the environment in the vehicle cool and shaded. Cool, shaded conditions will help prolong the best condition of the cut flower.

Selling of cut flower in local market

The produced cut flowers will be marketed in the local market. The vendors of flower shops used to come to purchase and carry cut flowers to their shops.

Vase life

In spite of long lasting nature of the orchid flowers, proper handling of flowers is an important criterion to increase vase life. Immediately after arrival, the lower 0.75cm of the peduncle is cut off and the flower is inserted into a fresh tube of water containing preservatives.

In case of spray type of orchids, the basal 2.5cm of the stem is cut upon arrival and placed in warm water at 38°C with a preservative. The flower spikes are then hardened at 5°C.

In cut flower industry, ethylene is the major chemical environmental pollutant affecting senescence. Orchid flowers are very sensitive to ethylene like pollutants are important for the success of the industry.

Foliar application of Aluminum chloride 500 ppm, Aluminum molybdate 100ppm or Boric acid 1000ppm lengthened the vase life of *Oncidium foldiana*. Hydroxyquinoline resulted in additional bloom opening of the flowers with increased vase life.

Economics of Production

Total cost of cultivation (Y1): 38575.00

Number of flower per 100 m²= 3765

Total gross return (Y2) (Rs./100m²)=188250.00

Net return (Y3=Y2-Y1) =149675.00

Benefit: cost ratio (Y3/Y1) = 3.88

Note:

1. Yield of flower is calculated on the basis of net cropped area.
2. Out of total number of flower 5% of it is considered as unsold due to different environment and handling factors.
3. Sale price of flower: Rs. 50 per flower



State flower of Assam
Rhynchosyilis retusa



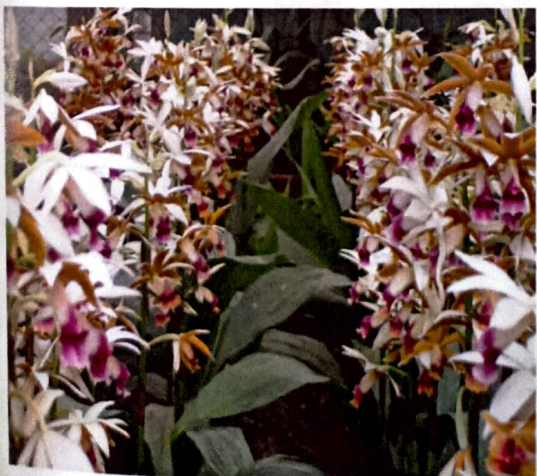
Coconut husk block for orchid cultivation



Hybrid orchid Sonia



Dendrobium Orchid



Terrestrial Orchid *Phaius tankervilleae*



Bamboo based low cost orchid house

COMMERCIAL CUT FLOWER PRODUCTION OF ANTHURIUM (*Anthurium andreaeanum*)

Anthurium (*Anthurium andreaeanum*) is an important tropical ornamental plant grown for its exotic beauty, producing various colorful spathe and attractive foliage. They are very popular as cut flowers for their beauty, bold effect & long lasting qualities which were essential prerequisites for floral arrangements. Anthurium are perennial evergreen, herbaceous plant with heart shaped leaves and spathe. The flower consist of colorful modified leaf called the spathe and hundred of spirally arranged bisexual flowers on a pencil like structure called 'spadix' arising from the base of the spathe. Cultivation of anthurium both in homesteads and commercially is fast catching up. Because of its long lasting spathe, it is an excellent export product.

Growing Environment:

Temperature: Anthurium thrive best at a temperature between 18°C and 28°C (With extreme range from 14 to 35°C). For luxuriant growth, anthuriums prefer optimum temperatures.

Light: Anthurium is basically shade loving plant. 75 – 80% shading is ideal for its proper growth and development. Higher light intensity coupled with low relative humidity and poor shading often result in scorching of young leaves and immature flower buds. In commercial practice it is advisable to have 50% shade net on the top and 25% shade net below it.

Relative humidity: The optimum relative humidity levels range from 50 – 80%. With R. H. less than 40% the vegetative growth is slower and flower development is poor. During the extreme temperature, watering with over head sprinklers helps in maintaining humidity and to avoid sunburns. Besides sprinklings, misting fogging or ground level sprinklers are used. For luxuriant growth.

Growing structures: Depending on the climatic conditions, the growth structures can be modified in the regions. Commercially anthurium can be grown in shade net house or climate controlled green house.

In North- Eastern region, the popular structure is shade net house due to its low cost and simplicity in the construction. The shade net house can be constructed in the open area with bamboo, wooden, angle iron or bamboo pillars placed at regular intervals connected by galvanized wires and a mesh (made up of bamboo sticks or the wire on the top). 75% shade net is placed over it. The sides of the house are covered with single layer of shade net to prevent the pest infestation. Over head sprinkler/ misters/ fogging system by GI pipes from one end to another and can be installed inside the house. Such shade structures are most preferable in these regions like Assam where RH is very high.

Anthurium varieties

For commercial cultivation, it is advisable to select varieties on the basis of the following attributes:

- i. Compact plants with short internodes producing suckers profusely.
- ii. Bright, clear colored, showy heart shaped spathe .
- iii. Spadix grows reclining to the spathe, shorter to length than spathe, oriented at 30° angle.

- iv. Erect long flower stalk, about five times the length of the spathe.
- v. Resistance to common pest and diseases.
- vi. Maximum vase life.

Varieties

Anthurium flowers are classified into three basic groups based on character of the spathe. They are: heart shaped spathe (the most common type), 'Obake' with bicour spathe and 'Tulip' with cup shaped spathe.

Anthurium varieties are classified into 9 different colour groups of the spathe.

Sl no.	Spathe colour	Cultivars
1	Red	Holland: Fire, Tropical, Calorie, Cherry Red, Sweetheart, Temptation. Hawaiian: Osaki, Kosohara, Micky Mouse, Hawaiian Red
2	Orange	Holland: Sunglow, Casino, Fla Orange, Avo Gino. Hawaiian: Nitta, Sunburst, Sunset Orange.
3	Pink	Holland: Avo Sonata, Cheers, Masic Pink Hawaiian: Blush, Candy Queen Others: Agnihotri, Lady Jane .
4	White	Holland: Acropolis, Carnaval, Angel, Moments. Hawaiian: Manoa Mist, Myron Moori.
5	Green	Laguna, Midori, Pistache, Verino.
6	Obake	Red Dragon, Fantasia, Fla Rose, Carnival
7	Chocolate	Tropic Night, Morano, Choco.
8	Green edged spathe	Simba, Baron, President, Marshall.
9	Mixed	Fantasia, Nunzia Champagne,

Growing Media:

Highly organic, well – drained and aerated medium with good water holding capacity and good drainage is used for growing Anthurium.

The ideal media for pot and ground should have the

- Good water holding capacity
- High porosity
- Good aeration
- Low salt concentration
- Optimum ph (5.5 – 6)

Different types of growing media

- Sugar cane bagasse
- Charcoal
- Wood shavings
- Leaf mould
- Coconut husk
- Course sand
- Small brick pieces
- Coir pith compost
- Cocopeat

Bed preparation:

Growing media of 4 inches brick pieces (in the bottom), 3 inches charcoal, 2 inches coconut husk , coco peat and sand in 3:1 ratio filled in 30cm raised beds (breadth 1.2m and length according to the convenience), framed with cemented brick walls or bamboos or shadenets etc. was found to be best for growing media for anthurium under Assam condition. Bed should prepare with 3 inch slope.

Planting:

Planting in pots:

In small scale planting, anthuriums are generally planted in earthen pots. Pot size 25 – 30 cm with a minimum of two holes is usually preferred.

Planting on the ground:

Large scale growing of anthurium is mainly done in beds. The width of the bed should be 1.20m and in between two beds a 50cm gap is given and the bed should be 30cm raised and any convenient length according to the size of the shade net house. Spacing of 30 x 30cm accommodate 7 – 9 plants/m² and 61750 plants/ha.

Time of planting: May -June or August -September

Fertilizer:

• Nitrogen, Potassium, calcium, phosphorous, magnesium and sulphur are the important elements required in Anthurium.

• Foliar application of 1g urea + 2g Mop/ lit every week is found to be beneficial.

• Complex fertilizer, (NPK 17:17:17 g) 10 gm per lit of water in one month interval is also beneficial. Complete fertilizer, (NPK 19:19:19 All) @ 2gm per lit of water once a week is beneficial.

• Application of lime @ 3 – 5 gm per plant is recommended.

• Young plants may be sprayed with a fertilizer mixture containing higher ratio of nitrogen 3:1; 3 @ 2g/l twice in a week. For flowering plants, application of 1:2:2 NPK mixture 2 – 3 g/l twice in week is beneficial.

Irrigation:

Plants are to be watered twice daily during summer months. The methods of irrigation may be sprinkler, micro sprinkler, manual watering etc.

Pruning of leaves:

Old and diseased leaf should be removed, but there should be at least 4 – 5 numbers of leaves in the plant.

Removal of sucker:

Most Anthurium plants naturally produce small sucker at the base of the plant. The suckers should be removing at an early stage.

Propagation:

Conventional Method:

Anthurium can be propagated by cuttings and suckers. These suckers when they grow to 4 – 5 leaf stage with 2 – 3 good roots can be separated and planted.

Micro propagation:

Leaf segment, spadix segment, vegetative buds stem section etc. have been used as explant to get callus on the Nitsch or MS medium.

Post harvest management:

Stage of harvest:

The flowers are harvested after the unfolding of the spathe is complete. Best time for harvest is when 1/3 to 2/3 of the flowers on the spike are open. Harvesting in the morning time is preferable.

Post harvest management:

Stage of harvest:

The flowers are harvested after the unfolding of the spathe is complete. Best time for harvest is when 1/3 to 2/3 of the flowers on the spike are open. Harvesting in the morning time is preferable.

Harvest and Care of spike:

The flowers are cut with a sharp knife, leaving about 3cm of stem on the plant to prevent rotting of the stem. After harvest basal portion of the stalk of the flower should be kept in water as soon as possible to prevent drying out. For distant market the cut ends of each flower stem should be wrapped with cotton pad soaked with water covered with wax paper or polythene and securely tied. The spathe along with the spadix is then inserted into a polythene cover of appropriate size and there after placed in carton.

Pulsing:

Pulsing is a short term treatment given to cut flower immediately after harvest to increase the longevity – before packing and transportation (shipment).

A pulsing treatment with BA 50 ppm for 12 hrs delayed initiation of spathe blueing and spadix necrosis in Anthurium. This treatment also recorded the longest retention of spathe glow and longest vase life.

Holding solution:

BA 25 ppm and 8 HQ at 30 ppm resulted in delayed spadix necrosis, spathe bluing and longest vase life (27 days)

Common grades used in three Countries:

Code	Carribbean, Hawaii Flower Size inch	Stem/Box	Mauritius Flower size inch	Stem/Box
Pewee	<2.5	50	-	-
Mini	2.5 – 3.0	40	<3.0	80
Small	3.0 – 4.0	30 – 40	3.0 – 4.0	45
Medium	4.0 – 5.0	25	4.0 – 5.0	40
Large	5.0 – 5.5	18	5.0 – 6.0	30
Extra Large	5.5 – 6.0	15	>6.0	25
Premium	>6.0	8.0	8.0	20

Packing: The flowers are packed in cardboard boxes of size 60cm x 30cm x 23cm.

Packaging

An ideal packing should be air tight, water proof, strong enough to withstand handling and small in volume. Wet cotton is placed at the cut end of the flower stem which is wrapped with a polythene wrapper helps to maintain humidity.

Vase life:

Hydroxyquinoline resulted in additional bloom opening of the flowers and also increase the vase life.

Plant protection:

Pest management:

Aphid: Leaves and stem appear stunted, flowers may be malformed or fail to open.

Control: Application of Malathion or Rogor.

Mealy bugs: Cottony masses especially infest point of junction such as the crook between two leaves.

Control: Malathion.

Disease:

Black rot: Purplish blotches edged with yellow appear on leaves and new sheets.

Control: Application of fungicide such as captan.

Leaf spot: Raised or sunken spots in yellow, brown or purplish shades spread quickly over leaves. In advanced stages, leaves turn yellow or brown and die.

Control: Reduce humidity and increase air circulation. Cut of diseased leaves spray cut ends with fungicide. Apply captan or a systemic fungicide.

Bacterial Blight: Small brown circle, often with pink edges, appear on sepals and petals.

Control: Cut off the infected blossoms. Spray plants with fungicide like Captan or thiram.

Anthurium blight

Causal agent: *Xanthomonas campestris*.

Symptoms:

Initial symptoms are the appearance of small scattered angular water soaked spots near the margin of leaves. The infected tissue will be killed very soon and there will be a bright yellow halo around the spot. The bacterium can spread through the planting material taken from the diseased plant, irrigation water and contaminated tools.

Control: Main strict sanitation and spray the plants thoroughly with streptomycin sulphur or oxytetracycline 200mg/l on a weekly schedule for about six weeks and then discontinue the spraying.

Economics of Production:

Total cost of production Rs/100 m² (Y1) = 46377/-

Number of flowers per 100 m² = 4978/-

Number of suckers per 100 m² = 775/-

Gross return from flower (Rs/100 m²) = 94582

Gross return from suckers (Rs/100 m²) = 93000

Total gross return (Y2) (Rs/100 m²) = 187582

Net return Y3=Y2-Y1= 141205

Benefit cost ration (Y3/Y2) = 3.04

Note:

3. Yield of flower and sucker is calculated on the basis of net cropped area.

4. Out of total number of flowers 10% of it is considered as unsold due to different

environmental and handling factors.

5. Out of total number of suckers 5% of it is considered as unsold due to different factors
6. Sale price of flower: Rs. 19.00 per flower
7. Sale price of sucker: Rs 120.00 per sucker



Bed preparation of Anthurium



Flowering stage



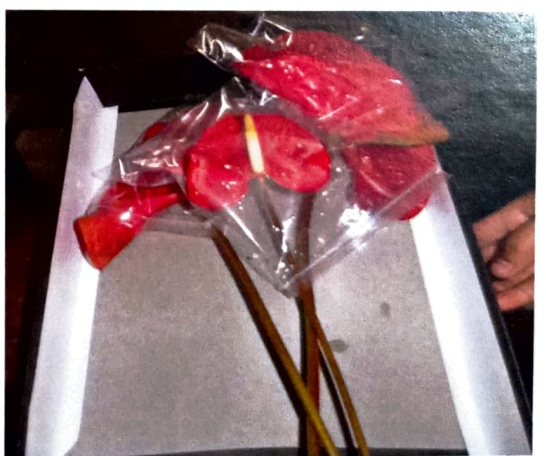
Cultivation of Anthurium under shade net condition



Cultivar: Tropical



Cultivar: Acropolis



Packaging of Anthurium