**LECTURE-25:** Ornamental gardening- importance- features of ornamental gardening

An ornamental garden is a place where plants are arranged in an aesthetic manner.

**Importance of garden:**

In modern cities with growing slums and factories gardens are essential to improve the environment and to provide healthy air for the inhabitants.They are really the lungs of the city. Gardens serve to beautify the country.Gardens are said to be the yardstick of the culture.This is true to some extent as they reflect the aesthetic taste of the people and are the chief pieces of art that confront a visitor and help him asses the cultural standards of the region.

An ornamental garden is a place where plants are arranged in a manner. Plants can be grouped together in various ways to give an aesthetic effect. Each such grouping is called a **Feature.** Any garden comprises some of all of such features and hence the features are also called the **components of garden**. Some of the important features found in most of gardens are

**1. Fence:** Fence is the outer most boundary to prevent tres pass and to ensureprivacy in home gardens. Fences can be created, eitherby using closely planted thorn bearing plants, hedges and shrubberies or structures where wood, bamboo, wire netting and chain links are used. Various climbers can be trained over the fences to enhance attractiveness.

**Ex.** *Casuarina equisetifolia* –sarugudu,*Prosophis juliflora*,*Caesalpinia pulicherima*

**2. Hedges:**are useful to divide the garden in to sections, to line the drives so as to direct the visitors to a central object.They aresown and grown in the same manner as the fence and plants are pruned to a height of 3-4 feet.

**Ex.***Clerodendron, Duranta, Lantana camera, Lawsonia inermis*

**3. Edges:**These are row of plants which do not exceed one foot height. They are grown along with paths and around the flower beds.Non living materials like bricks , tiles are also used for this purpose.Live hedges are more in harmony with the garden than features. The foliage hedges are not trimmed.

**Ex.***Alternanthera sps, Eupatorium cannabium, Pilea, Aerus tomentosa, Tradescantia*

**4. Drives and paths:** can be primarily functional facilitating easy and purposeful movement within a garden, providing access to all features with in a garden or can be included for their decorative value, usually designed to provide a visual line between separate areas. Cobbles, granite, flagstones, brick, concrete or wooden materials may be used. They should be laid with easy gradients and perfect paving and leveling.

**5. Lawn:** Lawn focus the background colour in the garden picture against which the colour of shrubbaries and flower beds is brought in to relief. Whether the garden is big or small it must have a lawn. In fact a lawn and a mass of flowers beyond it will constitute a garden without any other features. The lawn should be sown only to a single species of grass so as to give a uniform colour.

The most common lawn grass is ***Cynodon dactylon.*** It prefers slightly acidic soils (pH 5.5 -6.0). It does not grown well undershade of a tree. ***Dichondra ripens*** a new type of ground cover that has been recently introduced can stand sun and grows well under shade. ***Festuce*** is the quick growing and finest of lawn grass.

**6. Shrubbaries and shrub boarders:**When the plants are grown in a row but not trimmed the feature is called border.Borders are planted to different species of plants, while hedges are generally planted to a single species.Boarders may be of herbaceous plants they are called herbaceous borders or comprises of shrubs they are called as shrubborders. The shrubborders may be grown along wall or infront of fence of tree and also to seen together but are not in the row the feature is known as Shrubery.The border of the shrubbery consists of more than single row of plants.

**Ex.** Crotans – *Codium variegatum pictum*, *Hibiscus rosasinensis, Acalypha marcinata,*
*Cestrum nocturnum, dracera*

**7. Flower beds:** These are also known as annual flower bedsas they are planted with annuals or herbaciousperennials which are treated as annuals. They should be planted to a single species and variety so that each bed is of single colour. A flower bed should be behind a lawn or in the middle or atleast should have a strip of lawn in front of it.

**Ex.** Marigold: Zimnnia, Cosmos:Petunia, Phylo: Celosia

**8. Carpet beds:** Plants of different colour foliage which can be clipped close to the ground are choosen for planting in an intricate design on the ground. Such a feature knownas carpet bed. The design may be conventional, geometrical ones or map or clock or a sundial.

**Ex.** Alternanther Sps. (Purple and green varieties)

**9. Topiaries:** Certain plants which can stand severe and constantpruning and which posseses small foliage and relatively short internodes can be trimmed in to globes, ovals or in to fancy shapes of animals etc. These are generally found in formal gardens.

**Ex.** *Thuja orientalis*, *Casuarina equisetifolia, Murraya paniculate, Polialthis longifolia*

**10. Arches and pergolas:** Arches can be semicircular or rectangular shaped and are used to link one part of the garden with another. Arches are constructed near the gate or over paths. Its proper place is astride a path and its purpose is to support climbing plants. Pergola is a narrow vista consisting of a series of arches connected with climbers preferably leading to some other interesting feature of a garden. Pergolas are constructed over pathways. It brings height to the flat planes of a level compound.

**Ex.***Bougenville, Quisqualis indica, Vernomis, Allamonda catharties*

**11. Fern house (Fernery):** Plants of the humid tropical, subtropical and temperate regions cannot be grown in the open in the plains exposed to glaring sun. Such shade loving plants are grown in a structure calle the fern house. In the centre of fernery, a cement tub is constructed and is filled with water so as to increase the humidity inside and also facilitating watering of potted plants. The beauty of fernery depends on the proper arrangement of plants like ferns, begonies, anthurium, caladiums, diffenbechias, dracaons, palms etc.are grown pots and kept on galleries.Small pots with orchids, pilea etc., are hang from the roof.

**12. Orchids:** Orchids are humidtropical and subtropical plants loving shade. These are becoming great favourites because the flowers have gorgeous colour. They often assume shapes of birds, moths, butterflies and last longer.

**13. Pot galleries:** Circular galleries are constructed of masonry and on the steps of which potted plants are arranged. The height of each step and pot on the lower step should be the same.The plants grown should be taller than the height of steps so that the pots and the masonry structures are both hidden behind plants and present the apperence of a mound of plants.

**14. Lily pool:** Aquatic plants are grow in lily pools which may be dug in the ground and abetted with stones so as to look natural or may be constructed in cement of regular shape. In cement pools there should be an inlet at the bottom and an outlet a few inches below the top of pool, so that a constant level of water is maintained.

**Ex. *Nelumbium speciosum, Pistia, Nymphea, Eichornia crassipes***

**15. Rockery:**Plants growing on rocky situation are grown in the garden is rockery. The rockery is constructed by keeping up manured soil to a desired height and embedding rocks into it. The plants are set in the crevices between rocks. It can be raised under the tree or separately. Generally both foliage and flowering succulents as well as xerophytes are grown.

**Ex.** *Opuntia, Eupatoria, Agave, Coleus, Sansveria, Bryophyllum, Tradescantia*

**16. Single specimens:** In an extensive lawn the monatany can be broken by single beautiful tree of exiting quality without blocking the view of the other features beyond. Trees like ***Polyalthis pendulus, Aracariacolummeris, Ravenalis medagescrensis*** are useful for such a purpose.

**LECTURE-26:** Planning of ornamental gardens- principles involved in layout of gardens

In planning a garden, several factors like the size of the house, and the space available for gaden, availability of water, cost of the laying the garden and its maintenance, have to be taken in to consideration. A garden is planned primarily to suit the tastes of the people of the house hold and locality. There is no rigid system in garden planning and each system is open to modification to suit the environment and other factor.

**Principles involved in layout of gardens:**

**Initial Approach:** The available land for gardening may not be with ideal shape or size. When the site appears to be hopeless a good designer will make the best use of such site. Land with Natural undulations should never be leveled. The differences with levels should be utilized with advantage.

Fencing is essential and it should look natural and should not obstruct any natural view.
Till the plants grow full size it may be impossible to visualize how a garden design will look like in the long run. The man on the spot should be given enough scope to change it to adopt to the local needs and personal taste of the owner. Only formal gardens can be drawn on paper and implement it perfectly without change.

1. **Axis:** An imaginary line in any garden. Garden is created around the axis with balance. In formal garden central line is the axis. At the end of an axis there will be a focal point. Architectural features such as bird bath or sun dial.
2. **Focal point:** There is center of attraction which is generally an architectural feature focused as a point of interest it is one of the good land scape element.
3. **Mass effect:** The use of one general form of plant material in large numbers in one place is done to have a mass effect. Such mass arrangement should not become monotonous. The size of mass should be varied.
4. **Unity:** Unity has to be achieved from various angles. The unity of style, feeling, function between the house and garden has to be achieved and unity between different components of garden as if they merge harmoniously should be achieved. For example Cacti if planted in a sea shore garden are completely out of place. To achieve unity between house and garden some creepers are trained in front porch. It covers rudeness of masonry work. For the same reason foundation planting with bushy plants near the foundation of plants can be done.
5. **Space:** Garden should appear larger than its actual size vast open spaces are kept under lawn and planting is done in periphery. If any planting is done in the center its branches should be at higher level. The lines in the garden are made to converge slightly at a distance to create an illusion of space. Paths in the garden are gradually narrowed as the size of the farthest trees diminish. Large lawns are alternated by

a group of trees. If large open space has to be planted haphazardly it looks smaller than its size. The technique of creating an illusion of more space is also referred as forced perspective.

6. **Divisional lines:** It is necessary to divide or screen out a compost pit a malis quarter or a vegetable garden from the rest of the garden. Areas under cement path, shrub border will have their own natural divisional lines. Divisional lines should be artistic with gentle curves. These lines should harmonize with each other.
7. **Proportion and Scale:** Proportion may be defined as a definite relationship between masses. A rectangle having a ratio of 5 : 8 is a pleasing proportion. A simple rule in setting out a proportion is that the design should look pleasant. Scale—a narrow step leading to a wide terrace is completely out of scale. The steps should be spaced wider making climbing easier and pleasant. If a small rockery is placed at a base of large tree with thorny specimens looks ugly and it is out of scale and proportion. A tiny pool in the midst of a large lawn also looks disproportionate.
8. **Texture:** The surface character of a garden is referred to as Texture. The texture of the ground leaves of tree or shrub will determine overall effect of a garden. If we cannot lay out lawn the texture of the ground can still be improved by laying out meticulously chosen small pebbles. A Gulmohar is a fine textured tree where as *Spathodea companulata* is a coarse textured tree.
9. **Time and Light:** There are three different categories of time in a garden.
    i) Daily time: It provides different qualities and quantities of light. Morning sun is vital for all flowers. It should be considered for placing the flowering plants. It should be possible to sit in a shaded place in the afternoon.
    ii) Seasonal changes in the year: A lawn in Delhi which receives shade during early part of the day in the winter will not grow or remain patchy.
    iii) Visualizes the shape and proportion which may be attained by the shrubs and trees in the coming years. If tree grows to very large extent, the shrubs planted around it remains lanky because they will be shaded during hot days.
    iv) The pattern of shade caste by fine leaved tree or straight trunk tree like Royal palm (Oreodoxa regia) and planted in a row, on ground or lawn look very artistic.
10. **Time and colour:** A thorough knowledge is essential to select the plants depending on their flower colour or foliage colour. Colour schemes like monochromatic, analogous complementary or contrasting are laid out by selecting different plants. It is better to have masses of single colour against a mixture of colour. A bed of roses containing single colour Eg: Red or yellow or Pink has much softer tone and beauty than a bed of mixed colours.
11. **Mobility:** In temperate country the garden changes colour very shortly and contrastingly from one season to the other season, thus symbolizing mobility of movement. Some trees changes their leaf colour in autumn, suddenly in winter leaf fall and gives dullness. Again

in spring the plants spring back in light with new leaves. To create some symbol of movement in our country. Trees such as Indian Almond (Terminalia catappa) can be used because it changes its leaf colour into striking red twice annually. Lagerstromia also changes the colour of leaves to coppery shade in the autumn. Madhuca indica and Ficus religiosa has new foliage of coppery red in the spring. Some times the birds with beautiful colours also brings a type of mobility. Seasonal flowers will bring in the motion and colorful butter flies. Lilly pools should be filled with coloured fish.

12. **Style:** Every garden lover has to invent his own style. A good style has to be developed by studying great garden styles of the world and grasping the underlying principles. Even more know ledged gardener will commit mistakes. A novice gardener should be cautious and critically access every feature and should try to correct mistakes rather than getting disappointed through experience and learning from others a good artistic designer can develop his own style.

**LECTURE-27:**Types and styles of ornamental gardens-use of trees, shrubs, climbers, palms, indoor plants and seasonal flowers in the gardens

**Styles of Gardening :**

A gardener may think that a landscape garden can be laid out only on a gently undulated land, but it is not so. The goal in landscape gardening is to improve landscape with an idea of developing view or design. The other two familiar terms, which associate landscape gardening, are formal and informal gardens.

F**ormal gardens:** It is laid out in a symmetrical or Geometrical pattern. Everything is planted in straight lines. If there is a plant on the left hand side of a straight road similar plant must be placed on the right hand side also. Flower beds, borders and shrubbery are arranged in Geometrically designed shapes. Trimmed formal hedges Ashoka trees, Topiaries are the typical features of a Formal garden.

**Informal gardens:** The whole design looks informal. Features are arranged in a natural way without any hard and fast rules but here also the work has to proceed according to a well set plan. The idea behind this design is to imitate nature.

**Wild garden**: William Robinson in the last decade of 19$^{th}$ century made the idea of wild garden. His main idea was

i) to naturalize plants in shrubberies.
ii) Grass remains unmoved as in nature and
iii) Few bulbous plants should be grown scattered.

A garden enthusiast has to study the different styles available in the world to gain some knowledge. In India even though we were interested in the gardening since Ancient times there was no style to denote as Indian style of gardening.
Even the famous garden style of India i.e. Moghul garden is a replica of Ancient Persian garden.

The major garden styles of the world are

1. English garden
2. Moghul garden
3. Persian garden
4. Italian garden
5. French garden
6. Japanese garden

The Moghul, Persian, Italian and French styles fall in the category of Formal gardens where as the English and Japanese garden are classified in the informal style of garden.

**English garden:** Natural ground cover in the English countryside is grass. The main idea of British gardeners is that the gardens should look like country side.
The main features of English garden that are known in India are:

a. Lawn
b. Herbaceous borders
c. Rockery

Most of the flowering annuals we see today in India with few exceptions of *Amaranthus*, Balsam, *Gomphrena*, Marigold etc were brought here by Britishers.

**Japanese gardens:**

Persian and Japanese gardens were based on the ideas of heaven. Japanese continued the same style of gardening and still remain popular. Japanese gardens were planned with so much of care though appear so casual.
Immutability is another strong basis of Japanese gardens. Except some seasonal changes other strong, visible changes are hardly observed in Japanese gardens. They remain beautiful even in winter. The immutability is achieved rather than going for flowers, shrubs etc, more emphasis is placed on natural elements such as simple rocks, stepping stones, streams, waterfalls, bridges. Stone lantern and so on. Three elements of Japanese gardens are:

1. water
2. stone
3. plants

**Features of Japanese gardens:** Ponds, Streams, Waterfalls, Fountain, Wells, Islands,
Bridges, Stone Lantern, Stones,Pagodas,Fences and Gates

**Mughal Gardens:**These were laid out during the rule of Mughal emperors in India. They are similar to the Persian styles. The main features of Mughal gardens are largely borrowed from Persian style.

1. site and styles of design
2. walls
3. gates
4. terrace
5. nahars or running waters
6. baradari
7. tomb or mosque
8. trees.

**Baradari:** It is arbour like structure made up of stone and masonry with pacca roof and raised plat form for sitting. They were provided with 12 or more doors and they were used to watch the dances.
Principles in laying out a land scape garden:

**LECTURE-28:** Commercial floriculture- rose- importance- climate and soil – types of roses – varieties- propagation- planting – pruning- manuring- irrigation- harvesting - yield

Botanical name**: *Rose sinensis***
Family **: Rosaceae**
Origin: **Oregon and Colorado of USA**

The word Rose derived from Greek word Rhedon means scented.
Rose is commonly referred to as **Queen of the flower** because it stands first for its popularity as cut flowers.It is propagated commercially by means **Budding**.

**Importance:**

Rose is one of the natures beautiful creations and is universally called as the Queen of the flowers. No other flower is a better symbol of love, adoration, innocence than the Rose.

The Rose because of its utility occupies prominent place among the flower crops and is one of the oldest fragrant flower cultivated by man.
It has different types with beautiful flowers of definite shape, size, colour and most delightful fragrance. It is an important flower for its varied uses.

**Perfumes and Allied products:**

**Rose Oil: I**t is an important commercial product obtained from rose petals. It has sweet fragrance, medicinal properties, hence used in ayurvedic medicines Bulgarian rose otto is largely used in perfuming soaps and cosmetics. Limited quantities of the oil are used in flavouring soft dringks and alcoholic liquors. Rose oil has got anti bacterial property.
Commonly grown species for oil extraction are ***Rosa damascene*** **(Damask roses)**
***Rosa borboniana*** (Edouard roses) (**commonly used root stock for budding**) (highly scented) *Rosa centifolia* (Cabbage roses) *Rosa alba* and *Rosa gallica*
**In India, however*, R. damascena* and *R. borboniana* are commercially cultivated for Rose oil.**
Among different species R. damascena gives the maximum oil yield. Recovery of Rose oil from R. damascena is 0.06% in R. borboniana 0.04 to 0.042 To obtain good quality rose oil the flowers are to be harvested early in the morning as the percentage of volatile oil decreases with the advancing day. The flower should be harvested before 9.00 am. In dry hot weather the oil content of the open flowers decreased rapidly whereas the oil yield increased in wet cool weather.
**Rose water: I**t is also an important commercial product from rose petals. It is used as a perfume and in medicines and confectionary. It has the property of cooling the body and is often used in eye lotions and eye drops for its soothing qualities. It is also used in drinking water and sprinkled on the guests at weddings, feasts and other social functions.
Species like R. damascena , R. borboniana , R. centifolia , R. alba, R. gallica are used for extraction of Rose water.
**Rose gulkand:** Rose petals are preserved for direct consumption, by making gulkand, which is prepared by pounding equal proportions of petals and white

sugar. It is both a tonic and laxative.Species suitable are R. damascena , R. chinensis, R. gallica, R. pomifera and other scented roses. Edouard are used for preparing gulkand.

**Classification:** There are many classes of present day garden roses. The main classes are as below.

**Hybrid Teas**: Obtained by a cross between Hybrid perpetuals and Tea roses. Hybrids are most popular type of roses. **They bear large sized and highly scented flowers**. First of Hybrid Tea is La France produced in 1867.

**Polyanthas:** These are dwarf plants. Small flowers of **Polyanthas were forerunners of popular large flowered Floibundas**. Their ancestry includes crosses of Rosa multiflora, Rosa wichuriana, and Bengal hybrid Rosa indica major. The first cultivar of polyanthas was La Paquerette. Other cultivars are Baby Faurax and Echo.

**Floribundas:** They are also known as **Hybrid Polyanthas**. These are the crosses between Hybrid tea roses and Polyanthas. They **combine beautiful forms of the Hybrid Teas** with **perpetual flowering habit of the Polyanthas**.

**Grandifloras:** These are crosses between Hybrid Teas and Floribundas. **Grandifloras covers large flowered and clustered cultivars** of fine form or the type which produces beautifully formed, Hybrid Tea like blooms in clusters. The first Grandiflora developed was Buccaneer. Other cultivars are June Bride and Queen Elizabeth.

**China Roses:** China Rose(R. chinensis) is **responsible for nearly all the present day popular roses**. China Roses bear red to nearly white flowers in small clusters. China Roses were also known as monthly roses. They are known as Bengal rose. China roses are perpetually flowering types. The so called Green rose (R. chinensis viridiflora) is included in this class.

**Minatures:** These are popular **Baby Roses**, with small leaves and flowers. **They are hardy and are multiplied by cuttings as well as propagated on root stocks**. Those raised from cuttings are ideal for growing in pots. Examples are Baby Gold Star, Baby Masquerade, Peon.

**Ramblers:** They generally produce flowers with large clusters of small single or double flowers. They are of two groups namely Wichuriana Ramblers (R. wichuriana) and Multiflora Ramblers (Rosa multiflora). Examples: Wichuriana: American pillar, Multiflora: Crimson Rambler

**Indian cultivars:**

1. Hybrid Teas: Abhisarika, Akashsundari, Anupama, Anuraag, Arjun, Ganga, Dr. B.P. Pal, Golden afternoon, Haseena, Mridula, Nurjehan, Poornima, Rakta gandha, President Radhakrishnan
2. Floribundas: Akash nartaki, Arunima, Delhi Princess, Himangini, Madhura, Mohini, Sindhur
3. Polyanthas: Anjani, Nartaki, Swati,
4. Miniatures: Chandrika, Pushkala,
5. Climbers: Akash pradip, Delhi white pearl

**Plant management practices:**

**Pinching:** Removal of a part of terminal growing portion of stem is called pinching. This operation was found to reduce the plant height but promote axillary branching.

**Disbudding:** Removal of undesirable buds is known as disbudding. Keeping only the central bud and removal of others cause development of a quality bloom.

**Removal of young vegetative shoots:** This practice, also known as deshooting, is generally followed in Hybrid Tea roses. Young vegetative shoots developing from the axils of leaves of basal and lateral shoots are removed to allow only one terminal shoot. Deshooting in cvs. Sonia and Belinda was found to increase the flower production by 50 and 75% respectively.

**Defoliation:** Several attempts were also made to study the effect of leaf removal on subsequent growth and flowering of roses. Although defoliated plants produced about twice as many shoots as undefoliated, many of them were blind and the total number of flowers was less. Complete defoliation of mature and young leaves caused atrophy of almost all flower buds. Removal of only mature leaves caused about 50% blindness. Removal of only young leaves did not cause blindness.

**Desuckering:** Any sucker arising from stock should be removed from time to time.

**Removal of faded flowers:** If the spent blooms are not removed in time, there is a chance of developing fruits bearing seed. Once the hips are formed and reach the advanced stage of development, growth and flowering are severely reduced during the season. Cutting of faded flowers forced strong laterals which produced good quality flowers.

**Propagation:** Roses can be propagated both by **seeds** and various vegetative methods **like cutting, layering, budding and grafting**.

**Seed propagation:** This is adopted by breeders for developing new cultivars with desirable characters. It is suggested to stratify the seeds at 35 to $40^0$ F i.e. $1.6^0$ C to $4.4^0$ C. **Stratification** for six weeks is sufficient for *Rosa multiflora*. In temperate regions the root stocks needed for budding can be raised through seeds.

**Cuttings:** Some of the vigorous cultivars can be grown from cuttings. Some of the Climbers, Ramblers, and Polyanthas are raised by cuttings. Miniatures are more widely propagated by cuttings rather than by budding.

**Layering:** This propagation method is limited to Climbing and Rambling roses. They can be propagated either by Ground Layering or Air layering.

**Grafting:** Inarching is another method of propagation of roses, but it has many disadvantages.The scion shoot should be of medium texture, free from pests and diseases and 1-3 eyes in length. Cleft grafting has been suggested for the multiplication of roses.

**Budding:** This is most popular and successful method for multiplying roses. **Shield or T-Budding** is the most commonly used method of budding wherein on the selected root stocks, the buds are inserted into the T shaped incisions and then tied with a suitable wrapping materials like plastic film. Budding should be preferably done as low as possible on the root stock. When the new shoot from the grafted but is about 10 cm long. The top portion of root stock above the union is cut off and polythene tape is removed. It takes 3-4 weeks

for the bud to unite. The side branches of the stock are removed, which compete with the scion for supply of nutrients and water.

**Root stocks:** Some of the commonly used root stocks for budding of roses are as follows: Rosa borboniana (Edward roses), Rosa canina, Rosa indica, Rosa laxa, Rosa manetti, Rosa multiflora, Rosa rugosa etc.

1. ***Rosa borboniana*** (Edward Rose): This is one of the most popular root stock and **used extensively in northern plains of India**. It is found **useful for budding standards.**
2. ***Rosa indica* (var. odorata):** This is a large climbing shrub and used extensively as root stock for greenhouse forcing roses. It is easily **propagated from cuttings**. It is well **adapted to both excessively dry or wet soil conditions and can withstand high soil pH**. The root stock is also **quite tolerant to powdery mildew and insect pests**. In India, it has been recommended for Northern plains.
3. ***Rosa multiflora*** It is a native of China and Japan introduced into India in 1872. This is a widely used root stock for out door roses. It can be **easily propagated by cuttings**. It is adapatable **to wide range of soil and climatic conditions**. It does well in India in Bihar, Bengal and hilly areas.

Among the above *Rosa borboniana,* is commercially used as root stock for budding in the **plains of India**, while *Rosa multiflora* is used as root stock for budding of roses in **hilly areas**.

**Soil: The ideal soil should be medium loam having sufficient organic matter, with a pH of 6.0 to 7.5.** The land where the external drainage is poor and water stagnates during monsoon should not be selected for rose growing. **The land with high water table is not suitable for rose beds.**

**Climate: Roses love sunshine and free ventilation**. They need bright sunshine for the whole day, if not, at least for normal part of the day. The plants should be free from shades of trees and protected from the strong winds.

In the northern plains, roses flower best during winter whereas in the temperate hilly regions of the Himalayas best rose flowers are produced in summer. **Bangalore has mild climate, where roses can be grown for flowers throughout the year.**

**Layout and Preparation of Beds:** The plan of rose garden and design of the beds should be simple and informal. Rose beds may be of various designs. **Rectangular beds are advantageous** for maintenance. A plot size of 6.0 x 1.2 m or 6.0 x 1.65m is suggested for better management of rose plants.

**Preparation of Rose beds: With the help of digging spade, the soil, up to a depth of about 30 cm, should be dug out and heaped on the ground of adjoining the beds**.

If the soil is light, sandy and stony, the next 30 cm of the soil in the trench should be dug as deep as possible, pulverized and leveled in the trench itself. After that about half portion of the dug out soil, heaped on the ground surface, should be returned to the trench, worked with digging fork and leveled. This layer needs manuring with organic manure at the rate of 50-60 tonnes of farm yard manure or compost per hectare. **Super phosphate at the rate of 30 kg $P_2$ $O_5$ and Aldrin or BHC 5% dust at the rate of 100 kg per hectare are to be applied and the beds are irrigated thoroughly.**

**Pits of 75 cubic centimeter size are dug out a fort night before planting**.

**Procuring rose plants:**Roots shall arise within 6.5 cm of the base of the union.The plants should bear at least two shoots arising from the union or one shoot which produces branches not more than 6.5 cm above the union. The sum of the diameters of the shoots or shoots arising directly from the union shall exceed 3 cm. The earth ball should measure at least 20 cm in diameter and 25 cm in height. In case of double budded rose, the unions shall be as close together as possible on opposite sides and shall not be more than 7.5 cm apart.

**Planting:**

This operation should receive very careful attention.

1. Cut away all immature, dead, inward growing or diseased shoots and unduly long, dead snags.
2. Remove all suckers growing below the point of union.
3. Reduce the possibility of loss of moisture, leaves including dried and yellow ones should be removed.
4. If the roses are delivered with shriveled bark, it is suggested to immerse the plants in water for 24 hours to plump up.
5. Immerse each plant in a suspension of 1 g blitox in 1 litre of water to lessen the risk of attack of fungi.

**Depth of planting:** Budded plants generally are planted so that the bud union is slightly above the ground level in the bed.In temperate countries where winters are severe, it is usually recommended that the bud union should be placed slightly below the soil.In India, better results are obtained if the planting is done with the bud union 2.5 to 5.0 cm above the soil level.

**Season of planting:** In the most plains of India, the season of planting is during September – October and in the hills it is during October – November or February-March.Under the climatic conditions of northern India, **October is the best month for planting.**

**Planting distance:** A spacing of 60-75 cm is given between plants and rows, depending upon the vigour of the cultivars. The dwarf Polyanthas are planted 45 cm apart, Miniatures 30 cm apart and climbing roses 3m or more apart HT and Floribunda at 55 cm apart. Closer spacing tends to make the plants grow erect and produce long stalks.

**Gap filling:** Replace the casualties with healthy plants from time to time.

**Staking: It is necessary to stake the standard roses** by fixing the points at bottom, middle and top of the main shoots.

**Pruning:** Pruning refers to the removal of certain portion of a plant. It is an important operation for maintenance of floriferous ness and flower quality along with vigour of rose plants. Roses should be trained to give a definite shape to the plants. The practice of rose pruning consists of two operations, thinning out and shortening of stems.Thinning out comprises removal of old, weak, dry, twiggy and diseased stems and branches from the point of start while shortening of the remaining shoots aims at cutting down of last year's growth to a desirable height.

**Objects of Pruning in rose:**To remove the unproductive growth, ensure production of large number of strong and healthy shoots, which will bear flowers and improve the quality of blooms.

To force the strongest shoot bud to break in growth.

To Keep the rose bush in proper shape and size.

To allow light and air to reach the centre of plant

To encourage growth of new healthy shoots which bear more flowers than old branches.
The rose blooms harvested after pruning the bushes have longer stems than those cut from unpruned bushes.

**Pruning time:**

The best time of pruning is the period when the activity of the rose plant is least and the plant is at dormant to near dormant stage.

**The most usual time for pruning is during October- November in Indo-Gangetic plains** after the rains are well over and the cold season is approaching.

**In Bangalore, pruning is done twice a year, just before two flower shows held during Republic day and Independence day.**

Hybrid Teas are pruned 42 days before flower show.
Floribundas are pruned 45 days before flower show.
Three extra days are given for the clustering habit of flowers
In and around Madras city, rose plants are pruned only once at the end of November or early December.

**Where and How to prune:**

Every rose stem has eyes (buds) alternating on opposite sides, usually outward and inward. **The basic rule in pruning is always to make the cut at about half a centimeter above a vigorous bud that point in the direction one desires the new shoot to grow**.

Since a bush rose is to be kept open in the center, the cut is made at an out ward growing bud whereas in case of climbing rose, the pruning is done at a bud pointing more or less upwards. Whichever bud is selected, the cut should be slightly slanting. A horizontal cut retains moisture and, therefore is liable to cause fungal growth. While making the cut, care should be taken not to make it too high above the eye as there may be chance of die back of the shoot. If the cut is, on the other hand, very near the eye, the bud may die for want of sap flow. It is absolutely necessary to cut sharp and clean. Broken tissues, bruises or hanging shreds of bark are an invitation to pests and diseases.

**Types of Pruning:** There are three types of pruning – light, moderate and hard.

In the **light pruning**, the healthy shoots, left after thinning of diseased and unwanted portion, are cut either at the second or third eye (bud) immediately below the flower bearing foot stalk.

**Moderate pruning** is done by cutting back the ripe main and lateral shoots of the previous year's growth at an out ward growing eye, at about half the length of the growth.

**Hard pruning** consists of keeping only three or four shoots of the last year and heading back at about three or four eyes from the base.

All weak, diseased, dead and slender growing and overlapping branches are to be completely removed.

Generally strong and sturdy plants are pruned lightly, moderate growers, moderately and weak plants relatively hard.

If the soil is sandy and the nutrient level in the soil is not high, pruning should be light. In case of heavy and fertile soils, pruning may be a little harder.

**Pruning of one year old rose plants:**In the first year of planting, the pruning is done to give a definite shape to the plants and the operation will vary according to the class of the rose. For plants in Hybrid Tea and Floribunda

groups first of all, weak, dead and crowded branches should be removed from the base. The remaining healthy shoots should be cut back to less than half the length of the shoot.

Climbing and rambling roses do not require any pruning except the removal of weak growth and unhealthy, dead and interlaced twigs. The Polyanthas are pruned lightly whereas the miniatures are generally not pruned.

**Pruning of established rose plants:** The pruning of established plants is done to remove the weak, dead and damaged shoots and to obtain the large number of quality blooms by regulating the shape and size of the plants. The method adopted varies in the various types of roses.

**Hybrid Teas: Hybrid Teas are always pruned harder**. Remove all the dead, weak, damaged and crossing shoots from their point of origin. It is useful to retain only four or five healthy basal shoots and remove the remaining ones from their bases. Hard pruning i.e. cutting above three or four eyes from the base reduced the number of flowers per bush but increased the flower size and length of stem.

**Floribundas: The main object of pruning roses of this class is the production of abundance flowers with mass effect in the bed**.

This trend can be encouraged by removal of older growths at every opportunity and the young growths be shortened by about a third or half of their height. It is necessary to remove the mass of twiggy growth at the ends of the main stems.

Thus light or moderate pruning is the general recommendation of obtain higher yield of flowers.

**Manuring: Roses are gross feeders. At the time of pruning, well rotten cow dung is applied.** The doses would vary with soil type and its fertility status. Generally 4 to 8 kg cow dung manure per bush will be quite adequate. A hand full of bone meal should also be added along with manure. A little BHC or the Aldrin should be mixed with the organic manure to prevent the attack of white ants. Inorganic manures or fertilizers are more quick acting and small quantities of these are very effective. Nitrogenous fertilizers are more important. Phosphates also help in the production of more and better quality blooms. Indian soils are quite rich in Potash, but Potash fertilizers in combination with others give good results in some regions. **Complete Rose fertililsers such as Rose mix** are now available in the market.

**Liquid manure** can also be prepared by dissolving quick acting chemicals such as Nitrate of Potash and Phosphate of Potash at the rate of 30 grams each in 50 litres of water. About 5 litres of this liquid is added to each square meter at 5 to 7 days interval during the period when buds began to form until they bloom.

**Foliar feeding:**A foliar spray is prepared by dissolving 14 grams of the following mixture in 10 litres of water and sprayed at fortnightly intervals.

| | |
|---|---|
| Urea | 2 parts |
| Dihydrogen ammonium phosphate | 1 part |
| Potassium nitrate | 1 part |
| Potassium phosphate | 1 part |

**Irrigation: Roses do not like water logging but need plenty of water** for their optimum growth and development. The frequency of watering will

depend upon weather and nature of soil. Sandy soils need more frequent watering than clayey soils. In loamy and alluvial soils, such as that of Delhi, thorough watering once in seven days in summer and once in 10 to 15 days in winter is considered sufficient. In rainy season, necessary adjustment will have to be made. In between each watering, when the top soil becomes dry it is useful to stir it up with a khurpi and a hand fork. Frequent light irrigation is harmful hence, heavy drenching should be given at each irrigation. In eastern India, where rainfall is heavy, no irrigation may be required at all during the rains.In a climate like that of Bangalore, having red soil, one heavy irrigation at 5 days interval is recommended throughout the year except during the rains. When this has to be adjusted depending on the rainfall.

**Harvesting: The stage at which flowers should be cut, either for decoration or for dispatch is the tight-bud stage** when the buds show full colour but the petals have not yet started unfolding.If harvested at this stage, they last longer in vases or during transportation, retain colour and freshness. The optimum stage may vary slightly depending on cultivar and one has to be experienced to judge the right stage for cutting.

**Loose flowers,** used for making garlands, preparing perfumes and various other products and for worshipping are harvested only when they are fully open and collected in large open baskets. The flowers should be cut in the early morning before sun rise or late in the afternoon when the sun is about to set so as to avoid damage of buds due to high temperature during the day. Late harvest results in short vase life of cut flowers and low oil content in loose flowers used for preparing perfumes.

**For cut flowers**, the stem length should be little more than what is required and bear fairly good number of leaves. The cut should always be above a healthy outward pointing bud, a with a clean and sharp secateur. **The general rule observed by the most rose growers in cutting the stem is to allow two five-leaflet leaves to remain below the cut.** Immediately after cutting, the stem should be dipped in clean water up to the neck or base of the flower buds. Soon after cutting, the stems should be recut in water, about 2 cm above the previous cut end.

If they are not required for immediate use, the cut flowers along with stems dipped in water, in the bucket, should be stored at a cool air temperature of 4.4 to $7.2^0$ C , for about 6 – 12 hours to harden the buds and enhances the keeping quality.

**Yield:** The yield of cut flower depends on a number of factors like cultivar, plant density per unit area, flower quality, duration of flowering, pruning, fertilization and other cultural practices adopted from time to time.

In case of Hybrid Teas and Floribundas, 13.5 long stemmed cut blooms from one square meter are obtained in open field conditions in India, as against 144 cut flowers per square meter in Europe in glass house conditions.

**LECTURE-29:** Jasmine - importance- climate and soil – different species of jasmine – varieties- propagation- planting – pruning- manuring- irrigation- harvesting – yield

| | |
|---|---|
| Botanical name: | ***Jasminum sps*** |
| Family | **: Oleaceae** |
| Origin | : **India** |

Jasmine is one of the most popular flowers and are used for making garlands and veni for adorning the hair of women.

**Species And Cultivars:** A number of jasmine species are grown in India. Commercially grown important species are *J.sambac, J.auriculatum, J.grandiflorum* their brief description all as follows;

***J. sambac*:** Also called Arabian Jasmine. The flowers buds are white, with single or multi-whorled petals, used for garland-making, adorning hair and extraction of perfume. It is a bushy weak-stemmed shrub with pubescent branches.

**Important varieties are:**

Gundu Malli, Single Mohra, Double Mohra, Madanban, Ramabanam, Kasthuri malli.

***J. grandiflorum:*** Also called Royal or Spanish Jasmine, Chameli, Pitchi. It is a large shrub pinnate leaves. Flowers are white, often tinged with purple. Suitable for concrete extraction.

**Important clones are:**

Pin type, Thrum type, J.G.1 (Bangalore), J.G.2 (Coimbatore), J.G.3 (Lucknow), J.G.4 (Tenkasi white), J.G.5 (Thimmapuram), J.G.6 (Triploid), Surabhi, $CO_1$ Pitchi, $CO_2$ Pitchi.

***J. auriculatum:*** Also called Jathi Malli, leaves are mostly simple, usually trifoliate. The flowers are star shaped, white-scented blooms, borne in flan cymes. Black type of this is grown in home gardens.

High-yielding varieties are:

$CO_1$ Mullai, $CO_2$ Mullai, Pari Mullai, Long point, Long round, Medium point, Short round other important species of floricultural importance are;

***J. multiflorum***

Also called Kakada, Tundam. Resistant species, not scented, very ornamental.

***J. arborescens***

Also called tree Jasmine, Muta, Bela. Large shrub with fragrant white flowers.

**Planting:** Jasmine is perennial in nature. The plants remain in the same spot for many years. They are generally planted during rainy season. Pits of 45 $cm^3$ are dug at least one month before planting, the pits are filled with 2 parts of well-rotten cow dung manure and one part each of fresh earth and coarse sand. In termite – prone all as, dry leaves may be burnt in pits or a handful of BHC may be added to filling minture. Pits should be irrigated to settle the minture. Well-rooted, healthy and strong plants are planted in pits (one in each). Soils with proper drainage and irrigation facilities and sunny condition are ideal.

Planting distance plays an important role in flower yield. To get the highest yield, recommended distances are:

*J. auriculatum*, 18 x 1.8 m
*J. grandiflorum*, 1.5 x 1.5 m
*J. sambac*, 1.2 x 1.2 m

Climbing species are spaced to a wider distance, which depends on the purpose and choice of growers.

**Pruning:** Pruning is essential to get optimum yields and to keep the bushes within manageable size. The first pruning is done in the year following planting and thereafter once a year. The bushes are pruned during December – January every year. Irrigation is stopped 15 days before pruning and pruned to a height of 75-90 cm. from ground level.After pruning the soil around the bushes is dug upto a depth of 15 cm and a diameter of 60-75 cm all around leaving 30 cm of area close to the bush undisturbed. The dug basins are exposed for a week. After this manures and fertilizers are applied and irrigated sparingly (once in week) at initially and increased after the apperence of flower buds (once in 4 days).

**Manuring:** Many commercial growers use early organic manure by mining one part each of horse and donkey manaure and tank silt. The minture is applied @ 10 kg / plant / year. A fertilizer doze of 100g : 150g : 100g of NPK over a basal doze of 10 kg FYM / pH / year is ideal for getting minimum flower yield may be obtained if Mg (40 kg/ha), Zn (10kg / ha) and B (5 kg/ha) are applied along with NPK fertilizers.

The $N_2$ doze can be reduced to half (50 g / pH / yr) if applied as foliar spray in equal dozes beginning feem first week of February at fortnightly intervals. In *J. auriculatum,* 120:240:240 g of NPK is recommended / plant / year. In *J. sambac*, 90:120:240 g NPK / pH / year is recommended and most beneficial at Coimbatore. For *J. multiflorum*, 120 g N2 / plant / year is recommended at Bangalore.

**Irrigation:** Moderate watering is good for jasmine. It is more essential during flowering. During blossoming, the water should be applied twice a week if there is no rain and once a week during out of the months. Seen after the cessation of flowering, watering is to be completely stepped until pruning and fertilizer application. With the advancement of cold weather, the plants begin to shed the leaves. After pruning and manuring, watering is resumed. In *J. sambac* flowers come in phases. Each phase lasts for 7 days during which the blossoms are put forth in perfusion. There is an interval of about a month between one bloom and the commencement of the next with the close of each flowering phase, watering is completely stopped for weeks together till the appearance of fresh flowering buds.

**Piking:** Unopened but fully developed flower buds should be picked in the morning and marketed immediately.

**Yield:** Pari malli – 10,000 Kg / Ha Jathi malli – 11,000Kg / Ha
Gundu malli – 6200 Kg/ Ha

**LECTURE-30:** Chrysanthemum- importance- climate and soil – classification – varieties- propagation- planting – pinching- manuring- irrigation- harvesting - yield

Botanical name**: *Chrysanthemum indicum***
Family **: Compositae**
Origin: **Europe and Asia**

Chrysanthemum is a popular flower crop of commercial importance. Chryos means Golden; Anthos means flower meaning Golden coloured flower.

**Importance :**

1. In Japan Chrysanthemum is regarded as a symbol of Royalty
2. It is known as **Queen of East**
3. In India it occupies a place of credit both as a commercial flower crop and as an exhibition flower.
4. It's erect and tall growing cultivars are suitable for background planting or as cut flowers.
5. Dwarf and compact growing ones are suitable for pot culture
6. Decorative and pluffy bloomed small flowered cultivars are ideal for garland making and hair decoration.
7. Extra large bloomed cultivars have a great exhibition value
8. Species like *Chrysanthemum cinerareifolium and Chrysanthemum coccineum* are cultivated as sources of Pyrethrum an important insecticide.
9. Ryori Giku is a yellow flowering culinary type which is eaten as delicacy in Japan after frying.

**Cultivars:** There are innumerous numbers of cultivars; in Japan more than 50 thousand; in Britain more than 60 thousand; in India more than 500 cultivars are available.

**Exotic cultivars:**

1. **Spray cultivars:**

i) White : Ex: Arctic white spider
ii) Yellow : Celebrate
iii) Pink : Blue marble

2. **Standard cultivars:**

i) White : Giant India Napolis white
ii) Yellow : Bright Golden Anne
iii) Pink : Cessandra

3. **Pot cultivars**

i) White : Mountain snow
ii) Yellow : Golden crystal
iii) Pink : Always pink

**Indian cultivars:**

1. **Large flowered cultivars**

i) white : snow ball, Beauty
ii) yellow : Chandrama, Super Giant

2. **Small flowered cultivars for pot culture**

i) white : Mercury
ii) yellow : Aparajitha

**3. Small flowered cultivars for cut flowers**

i) white : Birbal Sahani
ii) yellow : Sujatha
iii) mauve : Apsara, Neelima

**4. Small flowered cultivars for garland**

i) white : Sharad shobha
ii) yellow : Freedom

**Classification of chrysanthemum:** Several countries classified Chrysanthemum based on number, size, form and arrangement of disc and ray florets.

The classification of National Chrysanthemum Society of America is given below:

1. **Division A:** It includes classes 1 to 8. Ray florets are flattened to concave or convex. Visible portions are never tubular

i) Section 1: It includes classes 1 to 3. Disc is prominent composed of many disc florets

Class 1: **Single:** Ray florets in a single row at right angle to the stem. Disc flat to slightly rounded.
Class 2: **Semi double:** Ray florets in more than one row at right angle to the stem, but may curve downwards at the tips.
Class 3: **Anemone:** Ray florets variable and *equal in length*. Prominent disc can be seen. It may range from flat to hemispherical in form.

ii) Section2: It includes classes 4 to 8. Disc is not apparent. Disc florets may be concealed or entirely absent.

Class 4: **Pompon:** Bloom globular, flat or small button type. Ray florets broad and incurved. Disc is not prominent
Class 5: **Incurve:** Bloom is globular.Ray florets smooth, narrow to broad and incurved and they don't have open centres Ex: Snow ball
Class 6: **Reflexing incurve:** Bloom is globular, less compact than incurve.
All mature florets not completely incurving or reflexed. The lower florets are reflexing to give a skirted effect. Ex: India-napolis.
Class 7: **Decorative:** Ray florets short and broad, long and pointed. Bloom are more flattened.Ex: Princess Anne
Class 8: **Reflex:** Bloom is globular, ray florets reflexed and gracefully overlapping. Ex: Coronation Pink.

**2. Division B:** It includes classes 9 to 11.
Tubular ray florets coiled and straight, hooked at distal end.

Class 9: **Spoon:** Ray floret is tubular distal potion is open and sppon like disc is apparent
Class 10: **Quill:** Ray florets tubular either closed to the tip and pointed or open and spatulate. Disc is not visible.

Class 11: **Spider:** Ray florets long and tubular, distal portion shows definite coils.Disc is not apparent.It has four sub classes namely a) thread b) fine c) medium d) coarse tubed

**3. Division C:** It includes classes 12 and 13. Ray florets flattened or tubular Disc may or may not be present includes two classes 12 and 13.
Class 12: **Lacinated:** Ray florets may be lacinated or feathered at the tips. Bloom form may be any of the classes from 1 to 11 Ex. Jack Straw
Class 13: **Brush or Thisle:** Ray florets are fine tubes.
They grow almost parallel to the stem in a brush or thistle like manner.

In India, chrysanthemums were classified into two broad groups, namely **large flowered and small flowered.**

**Large flowered cultivars** are usually grown as standards with 1-3 stems, bearing a single flower each and **Small flowered cultivars** are grown as bushes with multiple branches bearing a very large number of blooms per plant.

**Soil:** Chrysanthemum has shallow fibrous root system. This is very sensitive to water logging. It is prone to attack by diseases such as root rot and wilt, if there is lack of aeration.Physical, Chemical and Biological states of soil are therefore an important factor effecting growth of plants.Clay and Clay loams retain too much of moisture and thereby hinder the proper aeration resulting in rotting of roots.When dry, such soils become too compact and damage tender roots.Sandy soils on the other hand, dry too quickly and require frequent irrigation and also suffer from loss of nutrients due to leaching, though root growth is enhanced due to the plenty of aeration.**Sandy loams** retain sufficient moisture and provide optimum aeration essential for proper root growth and hence ideal for chrysanthemum growing.

**Climate:** Chrysanthemum is a cool season crop. It is grown throughout the world.**Light** and **Temperature** are two important environmental factors influence growth and flowering.The former is dominative in autumn flowers and later in summer growing cultivars.Chrysanthemum is short day plant requiring short days at the time of flowering and long days for vegetative growth.As far as light is concerned, both photoperiod and intensity are known to have major effects.It is found that chrysanthemum flower when day length decreases and this leads to their classification as **short day plant**.In general they require high light intensity. Plants grown under reduced light become taller and have thin stems and larger leaves.Flower buds in chrysanthemums have been found to initiate and develop above a critical temperature below which only vegetative growth occurs. Most of cultivars needs warm nights at the time of flower bud initiation.For flower bud initiation minimum temperature of 60 $^{o}$ F (15.5 $^{0}$ C approximately equals to 16$^{0}$ C) is required.

**Land preparation**: Land is brought to fine tilth by repeated ploughings, harrowings and planking.Entire prepared land is made into flat beds on light textured soils, raised beds or ridges and furrows in heavy textured soils.Before last Ploughing 15 tonnes of well decomposed FYM are applied to enrich the soil organic matter. It is thoroughly incorporated into the soil by subsequent ploughing and harrowing.

**Propagation:**There are three methods of propagation in chrysanthemum. Seed propagation: Mostly meant for establishment of crop for development of new varieties in Breeding programme. However for commercial cut flower production, seed is not used for propagation.

**Vegetative propagation:** Chrysanthemum is propagated vegetatively by Cuttings and Suckers.

**Cuttings:** Soft wood cuttings are obtained from laternal branches immediately after the completion of flowering. The terminal 8 to 10 cm long portions of laterals are simply cut from the left over plants and lower leaves of cuttings are stripped off.

Then the 1/3$^{rd}$ portion of cuttings should be inserted into soil of the rooting beds. In due course of time, adventitious roots are formed from cutting underground. These cuttings are said to be rooted cuttings, which should be lifted from nursery beds at the time of planting in the main field ( in July).

**Suckers:** Healthy suckers are obtained from healthy chrysanthemum crop of previous year. As soon as harvesting of cut flowers is over the left over plants are subjected to heading back to a height of 20 cm above ground level in the month of January and February.In due course of time the suckers will be arising from the adventitious buds present on the stem underground.As soon as they are long enough the suckers are cut to their base and are subjected to rooting in nursery beds (rooting beds)In rooting beds the suckers will produce roots at their bases and are said to be rooted suckers.These rooted suckers should be lifted from nursery at the time of planting in the main field.

**Planting time**:

June – July i.e. onset of South West monsoon.

Spacing: 35 cm x 20 cm

**Method of planting:** Rooted cuttings should be placed in a small planting hole made in the field at desired planting positions up to the point where it was there inside in the nursery. Then the soil is firm around the base of cutting such that no air pocket is left around the root system. Planting should be followed by light watering.

**Gap filling: I**mmediately after the establishment of rooted cuttings in the main field, observe for the casualties. Replace the same with healthy fresh rooted cuttings.

**Mulching:** Mulch the inter spaces with any locally available mulching material like paddy husk, groundnut shells and saw dust and dry leaves to a thickness of 2.5 cm

to check weed growth, to conserve soil moisture and to moderate soil temperature.

**Earthing up:** As soon as the plants are about 10 to 15 cm height, earthing up the soil around the base of plant is to be done to provide support to growing plant.

**Watering: I**mmediately after the establishment, the crop should be irrigated twice a week, depending upon the soil and climatic conditions. Care should be taken that water should not be stagnated in the field. Before harvesting of flowers, irrigation helps in enhancing the keeping quality of cut flowers.

**Staking: I**ndividual laterals should be provided with stakes individually i.e. Multiple Single Staking. Staked portion should be cut just below the level of flower bud at the time of bud opening so as to avoid the disturbance to the development of flower.

**Manuring:**Fully decomposed FYM is applied @ 15 tonnes per hectare as basal application. Nitrogen @ 50 kg per hectare; Phosphrous @ 160 kg per hectare; Potassium @ 80 kg per hectare should be applied as basal dose at the time of land preparation. Another 50 kg Nitrogen should be top dressed 30 days after planted.

**Regulation of growth and flowering in Chrysanthemum:** Chrysanthemum plant is left to grow naturally continues to grow tall until the natural break bud is produced at the end of a solitary branches. Side shoots develop later in the leaf axils and break bud shrivels. This side shoots continue growth to about 45 cm producing the first crown bud at the tip of primaries. First crown bud is characterized by a large number of ray florets with large sized coarse and ragged flowers. Second crown bud is produced at the tip of secondary branches. They are characterized by the small sized more intensively coloured, few ray florets, symmetrical and well shaped.

**Regulation of flowering:**

1. **Stopping or Pinching: I**f the plant is stopped when it is 15 cm tall before even the break bud stage, the side shoots appear in leaf axils earlier by 2-3 weeks (first pinching is done at $4^{th}$ week after planting).

The second pinching is done at ($7^{th}$ week after planting) by removing the first crown bud at the end of each lateral growth or by pinching the primaries before the crown bud has appeared. It will delay the flowering and produce second crown buds on secondaries.

Methods of pinching depends on nature of bloom to be obtained.

If only one bloom per plant is required no stopping is needed.

But if 3 or 6 stems are needed per the plant stopping is resorted too.

The tip of the main stem measuring 3 to 5 cm is removed. This stopping will encourage the lateral shoots (breaks) to develop from the leaf axils.

Three strong laterals are attained and others removed.

**Deshooting: (Thinning out):** When apical growing portion of main stem is removed number of laterals are produced from the leaf axils on the main stem. When all of these laterals (primaries) are allowed to develop, the size of the flower produced on this primaries is decreased. Keeping in this view three strong laterals are retained and others are removed. The laterals retained for flowering should preferably consists of one central stem and two on either side of it.

Deshooting is also practiced from time to time by removing all side shoots before they attain the size of 2.5 cm. The aim of deshooting is to divert the food materials to the retained laterals.

In singles, Koreans and sprays deshooting is restricted to prevent the plant from being too much crowded.

**Disbudding:**

First crown bud develops at the end of each lateral which contains maximum number of ray florets and will give the largest bloom, though may not be the best bloom. This is retained on all other growth arising from leaf axils is removed. Sometimes, the crown bud in laterals is stopped to obtain second crown bud which arises from leaf axils.

In many cultivars the second crown bud produce flowers of more intense colour, harder in texture, more symmetrical in crowd. However in most

cultivars, the first crown bud produces largest bloom. Disbudding stops as soon as flower buds appear.

In chrysanthemum if all the buds in one stem are allowed to bloom, the flowers become smaller in size. Therefore in large flowering cultivars only one bud or stem is allowed to bloom and others are removed. The ideal time for disbudding is when buds surrounding the central bud have developed. However in singles, Koreans and sprays no disbudding is practiced.

**Desuckering:**

All suckers that are arising from the adventitious buds present on the stem below the ground should be removed as and when they are produced. The practice of desuckering does not influence the flower number, but enhances the size and quality of flowers by diverting the nutrients to the flower bud.

**Staking:**

Laterals that are obtained after deshooting, should be staked with small split bamboo stakes inserted in the soil with a few to give support and also to see that this are spread out from each other. When buds start showing colour the bamboo stake is cut just below the basal level of bud so that it does not obstruct the bud in developing into a perfectly shaped flower.

**Harvesting:**

In general Chrysanthemum comes to flowering in about 80 to 90 days after planting (i.e. pre blooming period is three months). The early planted crop comes to flowering by July – August and late planted crop blossoms in January February. Early planted crops takes longer time to come to flowering than late planted ones. Flowers can be cut at an interval of 4 to 5 days in the beginning and once in three days during the peak period of production.

Fully opened flowers are harvested during cooler times like mornings

Standard chrysanthemum can also be harvested at unopened stage when only a few outer ray florets unfurl. The bud opening solution for this type is an absolute necessity. The ideal bud opening solution is 200 ppm, 8 HQC and 2 per cent sucrose (1-15%).

**Grading:**

Cut flowers are made into several grades depending on stem length and strength, colour and diameter of flowers. Pompons are graded into 250 – 340 grams bunches having several stems. Standards are generally graded into groups of 10 to 12.

**Yield:**

The average yield of loose flowers for garland making is about 7.5 to 15 tonnes per hectare. In case of spray cultivars about one lakh flowers are obtained from an area of one hectare.

**LECTURE-31:** Crossandra and marigold- importance- climate and soil – varieties- propagation- planting - manuring- irrigation- harvesting – yield

| |
|---|
| Botanical name: ***Crossandra infundibuliformis*** |
| Family **: Acanthaceae** |

It is also known as Kanakambaramu or Firecracker because of cracking sound during opening of seedpod.

**Importance:**

Flowers are commonly used for hair adornment, though not fragrant, flowers are very popular because of its attractive bright colour, light in weight and good keeping quality. These are used for making garland either alone or in combination with Jasmine flowers. Crossandra flowers in combination with Jasmine flowers give fragrance and contrasting (striking difference) beauty. It can be grown in home gardens, rockery gardens and for land scaping as an herbaceous border.

**Variety:** Crossandra varieties are available in a range of colours. Apart from the
orange, pink, red and yellow and double coloured blue types with white throat also exists.
Orange, Delhi, Lutea yellow and sebacaulis Red are the common cultivars grown.

**Propagation:** seed or cuttings can propagate Crossandra.

**Seed:**

The seeds mature in small ears similar to those of wheat. Seeds attain physiological maturity at about 55-60 days after flowering. The seeds can be stored for 6 months with seed treatment it either captain or Bavistin @ 2g/kg of seeds. Seedlings will be ready for planting when they have 4-5 pairs of leaves. To raise one hectare of crop of Crossandra about **22.5kg** seed is required. (9kg/Acre).

**Stem Cuttings:**

Crossandra may also be propagated vegetatively. The stem cuttings are rooted under mist chamber. The cuttings are transplanted in the field when sufficient numbers of roots have developed. It is preferable to treat the seedlings or rooted, cutting with nematicide and fungicide before transplanting.

**Soils:**

Crossandra can be grown in almost all types of soils. However, well-drained loamy soils rich in organic matter with a pH of 6-7 are well suited.

Alkaline and saline soils are not suitable as plant develops deficiency symptoms like chlorosis and lead to improper growth of the plant and poor flower production. This crop should not be cultivated in nematode infested soils.

**Climate:**

It is a tropical plant and cannot tolerate low temperatures and frost conditions. It grows luxurious when temperature is around **$30^{0C}$ .** It flowers profusely during cool months of the year; plants can also be grown under partial shade.

**Planting:**

The soil is ploughed 3 to 4 times to bring the soil to a fine filth. Well rotten FYM @ 25T/ha should be applied at the time of last ploughing. Furrows and ridges are opened at 60 cm. Apart. Rooted seedlings or cuttings are planted 30 cm apart on one side of the ridge. The seeds are sown in May-June and transplanted during August-September.

**Irrigation:**

Depending upon climate and type of soil immediately after planting irrigation is necessary. It required irrigation once in 4-5 days.

**Manures and Fertilizers:**

For increased growth and flowering in Crossandra application of N, P, K and FYM and Zinc Sulphate is also recommended.

Apply 33.4 kg N, 60 kg K per hectare. Entire P and K should be apply in the ferrous before planting.

N – should be applied in 2 split doses

**1.** 3 Months after planting

**2.** 8-9 months after planting

Zn $So_4$ 0.5% foliar spray once in 60 days.

Fe deficiency a common problem in Crossandra.1% $Fe_2 So_4$ + 2% urea spray once in every 30 days. Seed yields and reduce chlorosis.

**Inter-culture:**

Flowering in Crossandra commences 2-3 months after planting and continues to bears flowers through out the year flower production may drop during rainy season. Providing partial shade to the plants has been found to be beneficial to maintain the health of plants and obtain higher yield of flowers. During initial growth period the weeds are kept in check by manual method by using Khurpi or hand hoe. Timely application of fertilizer, irrigation, weed control, earthing of plants are required to maintain a good healthy crop. After the flowering is over, removed of dried spikes and branches will help in increased flower yield year round.

**Harvesting:**

Crossandra can be flowered 2 – 3 months after planting. Crossandra flowers open in sequence from the base of the spike. Two flowers are **diagonally** opposite the spike open at the same time. It takes about 2 days for (Joining opposite corners of a square or rectangular) complete opening of

the flower. Therefore picking of the flowers is done therefore alternate days in early morning hours. Depending on the length of the spike it takes nearly **15 – 25** days to complete flowering on a spike. Flower picking is done by pulling corolla out of calyx. In some plants flowers are picked along with the ovary. For local market flowers are packed in cloth or polythene bags. Crossandra flowers are very light and on an average about **15,000 flowers make on kg.**

**Yield:**

The flowers yield increases as the plants grow producing more number of laterals. Though Crossandra is reported to be perennial and lasting 2 or 3 years, it may be better replace every year to maintain healthy and fresh looking plants, capable of producing higher yields. 5.7 to 10 T/ha from earlier healthy crop.

| | |
|---|---|
| Botanical name: | ***Tagetus erecta* - African marigold** |
| | ***Tagetus Patula* - French marigold** |
| Family | **: Compositae** |
| Origin | : **Central and South America and Mexico** |

Marigold is one of the most popular flowering annuals cultivated in India. It is gained its popularity amongst gardeners and flower dealers on account of its easy culture wide adoptability, wide attractive colours, shapes, size and good keeping quality. In Andhra Pradesh Marigold is extensively used as loose flower for making garlands in religious and social functions.

**Importance:**

1. It is useful for floral decorations and floral arrangements.
2. Used in mixed herbaceous borders and bedding, cut flower, pot culture.
3. For religious offerings and French marigold is most ideal for rockery, edging hanging
   Baskets and window boxes.
4. Both leaves and flowers are equally important from medicinal point of view leaf paste is
   Used externally against boils and carbuncles. Leaf extract is good remedy for earache. Flower extract is considered as blood purifier, a cure for bleeding piles and is also a good remedy for eye diseases and ulcers.
5. Oil extracted from Tagetus can find a use in the perfume industry.
6. Extracts used as **natural dye**.
7. African marigold represents "**vulgar minds**" where as French marigold is a symbol of "**Jealousy**"
8. Marigold is also known as **friendship flower** in the United States.

**Species, Types and Cultivars:**

There are about 33 species of the genus Tagetus. Among all the species the following two species are important and suitable for commercial cultivation.

1. **African Marigold: - (Tagetus erecta):** The plant is tall and hardly. Flowers are single to fully double and large size globular heads. Flower colour varies from lemon yellow-to-yellow, golden yellow or orange. (90cm tall, erect, branched). It is a diploid, 2n=24. From commercial point of view African marigold is in greater demand as compared to French marigold.

   **Ex.** Giant double African yellow, Giant double African orange (Early orange

   and Early yellow are commercially cultivated in West Bengal and Orissa).

   Cracker Jack, Zinnea gold, Gold coin, Yellow supreme, Man in the moon.
2. **French Marigold: (Tagetus patula):** Plant is dwarf bushy, flowers are small either single or double. Flower colour varies from yellow, orange, reddish brown, golden yellow to bicolour. Foliage is dark green with reddish stem. (30 cm tall bush). It is tetra ploid 2n=48.

**Important cultivars:** yellow boy, Harmony boy, Red brocade, little devilbicolour, little devil yellow, Butterscotch, Royal Bengal, Queen Sophia, and Tangerene.

**Dwarf varieties of African Marigold:** Apollo, Aztee, Golden age, Spun gold, Spun yellow, Guys and Dolls, Happiness, Dolly, Pot -o- gold.

**Important varieties of French Marigold:** They are easy to grow and bloom earlier than African types. Sparky, Spanish brocade, flame, flaming of fire, orange flame and star of India. The important varieties of **triploid varieties** are showboat; sever star *(T-erecta x T-patula)* most of them are used as pot mums.

**Important improved Indian varieties:**

1. **Pusa narangi Gainda –** Cracker Jack x Golden Jubilee – Suitable for garland.
2. **Pusa basanti Gainda –** Golden yellow x Sun giant – Suitable for pots and beds in garden.

**Propagation:** Marigold is (commonly) generally propagated either by seed or by herbaceous cutting.

**Seed**: Seed rate for marigold varies from **0.8 – 1 kg / Acre (2-2.5 kg / hector**).

**Seed propagation** is very common because readily available and germinate quickly marigold seeds are sown in raised seedbeds or pots or seed pans. During preparation of nursery bed 8-10 kg of well-decomposed cow dung manure per $m^2$ of bed is thoroughly mixed with the soil. The width of the seedbed should not be more than 1.2 meters and height should be 15 cm. During the winter, the beds are covered with a layer of straw to accelerate the germination process. Seeds are sown thinly without over crowding. Seeds germinate well at temperature from **18 to 30 $^0$ C**. Seeds take about 5-7 days for germination.

**Sowing time:**

Marigold can be raised **thrice in a year**, i.e. rainy, winter and summer season.

| Season | Seed sowing time | Trans planting time |
|---|---|---|
| Rainy | Mid – June | Mid – July |
| Winter | Mid – September | Mid – October |
| Summer | Jan – Feb | Feb – March |

**By cuttings (Herbaceous): -**

Cuttings are generally used for perpetuation of a particular plant (or) cultivars. About 6 – 10 cm long cuttings are made from the apical portion of shoot and kept for rooting. Herbaceous cuttings each with one or two pairs of leaves are inserted in sand medium either in seed pan or nursery bed. Before putting the cuttings in rooting medium the basal portion of the cuttings is treated with Seradix B – 1 or Rootex – 1 to encourage profuse and early rooting. Regular watering should be done to keep the bed in moist condition with in 8 – 10 days, rooting is observed in the cuttings, which are later used as planting material. Varieties like Giant African yellow, Giant African Orange **does not set seed** therefore these are usually multiplied by herbaceous cuttings.

**Soil and Climate:**

Marigold can be grown in a wide range of soils, except water logging situation. However a deep fertile soil having good water holding capacity well drained and near to neutral in soil reaction ($P^{H:}$ 7.0 – 7.5) is most desirable. An ideal soil for marigold cultivation is fertile sandy loam.

It requires mild climate for luxuriant growth and flowering. High temperature effects the growth besides reducing flower size and number. In severe winter plants and flowers are damaged by frost. Therefore depending on environment planting is done. The environmental conditions after seedlings are transplanted greatly influence growth and flowering. Mild climate during growing period (14 – 28 $^{0}$ C) greatly improves flowering while higher temperatures (28 – 36 $^{0}$ C) adversely affected flower production.

**Selection of Site:**

A sunny location is ideal for marigold cultivation. Under shade marigold plants produce more vegetative growth and do not produce any flower.

**Transplanting of Seedlings:**

One-month-old seedlings with 3 to 4 leaves are fit for trans planting. Watering of nursery bed one day prior to up rooting will lessen the damage to root system. Trans planting should be done in well-prepared land and soil is pressed around root zone to avoid air pocket. After temperature a light watering with rose can should be done.

**Spacing:**

An African marigold – for seedling plants 40 x 30 cm spacing should be given while for rooted cuttings 30 x 20 cm is found to be ideal. French marigold – 20 x 20 cm or 20 x 10 cm.

**Irrigation:**

Depending on soil and weather conditions, the crop should be irrigated at least once in a week during winter and once in 4-5 days during summer. It takes about 55 – 60 days to complete vegetative growth and enter into reproductive stage. At all stages of vegetative growth and during flowering production sufficient amount of moisture in soil is essential. Water stress adversely affects normal growth and flowering.

**Manures and Fertilizers:**

FYM/cow dung @ 20 T/ Acres (50 T/hector) should be applied during wind preparation. Besides 40 – 80 kg of $K_{20}$ per acre should be applied (100 – 200 kg N, 200 kg $P_2$ and 200 kg of $K_2$/hector). Half of the N, entire dose of pad K should be applied as basal dose, preferably one week after transplanting and rest half nitrogen should be applied one month after the first application.

**Intercultural Operation:**

In marigold control of weeds is an important operation of the weeds are not removed in time, a great loss would occur in terms of growth and productivity and weeding should be done 3 to 4 times during the crop period.

**Pinching:**

In tall cultivars of African marigold plants first grow up wards to their final height and later on produce a terminal flower by apical dominance. After the formation of terminal flower bud, axillary's branches develop which also bear flowers. However if the apical portion of the shoot is removed early, large number of axillary shoots arises resulting in well-shaped bushy plant bearing more number of uniform sized flowers. Removal of apical portion of shoot is known as 'pinching' it is observed that pinching 40 days after transplanting enhances flower yield. However Giant double African yellow and orange do not require pinching, as the plants are bushy and branching type.

**Harvesting:**

Marigold flowers are plucked when they attain full size. Harvesting should be done either in the morning or evening hours. Field should be irrigated before harvesting of flowers so that the flowers keep well for longer period after harvest. The plucked flowers are collected in polythene bags, jenny bags or bamboo baskets for carrying to market.

**Yield:**

The yield of flowers in African and French marigold varies cultivars cultural practices adopted, spacing and fertilization etc. An average the yield of French marigold and African marigold varies from 8 to 12 T/hector and 11 to 18 T/hector respectively. Normally 10 – 15 T/hector flower Giant African yellow may give 25 T/hector.

**Seed:**

African marigold – 120 – 150 kg/Acre 300 – 375 kg/ha

French marigold 400 – 500 kg/Acre 1000 – 1250 kg/ha

Seeds should be collected from winter only.

**LECTURE-32:** Tuberose - importance- climate and soil – classification based on petals- varieties- propagation- planting - manuring- irrigation- harvesting - yield

| | |
|---|---|
| Botanical name: | ***Hyacinthus indicus*** |
| Family | **: Amaryillidaceae** |
| Origin | : **Mexico** |

In India, the commercially cultivation of tuberose is certain confined mainly to west Bengal, Karnataka, Tamil Nadu and Maharastra. However, it is adopted to the North Indian climatic conditions and grows well in Utter Pradesh. At present total area under the tuberose cultivation in the country is estimated to be about 20,000 hectare.

**Soil:** The tuberose grows in a wide range of the soils. Its cultivation can also be extended economically in almost unproductive soils affected by salinity and alkalinity. Loam and sandy loam soils having the pH range from 6.5-7.5 with good aeration and drainage are considered for its cultivation. The soil should be rich in organic matter and retain sufficient moisture for proper growth, according to Rameshwar, heowy soils, where rice is cultivated, should be preferred to light red soils. For cultivation in pots, a mixture of garden soil, FYM and leaf mould in the proportion of 2:1:1 should be used.

**Climate:** Tuberose grows in mild climate without extremes of high or low temperatures even though it can be grown under a wide range of range of climate conditions. In India, the commercially cultivation of tuberose is mainly confined in warm, humid areas with the average temperature range from 20$^{o}$ to 35$^{o}$C. For its urnuriant growth, it requires high humidity and a temperature around 30$^{o}$C. Temperature above 40$^{o}$C reduces the spike length is quality of the flowers. Very low temperature and frost also damages the plants and flowers. Tuberose grows well in sunny situation.

**Planting:**

Tuberose is generally planted is February – March in the plains and in April – May in the hills. In a two-years field trail on a medium fertile clay soil, the best time for the planting was reported between 14 & 29 June, the percentage of saleable bulb produced was about 85. in Southern pats of India, however, Nambisan and Krishnan suggested to plant the bulb in the month of July – August. Investigation on effect of time of planting of bulbs in the month of April recorded the highest yields of was also recorded by Mukhopadhyay and Banker (1981). Sequential planting may be practiced to obtain flowers almost throughout the year if the temperature is not very low in the winter months. Replanting is necessary after 3 years.

**Propagation:**

Tuberose is mainly propagated through vegetatively by means of bulbs, seeds if produced, are difficult to germinate and are seldom used for raising plants. Although not very common, propagation may also be done by the division of bulbs. To get virus-free the material or for a very rapid multiplication is done through tissue culture.

**Seed propagation:**

Under favourable climatic conditions, seed settings is observed only in the single flowered cultivar. Seeds are sown in well prepared growing medium containing leaf mould and garden soil in equal propagation. Moisture and garden soil in equal proportion. Moisture and temp of 80$^{o}$F (26.6$^{o}$C) is supposed to be optimum. The seeds are sown in rows 10cm apart and 1.5cm deep in heavy soils and 2.0m in light soil. Moisture can be maintained by spreading the much on bed. Seeds start germinated within 10 to 50 days after sowing. After the seedlings have attained a good growth, these are transplanted in pots or ground were they are allowed to grow.

**Vegetative propagation:**

**Bulbs:** This is most commonly used practiced commercially for the multiplication of tuberose. However care should be taken in the selection of suitable bulbs. Spindle-shaped bulbs free from diseases and having an average diameter of 1.5cm or above should always be preferred to conical flat bulbs. The maximum production of bulbs can be planting them early and to grow as late as possible.

**By division:**

Tuberose also responds to his method of propagation i.e. By using bulb segments. The success however on the size of bulbs and it was reported that only the segments from large bulbs (sum or more in diameter) regenerated well. Bulbs are cut into 2-3 vertical sections, each containing a bud and a part of the basal plate. Each of these sections is treated with fungicide and planted vertically in a rooting medium with their tips just showing above the surface. A moderately warm temperature, slightly higher than for mature bulbs should be maintained.

**Planting distance:**

Planting distance influences the yield and quality of flower and bulb obtained per unit area. Higher plant density has been found to produce greater yield of spikes, flower and bulbs was grown at planting rates of 24,36 and 48 bulbs 1m$^{2}$ on soil with high or medium ridges or on flat soil. In West Bengal suggested spacing of 10-15cm between the bulbs and 25cm between the rows. The planting of bulbs at a distance of 20x20cm with a population of 250000 plants / ha. Rameswar (1976) the suggested a spacing of 30 to 38cm between rows and 15 to 20cm between bulbs, accommodating 40,000 to 50,000 bulbs per acre for cultivation of tuberose in Bangalore. The planting was done at a distance of 20 x 25cm sharga (1977) recommended spacing of 30cm apart.

**Harvesting of flowers:**

Tuberose is harvested by cutting the spikes from the base of for table decoration or the individual flower is picked from the spike for making garlands and other floral ornaments. Picking of flower should be done in cool hours of the day either in the morning or evening. Harvesting in the next morning leads to a weight loss to about 40 percent. Four to five persons can harvest about 60kg flowers in 2 to 25 hours.

The flowers spike for table decoration should be cut when the first pair of flowers fully open, with a sharpe knife and placed immediately in water. The small clasping leaves on the flowers stalk should be retained for a longer life of the flowers.