

ORNAMENTALS - FLOWERS

Flowers are symbolic of beauty, love and tranquility. Besides their aesthetic value, they are important for their economic uses, such as for cut-blooms and for extracting perfumes and other products. In our country, flowers are sanctified and are commonly used in worshipping the deities in our homes and temples. We are intimately associated with them, and on all festive occasions like marriages, religious ceremonies and social functions, the use of flowers and garlands has become almost essential.

According to an early survey made by the Indian Council of Agricultural Research, flowers are grown in about 4,000 hectares for commercial purposes, with an annual production of about 10,500 tonnes of cut-flowers worth 9.26 crores of rupees sold annually in the markets of Bombay, Calcutta, Madras, Bangalore and Delhi. However, with the increase in demand for cut-flowers in recent years, the production is estimated to have gone up considerably. Consequent upon the rapid development of hotels and tourism, there has been a sudden rise in the number of florist's shops and kiosks in the metropolitan cities. The perfumes extracted from some flowers, e.g. rose and jasmine, are no longer luxuries, as considered by many earlier, but they have become the essential needs of our daily life. Perfumes are used in manufacturing soaps, cosmetics, hair-oil and in food and tobacco industries. Besides, the seed and nursery business is a source of income to many for their livelihood and provides employment for many. There is also a considerable scope for exploiting the export potential of ornamentals, particularly cut-flowers, plants, seeds and bulbs. Recently, there have been some sporadic, but unsteady, attempts also to export ornamentals.

There are some other perennial vegetables, such as *cho-cho* (*Sechium edule* L.), sea-kale (*Crambe maritima* L.) and horse-radish (*A Armoracia rusticana*) which are grown in a very limited area. There are also some fruit crops, e.g. banana, papaya and jackfruit, which are cooked as vegetables in the immature stage. The drumstick is also a popular perennial vegetable.

Botanically, the ornamentals are spread over the entire plants kingdom, including both lower and higher plants, herbaceous annuals, biennials or perennials or woody trees, shrubs and climbers, succulents, desert or aquatic plants and epiphytes and terrestrials. Of the large variety of ornamentals grown in the gardens of India, a few very important flowering plants, useful for garden display, cut-flowers or the perfume industry, are described in this chapter.



Rose (*Rosa* spp. And hybrids : Family : Rosaceae) The modern roses are derived from crosses between the Chinese roses (*Rosa chinensis* Jacq.) and the European roses (*R. gigantea*, *R. damascena* Mill., *R. moschata* Herrm). There are six different types of modern roses, grown in gardens, namely, hybrid-tea, floribunda, polyantha, climbing and rambling, miniature and shrub roses. The flowers in the hybrid-tea are well-shaped and are borne singly, whereas in the floribunda they are large and are produced in clusters, unlike those of polyantha, which has smaller flowers in larger trusses. The miniatures are dwarf, having small leaves and flowers, and are suitable for growing in pots.

PROPAGATION. Roses are propagated both by budding and by using cuttings but the former method is preferred for obtaining better-quality and faster-growing plants. In Bengal, roses are also propagated by inarching. The rambler, polyantha and miniature roses are successfully multiplied from cuttings. The cuttings are inserted into the soil or sand from December to February. The commonly used rootstock is the Edouard rose, whereas in Bengal, in the northern hills and in southern India *R. multiflora* is used for this purpose. The rooted plants of the rootstock are transplanted in July or August at sites where the budding is to be attempted. The best time to bud roses is from December to February in northern India.

PLANTING The rose-bed should be located in a sunny situation, away from trees or hedges and it must receive sunshine at least during the whole forenoon, if not during the whole day. The bed should be well-drained, as the rose does not thrive in a wet or water-logged soil. The best time to plant roses is from September to November in the northern plains of the country. The bushes are planted about 60 cm apart in a row and the distance between the rows is 76 cm. The standard or tree-roses (budded) at a height of 1 metre are planted about 1-1.25 m apart, whereas the distance between the climbers may be about 2-2.5 m. It is useful to apply about 8-10 kg of cowdung manure and 3 g of Aldrin or BHC 5% to each pit at the time of planting.

PRUNING. The rose plants are pruned once a year during the second or third week of October in the northern plains. After about 6 to 7 weeks of pruning, the plants start flowering. The time of blooming can be adjusted according to the date of pruning. The new or so-called "maiden" plants are not pruned and these are generally tipped lightly before planting. In the old hybrid-tea bushes, the previous season's thick shoots are pruned up to half their length, keeping about 5 to 6 eyes on each stem. A slanting cut is made a little above an

eye which is facing outwards. The floribunda is pruned moderately. The climbing and rambling roses do not require any pruning, except the removal of unhealthy, dead and interlaced twigs. The polyantha roses are pruned lightly, whereas the miniatures are generally not pruned.

MANURING. After pruning, the soil in the bed is dug up with a fork with due care to avoid any damage to the roots. About 8-10 kg of cowdung manure is applied to each bush by incorporating it into the soil, and then the plants are watered copiously. After a fortnight, a mixture of fertilizers may be top-dressed. A convenient and useful fertilizer mixture can be prepared, by taking the weight, ammonium sulphate (2 parts) or urea (1 part), superphosphate (8 parts) and potassium sulphate (3 parts), and about 100 g of this mixture may be applied to each bush. A top-dressing of the fertilizer mixture can be given again in January-February after the first flush of flowering is over. A foliar spray of 2 parts of urea, 1 part of dihydrogen ammonium phosphate, 1 part of potassium nitrate and 1 part of potassium phosphate is also useful. About 15 g of this mixture may be added to 2.5 liters of water for spraying. It is often useful to spray the foliar feed, along with an insecticide, e.g. Malathion or Masurdin. The foliar spray may be started by the middle of November and continued till the flowers open but it should not be applied when the plant is in full bloom, as it will damage the flowers.

WATERING. Heavy watering at comparatively long intervals is more useful than frequent light watering. Water-logging is harmful to roses.

SUCKERS. The suckers or shoots of the rootstock emerging from the base of the plant should be removed as soon as they appear. They can be distinguished from those of the scion by the shape and the size of their leaves.

DISEASES AND INSECT PESTS. The common diseases of roses are black powdery mildew and black spot. Die-back results in the blackening and drying of shoots from the cut-ends downwards after pruning. One spraying with rogor (0.1%) soon after pruning, followed after a week by another spraying with Captan (0.2%) is effective in controlling these diseases. Benlate (0.1%) may be sprayed from February to April to control powdery mildew and again in November to control black spot.

Among the insect pests, the important ones are aphids, thrips, chafer, beetle, red scale, mites and termites. The aphids, which appear during December to March, can be controlled by spraying the plant with Malathion (10cc in 10 liters of water). In July-August, the plant may be sprayed with DDT (0.2%) to control the chafer beetle and thrips. From August to October, and again in April, a spraying with Parathion (0.1 per cent) is effective in controlling the red scale. Aldrin-dust (5%) at the rate of 30 g per m² is useful against termites.

VARIETIES. There are several thousand varieties of roses and several hundred new ones are being added every year. The choice of varieties depends mainly on the climate and the soil of the growing region for cut-flowers, exhibition, garden display, etc. and on personal or family preferences. A few important varieties are mentioned below.

Hybrid Tea

Red and dark red : 'Avon', 'Papa Meilland', 'Oklahoma', 'Mister Lincoln', 'Christian Dior', 'Happiness'

Orange : 'Hawaii', 'Super Star'

Yellow : 'Summer Sunshine', 'King's Ransom', 'Kiss of Fire', 'Golden Splendour', 'Golden Giant'

Pink : 'Eiffel Tower', 'Michelle Meilland', 'Peter Frankenfildt', 'First Prize', 'Montezuma' (coral pink), 'South Seas'

White : 'Virgo', 'Matterhorn', 'John F. Kennedy', 'Dr. Homi Bhabha'

Bicolours : 'Bajazzo', 'Ingo Hortsmann', 'Rose Gaujard', 'Granada'

Lavender or Mauve : 'Blue Moon', 'Lady X'

Copper colour : 'Thais', 'Vienna Charm', 'Whisky Mac'

Striped : 'Anvil Sparks' (red with yellow streaks), 'Careless Love' (pink with white streaks)

Fragrant : 'Crimson Glory' (red), 'Papa Meilland', 'Oklahoma', 'Fragrant cloud', 'Charles Mallerin' (Velvety red)

Floribunda : 'Charleston' (yellow and crimson), 'Flame-neo' (salmon), 'Orange Sensation' (deep orange), 'Banjaran' (red and gold), 'Iceberg' (white), 'Arthur Bell' (yellow), 'Africa Star' (mauve), 'Else Poulsen' (pink, single), 'Delhi Princess' (pink), 'Himangini' (white), 'Prema' (soft-pink with deep-pink edges), 'Summer Snow' (white), 'Dearest' (rosy salmon), 'Zorina' (gealdine red) and 'Zambra' (orange)

H.T. Type Floribunda : 'Queen Elizabeth' (pink), 'Sea pearl' (pink), 'Pink Parfait' (light pink), 'Tiki' (shell pink)

Polyantha : 'Chatillon Rose' (deep pink, single), 'Vater Tag' (vermillion), 'Echo' (pink changing to white)

Miniature : 'Cri Cri' (salmon coral), 'Baby Masquerade' (lemon chrome), 'Little Buckaroo' (velvety red),

'Rosemarin' (silver rose), 'Coralin' (red orange)

Climbing : 'Clg. Show Girl' (pink), 'Clg. Virgo' (white), 'Clg. Summer Snow' (white), 'Prosperity' (white), 'Marechal Niel' (Lemon), 'Golden Showers' (yellow), 'Lamarque' (white), 'Mardan White' (white), 'Mardan Pink' (pink), 'Cocktail' (red with yellow centre), 'Josephs Caat' (red and yellow)

ROSE PERFUME. The oil of rose is extracted from *Rosa damascena* Mill variety. *triginipetala* Dieck (2n=14), popularly called Kazanlik Rose or 30 petalled rose. Bulgaria produces the largest quantity (2 tonnes) and the best quality of rose-oil in the world. The current price of oil is about 3,800 dollars per litre (approx. Rs 32 per g).

In India, the Damask rose, *Rosa damascena*, or the Bushra rose similar to the kazanlik rose of Bulgaria, is grown in several areas in Uttar Pradesh, namely Barwana, Banwaripur, Ban, the villages of Hasayan and Badanpur in the Aligarh district, Sikandarpur in the Ballia district, Jhinwar (Etah district), Kanauj, Ghaziapur, Kanpur, Saharanpur and Jaunpur districts and also in Kannaur in Haldi Ghati near Udaipur (Rajasthan). The largest areas (400 ha) is in the aligarh district, where the annual production is estimated at about 7,400 quintals. It is grown as an irrigated crops. Flowering occurs during March-April for about 20-25 days once a year. The bushes are pruned in December and at this time, the cuttings are planted in the field for raising a new crops. Very little fertilizer is used, except some farmyard or cowdung manure at the time of pruning. The yield of flowers is up to 3,600 kg per hectare, depending upon the age of the bushes.

The oil percentage in a rose flower is about 0.045. The flowers are plucked in the morning for the extraction of oil. The distillers, who usually come from Kanauj, set up the distillation apparatus in the cultivators fields in the Aligarh district, where the rose flowers are brought from the neighbouring areas for extracting oil. The common products prepared are rose-oil, *gulkand* and rose-water. Rose concrete is produced in very small quantities. The Indian rose-oil compares favourably with the Bulgarian rose-oil. The quality of rose-oil depends upon the percentage composition of alcohols, viz. citronellol fraction is always more than that of geraniol in the ratio of 1.2 : 1 to 1.5 : 1. The Kazanlik rose-oil contains 72 and 74 per cent of these alcohols.

Another variety grown is *R. damascena* variety *bifera*. It is commonly cultivated in Kanauj (Uttar Pradesh) and gives a second flush of flowering in September. However, its oil is inferior in odour. The Edouard Rose (*R. borboniana*) or Chiniya *gulab* is grown for making *gulkand*, but it fetches a lower price. The species *R. centipetala* is also grown in some parts of India for making *gulkand* and rose-water. Its oil is also inferior both in content and quality.



Jasmine. (*Jasminum* species; Family : Oleaceae) About 200 species of *Jasminum*, both climbing and trailing or shrub, with erect habit are found in temperate, tropical and subtropical regions of the world. Several species of *Jasminum*, including many important cultivated ones, are native of India.

The jasmines are highly prized for their fragrant flowers, used in the preparation of perfume and concrete. The jasmine flowers are commonly used for making garlands and 'veni' for adorning the hair of women. In the garden, the jasmine is raised as a dwarf-growing shrub, and a few species are grown as climbers.

SPECIES. The commonly grown species are *Jasminum officinale*, *J. grandiflorum* (*chameli* or *janti*), *J. sambac* (*bela*, *motia*, *mogra*, *donthara malle*, *boddu malle*, *moturia*, *rai* or *madanban*), *J. auriculatum*, *J. augustifolium*, *J. paniculatum*, *J. pubescens*, *J. arborescens* and the yellow-flowered *J. primulinum* and *J. humile*. The flowers of *J. grandiflorum* are used for extracting the essential oil. *J. sambac* is most commonly grown in the gardens. Its flowers are single, semi-double or double, and large or small, white and fragrant. Almost all species flower during summer and the rainy season. The species *J. pubescens* flowers during winter in northern India.

PROPAGATION. The jasmines are commonly propagated by layering or by using the cuttings of almost mature wood.

CULTIVATION. Planting is done in the rainy season. The dwarf shrub-like *J. sambac* is planted about 1-1.5 m apart whereas the creeper may be grown about 3.5 m apart, trained on arbours, arches, pegolas, screens or walls. *J. sambac* can also be grown in large pots. The plants may be pruned after flowering to obtain better growth and better flowers next season.

In Tamil Nadu, Andhra Pradesh and Karnataka, the jasmines, particularly *J. sambac*, are commercially cultivated for cut flowers. The watering of the plants is withheld in the end of November to bring them rest and shed their leaves. Sometimes, the foliage is also removed by hand. The shoots are also pruned to half their length in January, and cowdung or farmyard manure, at the rate of about 10 kg per bush, is applied after exposing the roots for a few days. The watering of the plants is started slowly and later increased after the appearance flower-buds. Watering is withheld after each flush of flowering until fresh flower-buds appear again. The flowering in *J. sambac* is best during summer, particularly in June-July. The creepers bloom for a longer period or almost throughout the year. Its flowering takes place in flushes at intervals of one week. The yield of flowers is about 1,000 to 1,500 kg per acre. The climbing types yield a little more, about 2,000 kg per acre.



Chrysanthemum. (*Chrysanthemum* spp; Family : **Compositae**) In popularity, chrysanthemums are perhaps next only to roses and have been in cultivation for more than 2,500 years. They have undergone remarkable changes as the result of artificial crossing and selection in their native countries, namely China, Japan, England, France, the USA and Australia. There are thousands of varieties now in cultivation in different countries. It is a national flower of Japan, where its cultivation has reached its perfection. It is very commonly grown in glass-houses for cut flowers and its flowering can be manipulated with artificial light and with controlled temperature.

CLASSIFICATION. Chrysanthemum varieties are classified into seven main groups, namely, incurved (a perfect ball), incurving (petals incurve loosely or irregularly), reflexed (dropping florets), Anemone (single petals with a tubular central disc), Pompon (very small flowers, without any visible centre), singles (five petals with a central disc), miscellaneous, such as Spider (petals with a hook at the tip), Spoon (with a spoon-like tip of petals), Koreans (small single, semi-double or double flowers with a visible disc) and Rayonnantes (with quilled petals).

In India, *Chrysanthemum indicum*, small-flowered (yellow or white), is used for commercial cultivation for cut-flowers in southern India, particularly near Coimbatore, Madurai and Bangalore.

CULTIVATION. The plants may be grown, both in pots and in the ground. During early February, the plants are beheaded after the flowering is over by cutting the stem, about 15-25 cm above the soil. After some time, when new suckers appear at the base of the stool, they are separated and planted in small 10 cm pots. Each sucker has its own roots. The potting-mixture consists of one part each of sand, soil and leaf-mould and a trace of wood ashes.

The second potting is done at the end of April and the suckers are transferred to bigger pots (15 cm) which are filled with a richer soil mixture containing one part of sand, one part of soil, two parts of leaf-mould, a quarter part of wood ashes and one tablespoonful of superphosphate. The third and final potting is done in August when the plants are shifted to 25-30 cm pots. The potting-mixture consists of one part of sand, one part of soil, two parts of leaf-mould, two parts of cowdung manure, a quarter part each of small pieces of wood charcoal and wood ashes and two tablespoonfuls of superphosphate. During May-June, the young plants should be protected from strong sunshine and from heavy rain during the rainy season.

Sometimes, young cuttings can be taken in July-August from the lateral growths in the leaf axils for propagation. The cuttings are about 5-8 cm long and their cut-ends are dipped into a root-promoting hormone, e.g. Seradix B, before planting them in sand. The lower leaves of the cuttings are removed before planting.

STOPPING AND DISBUDDING. By late May or early June, the young plants are pinched (stopped) by removing the tip of the main stem at a time when the young lateral shoots or 'breaks' are just appearing in the leaf axils. Stopping induces lateral growths to develop from the leaf axils, and the number of main stems one would like to keep can now be decided upon. Generally one, three or six stems are retained for obtaining exhibition blooms. At the end of each stem, there develops the first crown bud which is allowed to develop and the lateral growths, arising from the leaf axils are disbudded or removed. The terminal end of a stem usually has three flower-buds, the central one, being large, is the crown bud, with two small buds on each side. It is the crown bud which is allowed to develop, whereas the others are removed. However, in the case of Pompons, Singles, Koreans and Sprays, no disbudding is practiced. Sometimes, in the case of a variety the first crown buds are removed and the second crown buds are secured to obtain flowers.

These second crown buds, in general, produce smaller flowers, but of a more intense colour, particularly so in the case of oink varieties. The date of blooming depends mainly upon the time of starting the suckers or cuttings and the dates of stopping and disbudding. In foreign countries, e.g. Japan, the USA and the UK, the exact dates of stopping and disbudding have been ascertained for each variety to produce best quality flowers. The plants need staking during October. In Japan, the plants are trained in different styles.

MANURING. Ammonium sulphate (30-35 g) or urea (15g) may be mixed with 9 liters (2 gallons) of water and 0.5 litre (pint) of the mixture may be applied to each plant during July-August. Soon after the appearance of flower-buds, sulphate of potash may be applied in the same way as ammonium sulphate. About one tablespoonful of superphosphate may be mixed with the soil at the time of final potting. The liquid manure can be applied once a week after the appearance of flower-buds till the flowers are half open. Over-feeding is harmful, and it can be judged by snapping a leaf into two. If the leaf is dark green and brittle and breaks into two clean halves, further feeding of plants should be stopped.

WATERING. The young plants require frequent watering in summer but less during the rains. Over-watering should be avoided. The pot which sounds heavy on tapping with a wooden hammer indicates that it needs less watering, whereas the one with a clear sound will require watering.

PESTS AND DISEASES. The grubs of chafer beetle appear usually in July-August at the base of the pot and cause the wilting of plants. These grubs may be removed by hand and destroyed. It is also useful to mix a little BHC and DDT (5%) dust with the soil. The aphid appears in winter and it can be controlled by spraying the plants with Malathion (10 cc in 10 liters of water).

Among the diseases, wilt and powdery mildew are important. The wilted plants should be uprooted and burnt as soon as they appear. Spraying with Karathane or Benlate (0.1%) is effective against powdery mildew.



Orchids. (Several genera and species; Family Orchidaceae). Among the native flowers, orchids are most important and have been introduced into several countries from India. The Indian species of orchids have been used by orchid-breeders abroad for crossing with other species to produce some very attractive interspecific and intergeneric hybrids. The modern hybrids of orchid are used for cut-flowers which are the most expensive among all the flowers. Several species of orchids are found growing wild in the forests of the Himalayas, particularly in the north-eastern region comprising Darjeeling, Sikkim, Bhutan, Nepal, Shillong and the Assam hills, in the Western Ghats, Kodaikanal and some other areas. Orchids are also the natives of other parts of the world, e.g. Burma, Ceylon, Java, Singapore, Malaysia, Borneo, Thailand, Hawaii, New Guinea, South Africa, the USA, South America and Mexico.

HABIT. In the tropics, most of the orchids are usually epiphytic, i.e. aerial plant growing on the branches of trees or on bushes, but not deriving nourishment from them. There are also terrestrial species which grow in the soil like other plants. A few species are also saprophytic and live on dead, decayed or dried animal or vegetable matter. They are, however, not cultivated, as it is difficult to provide them with the same conditions for their growth as are found in nature in which they thrive well.

FLOWER. The orchid flower is characterized by its three sepals, three petals and the column or gynostemium having the reproductive parts. Of the three petals, two are identical, whereas the third is highly modified and is the showiest part of the blossom, commonly known as the lip or labellum. The lip may be tubular or broadly expanded, with warts or protuberances and in a few cases it may be almost indistinguishable from the other petals. The flowers may be borne solitary, in sprays of inflorescences in clusters, spikes, racemes or panicles. The colours are vivid, solid, streaked, spotted or mottled.

PROPAGATION. The orchids are propagated by dividing the clumps of pseudo-bulbs or stems after flowering. They are also multiplied by dividing them into pieces, each having some roots, by cuttings (as in the case of *Renanthera*, *Aerides* and *Saccolabium*), each cutting having some aerial roots. Orchids are also propagated from seeds (particularly the hybrids) in an artificial culture medium. However, the plants raised from seeds take at least three years to bloom. The modern technique of propagation of healthy plants is by meristem tissue-culture on artificial culture media. Nursemymen and orchid-breeders abroad use this technique for the rapid multiplication of orchids.

CULTIVATION. Orchids thrive well only in places such as Assam, Darjeeling, Andhra Pradesh, Meghalaya, Tripura, Sikkim, Bhutan, Kodaikanal, Bangalore, Pune and Bombay. In the northern plains, most of the orchids, except a few do not grow well and usually die during summer. They can be successfully grown both indoors and outdoors. Generally, they thrive well in the fern-house or greenhouse or conservatory covered with creepers, and kept cool and moist by spraying water in the form of a mist on the plants during summer.

Of the numerous species of orchids, only a few can be successfully grown in the plains. The orchids that flower in the plains year after year are limited to the species *Aerides multiflora* (*A. affine*), *Aerides odoratum*, *Cymbidium aloifolium*, *Phaius wallichii* (terrestrial), *Saccolabium guttatum*, *Dendrobium pierardii*, *Dendrobium moschatum*, *Pholidota imbricata* and *Vanda tessellata* variety. *unicolor* (*V. roxburghii*) which are the natives of our country.

The epiphytic orchids are usually grown on hanging logs, or on small pieces of wood, with their roots covered with a thin layer of dried *Sphagnum*. Sometimes, they are also grown in small hanging earthen pots which are perforated on the sides for aeration and drainage. They are also grown in baskets. The potting-mixture contains five parts of small broken pieces of brick and one part of fern roots of bird's-nest or *Polypodium*. A mixture containing equal parts of small broken pieces of husk, dried moss or peat, small dried pieces of bone and small pieces of charcoal can also be used. For terrestrial orchids, the potting-mixture contains equal parts

of cowdung manure, leaf-mould, soil sand and crushed charcoal. The potting of plants should be done during November to February. They will bloom in March-April.

DISEASES AND PESTS. Orchids are attacked by virus diseases. They are also attacked by insects such as thrips, red spiders and mealy bugs. The use of insecticides is effective in controlling these pests.

SPECIES. There are hundreds of genera and thousands of species and varieties of orchids. A few very important species include *Aerides odoratum*, *Calanthe vestita*, *Cattleya gigas*, *C. mendelii*, *Coelogyne cristata*, *Cymbidium giganteum*, *C. eburneum*, *Cypripedium insigne*, *Dendrobium densiflorum*, *D. draconis*, *D. aggregatum*, *D. fibriatum*, *D. nobile*, *Phaius wallachii* (terrestrial), *Phalaenopsis amabilis*, *Renanthera coccinea*, *Rhynchostylis retusa*, *Saccolabium giganteum*, *Paphiopedilum*, and *Vanda caerulea*.



Gladiolus. (*Gladiolus* species and hybrids; Family Iridaceae). With its majestic flower spikes with massive florets of brilliant colours, attractive shapes, varying sizes and excellent keeping quality, the gladiolus is ideal both for garden and for cut-flowers. It was brought into cultivation from its native habitat in South Africa, perhaps during the ancient Greek period. Its systematic improvement began only in the early years of the present century after the discovery of the *Primulinus* (*Gladiolus primulinus*), gladiolus growing wild near the Victoria Falls in South Africa. The hybridization of *Primulinus* and a few other species, e.g. *G. byzantinus*, *G. psittacinus*, *G. cardinalis*, *G. childsii*, *G. colvillii* and *G. gandavensis*, resulted in the present-day gladiolus. It is undoubtedly the best bulbous flower in our country and ranks next only to tulips in Holland and other countries.

USES. Gladiolus is excellent for growing in beds and pots and as herbaceous borders and for cut-flowers. As soon as the first floret has started opening and the others are showing colour, the flower spike is cut neatly with a sharp knife and is immediately placed in water. The other top florets will then open gradually and last for a long period.

TYPES AND VARIETIES. The two most important types are the large-flowered varieties and the butterfly or the miniature gladioli. Both types are early, mid-season and late-flowering requiring 65-75 days to 100-120 days for flowering. The butterfly types have small spikes of various colours and in many cases with dark and attractively coloured throats. They are ideally suited for small gardens and flower arrangements. Besides, the primulinus and colvillei are two other types; the former have small florets borne on thinner spikes with a hooded top petal in each floret. Psittacinus hybrids are also popular in gardens.

The flowers of gladiolus may be large, medium or small, sometimes with petals ruffled, blotched or streaked. The colours range from white to near black, including pink, salmon, orange, red scarlet, maroon, yellow, greenish, purple, lilac, mauve, violet and several other shades. Some varieties are also dark or 'smoky'. There are also double-flowered varieties. Recently, scented gladiolus varieties have been evolved through the hybridization of *Gladiolus* with *Acidenthera bicolor* var. *murielae*. This intergeneric hybrid is known as 'Gladenthera' and one such variety is 'Lucky Star'.

The important varieties are : 'George Mazure', 'Fay', 'Gold Dust', 'Tunia's Yellow Triumph', 'Elizabeth the Queen', 'Jo Wagenaar', 'Spic and Span', 'Spotlight', 'Dream Girl', 'Goeff Whiteman', 'Blaur Dominos', 'Polygoon', 'Banaras', 'Mary House', 'Snow Princess', 'Ratnas', 'Butterfly', 'Masholra Butterfly', 'Sylvia', 'Apple Blossom' and many others.

CULTIVATION. Gladiolus grows almost equally well in beds and pots. The beds should be dug out thoroughly and prepared finely. Before the final preparation, rotted cowdung manure, leaf-mould or compost about 5 to 6 kg and superphosphate 60 g per square metre may be added to the soil.

Gladiolus is generally planted from corms. It can also be grown from seeds, but the variety does not breed true in such cases. Propagation from seed is used for evolving new varieties through hybridization. The size of the spike and the flower depends upon the size of the corms planted. A medium-sized corm (10-12 cm), with a high crown is better than a larger and flatter corm. The corms are planted about 15-20 cm apart in rows spaced 30-45 cm apart. Sometimes, they may be planted in clumps of three or four, particularly for mass effect or as borders. The depth of planting corms is about 10-12 cm. Deeper planting being adopted in a lighter soil.

In the northern plains, it is best planted from September to October and sometimes even earlier in August. Flowering takes place from December to April. In the hills, planting is done in March-April and it flowers from June to September. The time of flowering depends upon the variety and the time of planting. Successive planting of suitable varieties will ensure continued flowering over a longer period.

MANURING. Gladiolus grows best in a bed which has been manured previously for another crop. It does not require heavy manuring or excessive nitrogen as this practice tends to deteriorate the quality of the flower spikes and the keeping quality of corms. The plants respond better to organic manure than to artificial fertilizers. After 6 to 8 weeks of planting, the plants may be fed with liquid manure, about once a week. An application of light soot water can also be given once a month or once a fortnight. At the time of emergence of flower spikes, a dressing of about 2.5-cm-thick layer of leaf-mould is beneficial in producing better flowers with stronger spikes and better development of corms.

WATERING. The plants may be watered weekly or fortnightly depending upon the weather. During winter frequent watering may not be needed.

EARTHING AND STAKING. After about 6 to 8 weeks of planting, the plants may be earthed up. After the emergence of flower spikes, they may be staked, so that the spikes do not fall down when there is a strong wind. However, staking is not necessary when the plants are grown closely or in clumps, and it is not needed in the case of miniature, butterfly or primitive gladioli. Care should be taken not to injure the leaves at any stage as the injury is harmful to the plants.

LIFING AND STORAGE OF CORMS. After flowering, when the leaves have turned yellow and have dried, the corms are lifted from the ground, preferably with a fork, and care is taken not to injure the corms while digging them out. After drying the corms thoroughly, they are put in paper bags, each with a few perforations for proper aeration or are wrapped up in sheets of newspapers, and stored in a cool and dry place or preferably in a cold storage room. The corms are best stored at 4.5° to 10°C and at 80-90 per cent relative humidity.

DISEASES AND INSECT PESTS. The commonest diseases are the *Fusarium* and *Botrytis* rots which cause the rotting of corms in the field and during storage. *Botrytis* rot occurs mainly in the hills. During storage, the corms are attacked by *Aspergillus*, *Penicillium* and other fungi, causing them to rot. In plants raised from disease-affected corms, the leaves turn prematurely yellow and flower spikes become stunted. It is not possible to control *Fusarium* and *Botrytis* rots easily with fungicides. However, to check the diseases, it is necessary not to grow gladiolus in the same beds every year, as the casual organisms are soil-borne.

The anti-biotic Aureofungin has been found to be effective in controlling the diseases of gladiolus. The corms should be planted after dipping them for one hour into 0-0.5 per cent Aureofungin solution. Two sprays of Aureofungin may be given to plants, one at the 6-leaf stage and the other 20-30 days before lifting the corms from the ground when the foliage is still green.

Thrips damage the leaves and petals by silvering them. They can be controlled by spraying the plants with Malathion (10 cc in 10 liters of water), once every fortnight or so. Caterpillars, which also injure the leaves and flower-buds may be effectively controlled by spraying the plants with DDT or BHC. It is useful to treat the corms with DDT or BHC (5%) dust and with Captan before storing them. The dusting of corms with naphthalene, about 30 g for every 100 corms and covering them with sheets of old newspapers or with gunny bags to retain the fumes may also be practiced before storing the corms.



Bougainvillea. (*Bougainvillea* species and hybrids; Family Nyctaginaceae). The bougainvillea is a versatile ornamental plant for planting in both small and large gardens. It is highly prized for its beauty and utility. It is named after Louis Antoine de Bougainvillea, a French navigator. Being a native of tropical and subtropical South America, it is well adapted to our climatic conditions.

SPECIES AND HYBRIDS. The cultivars commonly grown in gardens belong to four botanical species and their interspecific hybrids, viz. *Bougainvillea glabra*, *B. spectabilis*, *B. peruviana* and *B. buttiana*. The species differ from one another in some characters such as growth, habit, leaf shape and size, colour of bracts and habit of flowering. Many cultivars have arisen as a result of natural crossing between two species, such as *spectoglabra* or *glabra-peruviana* hybrids, or as selections from seedling progenies. The variegated foliage types have evolved in nature as bud sports.

VARIETIES. There are hundreds of varieties of *Bougainvillea* in various attractive colours grown in gardens. The flowers of *Bougainvillea* are usually referred to the three coloured bracts, and real flowers are small and tubular, with a star-shaped apex that is often inconspicuous and attached to the centre of each bract. The bracts are white, light mauve, magenta, pink, terracotta, deep mauve, red, yellow, orange or lilac. The bracts may be small or large. Some of the outstanding varieties are 'Snow Queen' (white), 'Shubhra' (white), 'Sanderiana' (deep mauve), 'Trinidad' (pale mauve), 'Mrs. H.C. Buck' (deep rose), 'Mary Palmer' (bicoloured deep rose and white flowers on the same plant), 'Louis Wathen' (orange), 'Enid Lancaster' (yellow with shades of rose), 'Ladt Marry Baring' (Yellow), 'Mrs. Butt' (deep crimson), 'dr. R.R. Pal' (brick red), 'Sonnet' (light rosy

purple), 'Spring Festival' (medium magenta purple), 'Summer Time' (bright red), 'Partha' (young bracts orange changing to pink purple), 'Tomato Red' (terracotta), 'Sensation' (deep magenta), 'Blondie' (orange turning light rose), 'Isabel Greensmith' (coppery changing to rose), 'Bois due Rose' (biscuit colour), 'Begum Sikander' (white with rose edges) and 'Wajid Ali Shah' (rose). There are also multi-bracted cultivars like 'Mahara' (red), 'Roseville's Delight' (orange), 'Cherry Blossom' (white), 'Los Banos Beauty' (rose). A few important varieties having variegated leaves are 'Rao' (white and green bracts red), 'Thimma' (yellow and green, bracts bicoloured like 'Mary Palmer'), 'Louis Wathen' (variegated white and green, bracts orange) and 'Glabra' (variegated white magenta green). The variegated 'Mahara' - white and green and 'Archana' (variegated 'Roseville's Delight' yellow and green).

USES. The bougainvillea can be used both as a shrub and as a climber. The shrub forms an attractive lawn specimen. It is also grown as a standard. A hedge of bougainvillea is quite common and colourful. It can also be trained on a tall tree, on the trunk of a dead tree or on a trellis, arch, pergola or screen. It is ideally suited for growing in large earthen pots, wooden tubs or cement pots.

PROPAGATION. The bougainvillea is propagated from cutting, layering or budding. For budding, the commonest rootstock is the cultivar, 'Dr. R.R. Pal'. The best time for propagation from cutting and layering is during the rainy season (June-July). Seeds are used only for evolving new varieties. However, many varieties fail to set seeds but seed-setting is better in Bangalore, Mysore and Hyderabad than in Delhi and the Punjab.

PLANTING. The best time to plant bougainvillea is from July to September. The plant may be grown about 1.5-2.5 metres apart but in a hedge, a closer distance may be adopted. At the time of planting, about 8-10 kg of well-rotted cowdung manure may be added to the soil in each pit which is about 75 cm in diameter and 60 cm deep.

The plants do not require much manuring. They should be pruned in June after they have finished their flowering to obtain better blooms in the next season, i.e. in winter (October-January) and in summer (March-June). After pruning, about 8-10 kg of cowdung manure may be applied to each plant, followed by copious watering.

The plant must receive full sunshine for good growth and abundance of flowering. The soil should be well-drained. During peak flowering, watering should be restricted; otherwise the flowers will fall off quickly under heavy watering. The plants usually need more frequent watering during summer than in winter. The plants are very hardy and, once established they grow successfully and flower profusely without much manuring or watering. The plants are almost free from disease and insect pests.



Tuberose. (*Polianthes tuberosa* L.; Family Amarylidaceae). The tuberose is a native of Mexico. Its leaves are long, narrow, linear and grass-like. The flowering stalk emerges from the centre of the leaves. The flowers are tubular, single or double, white and highly fragrant. Usually, the single-flowered varieties are more fragrant than the double-flowered ones.

Tuberose can be successfully grown in pots and beds, on borders and as shrubbery. It is also used for cut-flowers which last long and are highly prized for their delightful fragrance.

It is grown as a commercial crop for cut-flowers near Madurai in Tamil Nadu, in Bangalore (Karnataka) and also near Calcutta in West Bengal.

The bulbs are planted in September-October in the plains. The flowering takes place during summer and the rainy season (April to September) in the northern plains and in May-June in the hills. The plants thrive well in a well-drained and sunny situation. They can also be grown in partial shade. After flowering, the flowering stalk should be cut down to encourage the production of more blooms in succession. The bulbs are left undisturbed in the ground and occasionally they are separated and replanted.



Marigold (*Tagetes erecta* L. - African marigold; Family Compositae). *T. patula* - French marigold.

The African marigold is a native of Mexico and the French marigold is from Mexico and South America. Because of their being cultivated easily, wide adaptability to varying soil and climatic conditions, long duration of flowering and attractively coloured flowers of excellent keeping quality, the marigolds have become one of the most popular flowers in India. They are commonly grown in gardens, both in the urban and rural areas, and are cultivated commercially for use as cut-flowers, particularly for garlands. They can be successfully grown in pots too, and are used in mixed borders and beds. The dwarf varieties of French marigold are grown in window-boxes, hanging baskets, rockeries and as edgings. They

are also ideal for growing in a newly planted shrubbery to provide colour and for a planting in blank spots in the garden. The dwarf French marigolds can also be grown effectively in drafts and along paths or driveways.

AFRICAN MARIGOLD. It is generally tall with large double globular flowers which are lemon, golden yellow, primrose, orange or bright yellow. There are also the nearest-to-white marigolds, though not pure white. There are also dwarf varieties having large double blooms. The varieties belong to two main types, namely the carnation-flowered with medium-sized carnation-like double flowers and the chrysanthemum-flowered, tall or dwarf, growing with fluffy and shaggy flower-heads like an incurved chrysanthemum. There are also the giant-flowered uniform and vigorous F₁ hybrids, producing large globular fully double ruffled blooms in profusion and are ideally suited for cut flowers and garden display.

FRENCH MARIGOLD. It is mostly dwarf, early-flowering and compact with dainty single or double blooms, borne freely and almost covering the entire plant. The flowers may be yellow, orange, golden yellow, primrose, mahogany, rusty red, tangerine or deep scarlet or of a combination of these colours. The flowers may be self-coloured, spotted, striped or botched.

INTERSPECIFIC HYBRIDS. Interspecific hybrids between the diploid African marigold and the tetraploid French marigold have also been evolved. These interspecific hybrids are triploids, with intermediate characters, early flowering, medium tall, bushy with double flowers of delightful colour combinations of red and gold or pure yellow, orange, bright and rich mahogany scarlet.

The Single Signet (*Tagetes tenuifolia*). This is a dwarf type of marigold. It is bushy, with five lace-like foliage and covered with small single orange, yellow or lemon flowers. A dwarf variety, 'Pumila', is very compact. The single signet marigold is ideal for edging and rock-gardens.

CULTIVATION. Marigolds can be successfully grown in different types of soil and climate. The French marigold grows best in a light soil, whereas the African marigold requires a rich, well-manured and moist soil. A well-drained soil and a sunny situation are essential for both types of marigolds. They can grow in almost all seasons, except in very cold winter, as they are susceptible to frost. The seeds are sown in May-June in nursery-beds or in shallow seed-pans or boxes. Seeds can also be sown in September-October and in February-March. In the hills, the sowing is done in March-April. After about a month of sowing, the seedlings are transplanted into beds or pots. The plants should be grown in a well-prepared soil which has received a liberal application of cowdung manure or farmyard manure. The French marigolds should not be heavily manured; otherwise, they may produce excessive vegetative growth, resulting in poor flowering. As soon as the first flower-bud appears, the shoot is pinched to make the plants bushy and compact. In general, the marigolds are hardy and almost free from diseases and insect pests.

DEK (Melia azedarach Linn)

'Dek/'Dhrek' is an indigenous species commonly distributed throughout the country. In Panjab, the farmers grow this plant on field boundary or near tube-wells for shade or timber. It is fast growing, thin canopy and deciduous tree. It tolerates heavy lopping. The leaves are lopped for fodder. It is most suitable for growing on the boundary of the field. There are two types of Melia plants grown. The one with umbrella like spreading canopy is Melia compacta, 'Bakain' primarily grown for shade. The another type is avenue agroforestry species-Melia azedarach.

Climate and soil requirements Melia grows well under dry conditions with rainfall of 60-100cm and temperature and 8 to 40°C. Young seedlings need protection from frost. It preferred well drained deep soils. It can grow on a variety of soils including saline and alkaline ones.

Silvicultural practices

Nursery Raising : Propogated through seeds, cuttings and root suckers. Collect the ripe fruits in winter. These fruits are five seeded drupes and the seeds remain viable atleast for two years. Soak the seeds in water for 2-3 days before sowing to enhance the germination. The nursery is raised during February-March. Sow is soaked seeds in seed beds of one metre width and 4-5 metre length. Sow the seeds about 15-20cm apart. The seedlings start emerging after three weeks. Single fruit gives to 2-4 seedlings. Seedlings are spaced to 15 * 15cm by pricking out seedlings in nursery beds during July when these are 5-8cm in high. these are retained in the nursery beds for one year and are uprooted for planting out in the field.

Field planting : Transplant are rooted dek seedlings during February or with earth ball during rainy season or in the beginning of spring where irrigation is available. Adopt spacing of 3 cm apart in boundary plantations. Irrigation and fertilization enhance the rate of growth.

Harvesting and Marketing :Harvest the trees in the beginning of winter. The wood is comparable to that of neem and is widely accepted in the market for furniture, doors and windows, packing cases etc. The leaves and fruits of Melia contain pest-repellant qualities.

KIKAR (*Acacia nilotica* sp. Indica)

'Kikar' or Babool' is a valuable source of fuel, timber, fodder and tinnin. The wood is used for making furniture, doors, windows, carts, trolleys, agricultural implements and other household articles. The pods and leaves contain digestible protein. The bark is a rich source of tannin. Kikar is grown in semi-arid and 'Kandi' regions.

Climate and soil requirements :

It can be withstand extremes of temperature but it is frost tender when young. The tree can grow throughout dry and hot regions of the country under average average annual rainfall of 2000 to 1200mm. It grows on a variety of soils ranging from sandy to loam. It can grow on soils upto pH 9.0.

Silvicultural Practices

Nursery Raising :Collect seeds from superior, healthy and straight trees. Treat the seed in hot-water (80°C) for 10 minutes, followed by soaking in ordinary water for 24 hrs. Prepare raised beds of 1 * 5m size and sow at 0.5cm depth in lines which are 10-15cm apart. One square metre area needs 150-200g seed to produce about 1500-2000 seedlings. wooden boxes or earthen pots can also be used to raise the nursery on a limited scale. Sow the seed in February-March.

Prick out the seedlings when they are 5-10cm tall and transfer them in polythene bags of 22-10cm. Seed can be directly be sown in polythene bags.

Field Planting :

Transplant the seedlings with earth balls during February to March where irrigation is a available, and during July-August in rainfed areas. July to August plantation has better survival. Dig pits of 50-50 cm well in advance. Mix 10-15g BHC 10% before filling each pits. fill the pits with 50 percent top soil and 50 percent Farm Yard Manure (FYM) and water them properly.

Spacing :For block plantation , plant at 3.0 * 3.0 m spacing. Thin out at the age of 5-6 years. For fuelwood plantation, 1.5 * 2.0m spacing is required with 5-6 years rotation. For boundaries and roadsides, two rows, 3m apart are planted.

Tree-Crop Association : To obtain better grain yield of wheat under kikar plantation (3 * 2m), PBW-299 (10.5 q/acre) and PBW-175 (8.0 q/acre) varieties should be sown. Barley can also be grown under Kikar plantations.

Fertilization :Add 25 g third year of urea per tree during the second year and 50g during.

Irrigation : Irrigate at 10 days interval during the initial two years for better survival and growth.

Harvesting and Marketing : Normal rotation is about 20 years. With intensive cultivation, this can be advanced by 4-5 years. Average timber yield is 10-15 tonnes/year/ha. the trees are mostly sold standing to the local contractors. The price obtained depends on the age and size of the trees.

Over bark Production (m³/tree) and weight (quintal/tree, fresh weight) of timber of Kikar trees.

Girth* (cm)	Over bark volume	Weight	Girth* (cm)	Over bark volume	Weight
60	0.089	0.712	125	0.574	4.592
65	0.112	0.896	130	0.629	5.032
70	0.136	1.088	135	0.686	5.488
75	0.164	1.312	140	0.746	5.968
80	0.194	1.552	145	0.808	6.464
85	0.226	1.808	150	0.873	6.984
90	0.261	2.384	155	0.940	7.520
95	0.298	2.088	160	1.009	8.072
100	0.338	2.704	165	1.082	8.656
105	0.380	3.040	170	1.186	9.488
110	0.425	3.400	175	1.233	9.864
115	0.472	3.776	180	1.313	10.504
120	0.522	4.416	185	1.395	11.160

*Girth at breast height (GBH) at 1.37 m from ground level.

Seasoning : The greenwood contains about 70 percent moisture. Air drying to reduce the moisture to 12 percent level is achieved in 2-3 months for 25 mm thick planks. Solar kiln drying will reduce the time requirement to about 20 days.

Plant Protection Measures

Insectpests

Babool borer :

The larvae bore into the stem and roots of the tree from mid-July to October. The growth of the attacked young tree is stopped and the tree ultimately dies. Avoid growing 'Ber', Casuarina and Prosopis juliflora near Kikar plantations as they serve as alternate host of Babool borer.

NIM

(Azadirachta indica A. Juss.) 'Nim'/'Neem' is one of the important indigenous tree as potential timber. Neem is also a source of fuelwood. The wood is relatively heavy with specific gravity varying from 0.56 to 0.85 (average 0.68). Timber is durable. Nim seed is a rich source of non-edible oil (about 45%). During recent years, nim has caught the attention due to anti-insect, antifungal and antiviral activities of azadirachtin-an extract from neem seeds. Nim cake-blended urea adds to the efficiency of nitrogen use. The tree is widely distributed throughout sub-tropics and dry zones of western India and parts of Deccan. It grows well in Punjab.

Climate and soil requirements It is widely distributed in dry and semi dry conditions and can tolerate long drought conditions. Suitable rainfall is 450-1150mm, however, it can survive even below 130mm annual precipitation. Frost affects the growth of young neem trees. It can grow on variety of soils, including dry, stony, clay and shallow soils. It does not grow well on saline or water logged soils.

Silvicultural Practices

Nursery Raising : Raise the nursery either in seed beds or in polybags. When raised in nursery beds, do prick out at 15 * 22 cm spacing or transfer in polybag filled with field soil and F. Y. M. (1:1). About one kg of seed is required to raise 100 plants. Fruits are collected in July-August when they are fully ripe. Extract the seeds with care and sow immediately.

Field Planting : Transplant nim in the field at 3 * 3 metre spacing. Wider spacing (6m apart) is suggested where intercrops are to be raised. Transplant seedlings in August-September in pits (50 * 50 * 50 cm) filled with 50 percent top soil and 50 percent FYM. Plant the seedlings with earthen balls intact. Regular weeding and hoeing during the initial years is recommended. It is not readily browsed by cattle and goats. Nevertheless, protection is needed from damage by animals.

Fertilization and Irrigation : Fertilization during the initial 2-3 years helps better establishment and growth. Irrigation is applied 10 days interval during dry spell in summer months. Whereas during winter it may be at fortnight interval.

Harvesting and Marketing : Harvest the trees in late winter. The tree on an average puts girth increment of 2.3-3.0 cm in unirrigated and 8 cm per year in irrigated plantations. The total volume including fuelwood obtained to the extent of 120-170m³/ha in 8-10 years. The wood is used as timber and fuel. Timber is used in housebuilding, ploughs and agricultural implements, making boards, panels, and toys. When large plantations are raised, collect the seeds every year and supply to the concerned organizations for oil extraction.

Plant Protection : No major problems of pests and diseases are noticed.

PAHARI KIKAR

(Prosopis juliflora (Smutz)) Pahari Kikar (Mesquite) is native to Central America and the northern south America. It is a thorny deciduous, large crowned and deep rooted bush or medium sized tree. The tree has been planted in many arid zones of the world. The species is widely propagated, mainly for stabilizing dunes. It is excellent for firewood and makes superior charcoal.

Climate and soil requirement : Mesquite grows in very warm and dry climate from sea level to 1500m altitude. It is least affected by drought. It prefers sandy soils. It grows well on rocky terrain provided that root growth is not impeded. Can tolerate temporary water logged conditions and grows well in salt affected 'Kallar soils'.

Silvicultural practices Nursery Raising : Collect the seeds in May-June and scarify mechanically or treat with 20% sulphuric acid for one hour. Wash thoroughly and keep in water for 24 hours. Sow the seeds in polythene bags. Germination of treated seeds is 80-90 percent.

Field Planting :Transplant the seedlings in august-September or in February-March depending upon the availability of water. dig the pits of 30 * 30 * 30 cm size at distance of 1.5 * 1.5 m. Add 5 kg of well rotten FYM and 10-15g BHC 10% with soil and fill the pits. Irrigate the pits. Prefer planting of this tree on the waste lands specifically on salt affected soils.

Training and pruning : For small timber, training to single stem is required.

Harvesting and Marketing : Early harvesting is generally done to meet local fuel requirement. The plants, however, when grown for small timber are retained for 10-15 years. Wood makes good fuel, charcoal, fence post and light timber.

Limitations : Mesquite is an aggressive invader and has the tendency to turn into a weed.