

# Package of practices for ornamental crops in Assam.

## 1. Tuberose (*Polianthes tuberosa*)

**Variety:** Prajwal, Shringar, Arka Nirantara, Phule Rajani, Local Single and Rajat Rekha (Single type); Local Double, Suhasini, Vaibhav (Double Type)

**Time of planting:** The best time of planting is mid March to April. However the time may be extended to June. Late planting cannot cope the heavy pour of rains and usually skip the summer blooming.

**Planting material:** Bulbs size more than 2.5 cm diameters are generally planted at 6 cm deep. Smaller bulbs of 2-3 numbers are clubbed together in a hill to avoid low flowering.

**Plant spacing:** Bulbs are generally planted at a spacing of 30x25 cm or 25x25 cm. However for high density planting spacing is maintained at 20x20 cm or 20x10 cm.

**Soil and Site:** It is grown in a wide range of soils. Well drained loamy and sandy loam soil rich in organic matter with a pH of 5.0-6.5 and having ample sunlight is suitable.

**Manures and Fertilizers:** A complete fertilizer of NPK 15:20:20 g/sq.m is given in 2 split doses for better growth, quality flowering and yield of bulbs. The FYM @10 t/ha is applied at the time of final land preparation. First dose of NPK is given at 30 days after sprouting as bend placement and the second dose during August-September. A basal dose of bio fertilizer comprising of FYM 2kg/m<sup>2</sup> /year + Mustard oil cake 200g/m<sup>2</sup>/year+Bio-fertilizers (Vam=*Azospirillum*+PSB) @ 2g per plant at an interval of 2 months with *Trichoderma viridi* 20g/m<sup>2</sup>/year along with a common dose of inorganic fertilizer may be applied to increase flower and bulb yield of tuberose for fresh and ratoon crops.

**Use of Mulching:** Black polyethylene mulch is very useful to counter weeds in summer and water stress during winter.

**Irrigation:** Watering should be done at weekly interval during dry spells in summer and winter.

**Plant protection:** (i) Sclerotial Wilt (*Sclerotium rolfsii*): Dipping of bulbs in captan (0.3%) for 30 minutes before planting followed by soil drenching soil with captan (0.3%) @ 1.5 l/ m<sup>2</sup> bed area at monthly interval for three months. Alternatively, pre-planting dipping of bulbs in the

solution of *Trichoderma viride* (10 g/l) followed by soil application of *T. viridi* @ 100 g/ m<sup>2</sup> after mixing with 1kg FYM at the time of planting.

(ii) Leaf spot: (*Alternaria polyanthi*) :Spraying with Azoxystrobin (Amister) (0.1%) or Difenoconazole (Score) (0.1%) or Iprodione + carbendazim (Quintal) (0.1%) at 10 days interval is recommended for the management of leaf spot disease of tuberose.

**Intercropping:** In commercial cultivation of tuberose as ratoons certain winter vegetables like peas, spinach, beet, French bean and carrot can be taken up as intercrops. In practising intercropping system an alternate row is evacuated to facilitate better space for vegetable.

**Ratooning:** Fresh planting should be done in every year to harvest better quality flower and bulbs. Prajwal is most suitable for first and second ratoon. Local Single is suitable for a single ratoon only. Regular and frequent weeding should be done. Recommended dose of fertilizers should be applied during first and second ratoon crops.

**Vase life:** A holding solution containing potassium permanganate (25ppm) and also sodium chloride (1000ppm) alone improve the vase life of cut spike of tuberose. Also Citric acid 300 ppm, Cobalt chloride 100 ppm and Alluminium Sulphate 300 ppm combined separately with 5 % sucrose solution is recommended as promising holding solution for extension of vase life of cut spike of tuberose.

**Cost of cultivation:** Rs. 47,100.00/Bigha

**Benefit cost ratio:** 3.75

## **2. Gerbera (*Gerbera jamesonii*)**

**Varieties: A.Field grown gerberas:** Red Gem, Red Monarch, HRSG-OWC, Jawahar, HRSG-IP, HRSG-Saffron, HRSG-Red, and Pink Melody

**B.Exotic gerbera:** Shimmer, Goliath, Tecla, Miracola, Piton, Pink Elegance (PIK), Blessing (BNG), Salvador (SVD), Fusion (FUS) Optima and Red Explosion

**Propagating material:** Gerberas are propagated by suckers separated from mother clumps.

**Growing condition:** Exotic gerberas can be cultivated under low cost polyhouse.

**Soil and site:** A well drained sandy loam type of soils with semi sunny situation is best for field grown gerbera.

**Time of planting:** Separated toned suckers are directly planted in raised bed during the month of September-October.

**Spacing:** Gerberas are replanted every year in raised bed at a spacing of 30cm between plants and 35cm between rows.

**Preparation of bed:** Soils are well pulverised with organics @5-10 kg/m<sup>2</sup> and making beds with 10 inches height to accommodate at least three rows .Black polythene may be used for cent percent rooting and better management of the crop.

**Manures and Fertilizers:** FYM 5-10 kg/m<sup>2</sup> to be applied at the time of preparation of bed.The level of NPK @ 30 g N, 10g P<sub>2</sub>O<sub>5</sub> and 20 g K<sub>2</sub>O per square meter is the best economic level for the agro climatic conditions of Assam. If black mulch is used half dose of nitrogen and full doses of phosphorus and potassium are to be applied at the time of preparation of bed. The remaining dose of nitrogen is split as foliar spray at monthly interval.

**Irrigation:** Irrigate the crop as and when necessary to keep the soil under saturated condition.

**Plant protection:**(i) Foot rot (*Phytophthora* spp) Basal application of *Trichoderma harzianum* @ 500 g/m<sup>2</sup> at the time of planting followed by soil drenching with fungicidal solution of Metalaxyl (8%) + Mancozeb (64%) @ 0.25% one month after planting.

(ii) Leaf spot/blight: Spraying of iprodion+carbendazim (0.2%) or difenconazole (0.05%) at 7-10 days interval are effective for managing the leaf spot/blight disease of gerbera.

**Harvesting and post harvest handling:** Gerberas are harvested when second row of disc florets shows pollen development. Flowers are graded to the size of flowers and length of stem. Individual flower heads are packed by polypropylene sleeves and packed in insulated boxes and then transported.

**Vase life:** A holding solution containing sucrose (2%) along with Tartaric acid (300ppm)or Aluminium Sulphate (300ppm) alone and in combination with sucrose(5%) solution is recommended as promising additives for extension of vase life of cut stalk of gerbera .

### **3. Orchids (*Dandrobium* spp.)**

Cultivation of orchids one of the prime flowers of the region have huge potentiality for grabbing international market. Assam is blessed with 192 species of indigenous orchids. From the floricultural point of view orchids are broadly classified into epiphytes and terrestrials. The

epiphytes live an independent life as far as their food requirement is concerned and they perch themselves on trees and rocks. On the other hand, the terrestrial types grown on earth like ordinary plant.

**Genera suitable for the region:**

Epiphytic: Dendrobium, Vanda, Arenda, Arenalthera, Mokora, Oncidium, Phalaenopsis, Rhynchostylis, Areodes

**Terrestrial:** Phaius, Spathoglottis, Cymbidium, Paphiopedilum, Arundina etc.

**Variety: Dendrobium:** Snow White, Sonia-16 and 17, Sakura, Pompadour, Genting Red, Miss Singapore, Juwita and Green Mist Mokara CKP, Mokara CKO, Mokara Red, Aranda HG, Aranda KCB, Aranda Pata, Aranda

ACA, Arenalthera ABLR

**Propagating material:** Conventionally plants are usually propagated by division of shoots and by cutting of Kiekies in Dendrobium. Terrestrial orchids especially Phaius are propagated by division of off shoots and cutting of flowering stalk.

**Potting material:** Perforated earthen pots, tree logs, ordinary rough brick 1.5 inch diameter cylindrical block, coconut husk block (30 cm x 25 cm x 12 cm), hanging poly net bag containing bricks and charcoal are generally used for epiphytic orchids. On the other hand for terrestrial orchids ordinary earthen pots are used.

**Pot mixtures:** For growing Dendrobium orchid coconut husk blocks are superior. If growing on earthen pots a mixture of burn brick pieces, charcoal and bits of coconut husk (3:1:1) can be used.

For terrestrial species, a mixture of loam soils, rough river sand and coconut husk bits (3cm x 3cm) and peat moss or leaf mould in equal proportion is the best growing media for higher pseudo bulb production.

**Growing condition:** commercially orchids are grown in low cost (concrete pole- bamboo framed) or medium cost (concrete pole- iron framed) agro shade net house of 30-50% intensity.

**Nutrition:** Application of NPK (20:10:10) @ 0.2% at weekly interval along with *Azospirillum* and Phosphobacterium each of 2g per plant at two month intervals is optimum for suitable

growth and flower production in *Dendrobium* spp. For micro and macro nutrient supplements Ohio solution may be applied at quarterly interval.

**After care:** The pots or blocks of epiphytes should be watered regularly and those of terrestrials at an interval as and when necessary. Occasionally emerged weeds should be removed from time to time. Monopodial orchid should be properly staked. If the basal portions of monopodial orchids become leafless it is suggested to cut off the portion to encourage healthy roots.

**Harvesting and post harvest handling:** *Dendrobium* orchid spikes are generally harvested 3-4 days after opening of flowers. Grading of spike is done in three categories based on florets number, size and arrangement of florets in a spike. *Dendrobium* is usually packed in 4 dozen sprays per box. The cut ends of flower spikes are to be covered with wet cotton wrapped with polyethylene to maintain turgidity.

**Vase life:** Use of Hydroxy Quinolin (HQ) @ 400 ppm along with 5 per cent prolongs the vase life of *Dendrobium* orchid. Combining pulsing of 500 ppm of HQ and 5% Sucrose for 6 hours then held the flower spikes in the holding solution containing 25 ppm of Ag NO<sub>3</sub> along with 400 ppm HQ and 5% Sucrose also prolongs the longevity of cut orchid spikes. The spikes wrapped with polypropylene sleeves along with KMnO<sub>4</sub> before transit improves the flower longevity of cut spikes of *Desndrobium*.

**Plant protection:** Pests and diseases attack orchids; growing of healthy plants under good hygienic condition is the best way to prevent diseases.

- i) Pythium black rot which infects roots and spread into the rhizome and pseudo bulb can be checked by spraying 10 ppm copper sulphate solution at weekly interval.
- ii) Anthracnose which causes leaf spots and soft leaves can be controlled by copper fungicide spray.
- iii) Rust causes reddish brown spots and quickly spreads from plant to plant. This can be controlled by dusting sulphur or spray with Mancozeb 75WP (2 g/l).
- iv) Bacterial soft rot causes slimy rot of pseudo bulbs and stembases. The affected plants should be destroyed and other plants should be sprayed with streptomycin or streptocycline (100 ppm) .
- v) Cercospora leaf spot can be controlled by spraying captan 50WP @2g/l of water.

- vi) In case of Black rot caused by *Phytophthora*, application of combo fungicides like metalaxyl + mancozeb or aliette @ 2.5 g/l should be done.

**Insect Pests:** The following are the major pests of orchids prevailing in Assam. The control measures are given against each of them

**Snails and Slugs:** Metaldehyde baits containing arsenic

**Yellow beetle:** Eaten up the flower buds, half bloom flowers and tender leaves. The pupation takes place in the plant itself. Can be controlled by applying any contact insecticides like Dichlorophos (1ml/l), Malathion (2g/l), Quinolphos (2g/l).

**Irrigation:** The requirement of irrigation is depended on local weather, media on which it is grown and size of the container. Regular irrigation in judicious manner especially during active growing seasons is considered worth management practices to get satisfactory yield. Otherwise it will invite diseases and impaired normal growth of the plants. Frequent irrigation is restricted in newly planted seedlings. Overhead irrigation is preferred method.

#### **4. Gladiolus (*Gladiolus grandiflorus* L.)**

**Variety:** Red Candiman, White Prosperity, Subhangni, Priscilla, Novalux, Yellow Gold, American Beauty, Eight Wonder, Friendship, Red Sea, Suryakiran, Gold Beauty, Dhanawantry, Tiger Flame, Poppears, Sunayana, Suchitra, Copperking, Sylvia, Agnirekha, Oscar, Mohini, Mukta, Shobha, Meera, Nazrana and Poonam.

**Propagating Materials:** No stake varieties having 3-5cm diameter with average yield of three spikes are considered best for cut flower production. Tall varieties are preferred for bedding plant. Large corms can be vertically cut into two to three pieces which are then used as seed material.

**Preparation of corms:** Cold stored corms during the first part of September de tunicate and treat with 0.2% Carbendazim and kept in open at least for ten days. Thereafter the corms are placed over sand bed in a partially darker environment to induce sprouts. Within few days as soon as roots appear from bottom and also sprouts emerge corms should be planted.

**Soil and Site:** Gladiolus can be grown in a wide range of soils but deep, rich, well pulverized and well drained loam soil is considered best.

**Planting:** Sprouted corms are planted in six inches deep furrows at 45cmx10cm spaced. After fertilization the rows should be levelled and hilled up after 15 days of levelling.

**Manures and Fertilizers:** Apply 10t/ha of FYM at the time of final land preparation. NPK should be applied in the ratio of 1:2:2 @ 56 g/m<sup>2</sup> in two equal splits. Once at the time of planting by properly mixed in the furrows before planting of corms and other at 4 to 6 leaf stage before hilling up. Application of slow release fertilizer Basacote Plus' (16-6-12) @4g per pot once in 9 months is beneficial for healthy growth and flowering.

**Plant growth regulator:** Soaking corms with GA<sub>3</sub> (2500ppm) before planting has shown the best performance on growth, flowering and corm production. Treating corms with ethrel (2000ppm) increases the number of cormels at harvest.

**Irrigation:** Watering should be done at weekly interval to keep the soil under saturated condition.

**Plant protection:** (i) Fusarium wilt (*Fusarium oxysporum* f.sp. *gladioli*): Pre planting dipping of corms in the solution of carbendazim or Benomy @ 0.2% for 20 minutes followed by need based soil drenching with the same fungicidal solution. Alternatively, Pre-planting dipping of gladiolus corms in the solution of *Trichoderma viride* (10<sup>6</sup> cfu /ml i.e. 10 g/l ) for 45 minutes followed by the soil application of *T. viride* (500 g/m<sup>2</sup>) at the time of planting may be recommended.

(ii) Thrips and cutworms are serious pests of gladiolus. Dusting of malathion 5% dust at the base of the plants is effective against thrips, while spraying of malathion 50EC 0.2% at 15 days interval effectively control cutworms.

**Harvesting and post harvest handling of spike:** For local market spikes are harvested when first pair of florets just started opening. For distant market flowers are harvested when 1-5 florets show colours with at least two numbers of clasping leaves.

**Vase life:** Use of holding solution containing Sodium hypochlorite (50ppm) and Potassium permanganate (25ppm) along with sucrose (4%) extends vase life. Pulsing with sucrose (20%) along with alluminium sulphate (300ppm) extended storage life for a week under dry refrigerated condition.

**Harvesting and Storage of corms:** When leaves turn brown the corms along with the cormels are lifted from ground and allowed for curing by spreading in cemented floor. The corms are then cleaned by removing roots, clots etc. and treat with carbendazim(0.1%) + captan(0.2%) together by soaking 15-30 minutes. Thereafter the corms are properly sundry and stored in cold storage at least for three months.

**Benefit cost ratio:** 3.21

## **5. Heliconia (False Bird of Paradise)**

**Variety:** Bihai Yellow Dancer, Bihai Orange Dancer, Shrimp heliconia, Psittacorum, Red heliconia

**Propagating material:** Healthy rhizomes containing 2 to 3 buds with an average weight of 40 g is suitable as seed material.

**Soil:** Heliconias can be grown in a wide range of soils but deep rich in organic carbon well pulverized and well drained loam soil is considered best.

**Time of Planting:** January to March is suitable for establishment of the plant to get a quick response of growth in the beginning of monsoon.

**Spacing:** 100cm apart from plant to plant and row to row.

**Manures and Fertilizers:** 4 kg of FYM/m<sup>2</sup> and 40:20:20 g NPK/m<sup>2</sup> is given in 2 split doses for better growth, yield and quality of flowers. The first dose is given at sprouting of new shoots and second when suckering started.

**Irrigations:** Watering should be done at regular intervals to keep the beds under saturated condition.

**After care:** A timely weeding and pruning of scorched and older leaves should be a regular operation. As flower is monocarpic in nature once the flower is over the flower bearing shoot should be pruned to ground level to encourage lateral growth of shoots.

**Harvesting:** Flower should, be harvested when 2 to 3 flower bracts unfurled.

**Plant Protection:** There are no serious insect pest and diseases of heliconia.

## **6. Anthurium (*Anthurium andreanum*L.)**



**Varieties:** Eveta, Ellen, Tropical, Red Dragon, Ozaki, Cherry Red, Sweet Heart, Fire, Agnihotri, Passion, Madonna, Lima White, Sunset Orange, Orangeeth, Nitta are some promising varieties for the region.

**Climatic requirement:** Anthurium requires conditions of high relative humidity well above 70%. It is grown commercially in low cost (bamboo frame) and medium cost (angle iron) net house with 75% roof intensity. Protecting the plants from heavy rain UV stabilized 200 micron plastic film can be used along with net during rainy seasons. The sides of the net house should be covered with shade net (50% or lower) to improve the microclimate within the house. These nets can be raised for proper ventilation when the temperature rises.

**Planting Season:** Anthurium can be planted round the year except winter months, when the plants become lesser active in growth and development.

**Planting material/propagation:** Tissue cultured saplings are usually used for commercial cultivation. However, conventionally by separating suckers produced at the base of stand crop may also be utilized. When the ground suckers grow to 4-5 leaf stages with few good roots attached to them, they can be separated by pulling out from the base and directly plant in beds.

**Growing media:** The growing media for anthurium should be organic rich, slightly acidic, porous and well aerated. According to availability different organic materials like rice husk, coconut husk, sugarcane bagasse, wood savings, tree bark, water hyacinth, leaf mould, saw dust etc. can be mixed and used as growing media. Growing media consisting of 2 parts of rice husk or pine bark + one part peat + one part coarse sand + one part cow dung + half part charcoal produced best vegetative growth and good flower characters.

**Pot culture of anthurium:** In small scale cultivation, anthurium can be grown in earthen pots of 25 to 30 cm width with two or more holes in beneath. Crock pieces are placed at the bottom of the pot above which a 2cm layer of coarse sand is spread. Over this, brick or charcoal pieces are arranged so that the root ball can be placed easily. The sides of the root ball are covered with pieces of coconut husk and a filler mixture of sand and cow dung is spread over it to fill up the gaps. Initially the pot is filled to about 1/4<sup>th</sup> to 1/3<sup>rd</sup> and subsequently with increasing growth, fresh medium is incorporated once in about three months.

**Planting in beds:** Large scale commercial cultivation of anthurium is done in beds.

1. The bed should be 1.2 to 1.4m wide depending on the length and breadth of the growing environment and plant spacing adopted.
2. The side wall of the beds can be made either by using short bamboo pole/areca nut wood/wood or bricks
3. A convenient space is made in between beds.
4. Polyethylene sheet (0.1cm thick) is placed on the bed to separate the media from the
5. A drainage hose should be placed on the bottom of the bed to drain out the excess water located at the lowest point.
6. The bottom of the bed should have slope (2-3cm) from centre to wall so that excess water flows to the drainage hose. The gradient of the slope should not be more than 0.03% (3cm per 100m).
7. A sprinkler system, which provides adequate distribution of water can be installed in the middle of the bed.
8. The height of the growing medium should be minimum 20cm. It can be refilled within 2-3 years to a maximum of 30cm.
9. A wire should be tied long the bed (fastened to posts placed 4m apart) to keep the flowers out of path.

**Plant spacing:** 40-45cmx40-45cm depending on the cultivar.

**After care:**

**Application of PGR:** Plant growth regulators play an important role in increasing growth, sucker production, flower yield and quality and in reduction of juvenile phase of anthurium. Plants sprayed with Maleic hydrazide 1000 ppm at one and three months after planting produced shorter plants with more number of suckers. Plants sprayed with GA<sub>3</sub> (500ppm and 300ppm) and BA (200ppm) showed better vegetative growth and flower characters.

**Pruning of leaves:** About 5-6 healthy leaves are sufficient for normal growth and flowering. Diseased and old leaves should always be pruned as a routine management practices.

**Removal of suckers:** Suckers produced at the base of the parent plants should be removed to encourage quality flowering. Crowding of suckers at base leads to poor quality of flowers. Suckers should be removed from the base while their roots are still not penetrating the medium.

**Manures and fertilizers:** Fertilizers should be applied in smaller doses at frequent interval; rather than larger doses at longer intervals. For pot cultivation, 10 g of complex fertilizers (N: P: K;

17:17:17) in 1000ml of water is sprayed on foliage at monthly interval. In case of Ca deficiency lime @ 5g/plant/month is recommended. Soil drenching of liquid manure consisting of cow dung/urea once in a month is beneficial. A handful of dried sieved cowdung is applied at the base of the plant at monthly interval. It is advisable to reduce the quantity of nitrogen application during flowering as it reduces the post harvest life of flowers.

**Plant protection:** Bacterial blight of anthurium (*Xanthomonas campestris* pv. *dieffenbachiae*): Spraying with streptomycin sulphate (100 ppm) + copper oxychloride (0.25%) after destroying the severely infected leaves at weekly interval. Root rot (*Phytophthora* sp., *Rhizoctonia* sp., *Fusarium* sp., *Pythium* sp.): Controlled by soil drenching with 0.25% Mancozeb and 0.25% Thiram or 0.2% Captan.

**Harvesting and post harvest handling:** Stalks are harvested when spathe is fully opened or 1/3<sup>rd</sup> to 2/3<sup>rd</sup> of true flowers on the spadix are open. The flower stalk should be cut with a sharp knife, leaving about 3 cm of the stalk on the plant and the basal portion of the flower stalk should be immersed in water to prevent drying out. Using of additives containing Sucrose (5%) and 300ppm of  $Al_2(SO_4)_3$  improves shelf life of anthurium spathe.

## 7. Marigold (*Tagetes erecta* L.)

**Variety:** Hajo Local (Orange), Hajo Local (Yellow), Pusa Narangi Gaidha, Pusa Narangi Gaidha, Seracoal, Golden Glow, Glitters, Burpee Gold, Guinea Gold, etc.

**Propagating material:** Rooted cuttings and seed.

**Soil and site:** All types of well drained soils with sunny locations are preferred.

**Planting time:** September-October for winter crop, January-February for early summer crop and Mid June to Mid July rainy season crop.

**Making of rooted cuttings:** For winter and early summer crop tender shoots having 3-4 nodes are preferred for cutting. However, for rainy season crop matured side shoots of 8-10 inch long are selected for cutting.

**Plant Spacing:** A spacing of 40cm x 45 cm is adopted for winter and summer crop and 50cm x 50cm for rainy season crop.

**Plant protection:** (i) Leaf and flower blight (*Alternaria dianthii*) of marigold: In anticipation of rainfall with cloudy weather and low temperature, prophylactic spraying with difenconazole

(0.1%) or a combo fungicide, iprodion + carbendazim (0.2%) at 7-10 days interval were found effective..