THEORY NOTES

Course no: HORT-354 **Credit: 2(1+1)**
Course Title: Production Technology for Ornamental, crops, MAP and Landscaping

Ornamental Horticulture: It refers to the study of various groups of ornamental plants which are used to decorate indoor and outdoor gardens

Landscape Gardening: It consists of planning and arrangement of home gardens, Public garden for bio – aesthetic purpose.

Landscape gardening and ornamentals: It is branch of horticulture science which deals with planning and execution of ornamental gardens, parks, landscape garden for pleasure and fashion purpose.

Scope of Floriculture in India

Importance:

1. Flowers have been considered as the symbol of grace and elegance and a feast for our eyes.
2. They are used on all religious festival occasions. Flowers are given as a birthday presents, wedding gifts or while meeting sick people and even at funerals.
3. Most Hindu ladies adhere their; hair style with flowers i.e. *Gajara* and *Veni* and it is one of the important floral ornament which will and grace to their beauty.
4. All the people irrespective of their origin, race, sex and cadre love flowers.
5. Generally flowers are offered by devotees in Temple, Gurudwara, Church and Masjids- Flowers are used as a floral decoration.
6. Even dried flowers are also used in flower craft or arrangement of garlands and bouquets are prepared and offered to welcome the dignitaries.
7. When cut flowers are used for vase decoration, that will be a marvelous piece of indoor decoration.
8. Importance of flowers is not restricted upio the beautification, decoration or preparation of Gajra, Garland, Veni or Bouquets but afso have the industrial importance too. Some flowers like Rose, Jasmines, Tuberose, Kevda, Bakul are used for extraction of essential oils which is base for preparation of perfumes, scents or attar. From rose Gulkand, Rose water etc. products are also prepared.

Scope :

There is a good scope for commercial floriculture. The important factors which decide the scope for Commercial Floriculture are Soil, Climate, labour. Transport and Market.

1. All most all big cities are developing very speedily to accommodate this fast growing population, cement concrete, jungle is also developing at the same rate and thus peoples are now realizing the importance of open space, parks and garden for relaxation, peace of mind, recreation and unpolluted air. Thus, to meet out all these problems bio-aesthetic planning is essential, which runs hand in hand with town planning.

2. In modem life floriculture garden in the country yard is an integral part of the modern life and thus ornamental plants has find a pride of place in home gardening.

3. As far as flower trade is concerned i.e. for cut flowers and loose flowers, it is growing very well in our state because these cut flowers are used for vase decoration and now-a-days there

is a craze for indoor decoration. As far as loose flowers are concerned these are mainly used for preparation of gajara, veni, garland and bouquets and thus demand of flowers for these purpose is unending.

4. Thus, taking into consideration the different points i.e. bio-aesthetic planning, floral garden, indoor decoration, social functions and religious functions the demand for floricultural plants is increasing day by day and to meet out the same there is a good scope for growing and raising of Ornamental or Floricultural plants. When Flower Trade is concerned; different flowers like Rose, Chrysanthemum, Gladiolus, Tuberose are demanded in the market as cut flowers. While Aster, Gaillardia, Marigold, Chrysanthemum, Jasmines, Tager^ Nerium as loose flowers

Importance Of Landscape Gardening

The landscape gardening is not only aesthetic which is meant to beautify places but also functional and important. Surroundings make a significant contribution to our quality of life. The word 'landscape' does not only mean attractive scenery, but represents a rich historical record of natural features, molded by human activity over the centuries. It forms the context for our everyday lives and is reflected in our literature, music and painting.

- The art of landscape gardening will involve considering the total environment of any new development and then shaping it using natural elements such as landform, trees, shrubs, and water to form a pleasing harmony.
- This can make a constructive contribution to the improvement rather than the destruction of environment.
- Plants that form an important element in landscape design aid in reducing the pollution of the environment and minimizing some of the effects of heat, sound, wind, air etc.
- Plants absorb carbon dioxide and release oxygen during photosynthetic process and purifying the air.
- Plants with thick foliage also trap pollutants, which are later on washed away by the rains.
- Some plants, such as Hydrangea, Mustard, and Hyacinth absorb toxic material from the environment they are in.
- Plants can block, diffuse, guide or channel winds. Plants can be used to direct wind so that the wind flushes out the polluted air.
- Plants control erosion caused due to excessive wind, rain or snow.Plants with good branching and deep root system and also those with fibrous surface roots help reducing the loss of fertile top soil.
- Plants reduce radiated heat thereby bringing down temperature.
- In winter, deciduous trees which shed their leaves allow lights to pass through, thereby warm the space.

Medicinal plants

Medicinal plants are those plants rich in secondary metabolites and are potential sources of drugs. These secondary metabolites include alkaloids, glycosides, coumarins, flavonoids, steroids etc.

These plants form the main base for the manufacture of drugs of Indian systems of medicine (ayurveda, Unani, Siddha) and Homeopathy. These plants are found in various parts of the country in different environmental and climatic conditions. Plants which grow wild in forest regions, classified as minor forest produce, supply a substantial

amount of raw material required for the indigenous drug industry.

Importance and scope for cultivation of medicinal plants in India.

1. India is one of the few countries where almost all the known medicinal plants can be cultivated in some part of the country of the other. Among the various plants in great demand in the country and abroad are Opium poppy, tropane alkaloid bearing plants, sapogenin bearing yams, senna, psyllium husk and seeds, cinchona and ipecac.

2. The ancient Indian System of Medicine (ISM) is predominantly a plant-based material medica making use of most of our native plants. It caters to almost the entire rural population of our country mainly because of the scarcity of modern allopathic health care in our villages

3.ISM offers most appropriate or first line therapy against many diseases like jaundice, bronchial asthma, rheumatoid arthiritis, diabetes etc, for which allopathic medicines have as yet no cure. It is well known that most allopathic medicines have as yet no cure. It is well known that most allopathic medicines produce many morbid side-effects. It is for this reason that more and more people in the western societies are showing increasing interest and preference for organic drugs and their preparations.

4. India has about 2,000 species of medicinal plants and a vast geographical area with high production potential and varied agro-climatic conditions. Most of these plants can subsist under stress conditions and are thus suited even for rainfed agriculture. Cultivation of medicinal plants offers considerable scope for rural employment and export for foreign-ex-change earnings.

5. India is already a major exporter of medicinal plants. It is estimated that rupees

86 crores worth of raw materials and drugs from medicinal plants are exported from India. It holds monopoly in the production and export of psyllium and senna and is second largest exporter of Opium latex.

6. Many of the medicinal plants required by the trade are gathered mainly from the wild growth thus depleting the vegetation of its valuable medicinal plant wealth (eg: Rauvolfia, Dioscorea). On account of this practice, many species of medicinal plants in our country have become extinct or endangered. This should be prevented and herbal gardens and gene-banks covering important medicinal plants should be established to conserve them.

Aromatic plants

Aromatics Plants which possess essential oils in one or more plant parts.

Wood – sandal; Bark – cassia; Foliage – lemon grass;
Flowers – jasmine; Fruits – citrus; Seeds – coriander.

Essential oils are secreted in oil glands.

Essential oil: Complex mixture of odoriferous steam volatile compounds, which are deposited by plants in sub- cuticular spaces, granular hairs, cell organelles, excretory cavities, canals and heart wood.

Uses of aromatic crops:

1. In food and flavour industry – spices and condiments
2. In perfumery, soap and cosmetics

3. Pharmaceutical and drug industries.
4. To manufacture pesticides, disinfectants due to antifungal, antiseptic and insecticidal properties.
5. In pain industry – as solvents.
6. Distilled wastes are used in manufacture of card boards, cheap paper, packing material.

Essential oil industry in India:

In India it is a cottage industry. India is the traditional producer of essential oils such as sandal wood, palmarosa, lemon grass. Indians use the plants and products in rituals, ceremonies. Some aromatic plants find place in materia medica, sandle wood, mint and fennel etc. Distillation process was mentioned in charaka and sushrita samhita (written over 3000 to 4000 years ago). India is endowed with various agro-climatic conditions, suitable for growing different aromatic plants.

Essential oil industry is not strong in India because:

1. Farmers are not aware of the significance and profitability.
2. Lack of marketing facilities.
3. High initial investment.
4. Price fluctuation
5. Competition for land domestically.
6. Lack of scientific knowledge on cultivation.
7. Deadly diseases like spike disease of sandal wood or fusarial wilt of Geranium1
8. Lack of germplasm collection and maintenance.
9. Risk, as the produce is priced on the basis of the principle.
10. Larger quantities are required.
11. Lack of testing facilities.
12. Cheaper synthetic substitutes.
13. Dearth of trained personnel.

Importance of Aromatic Plants:

Aromatic plants are from a numerically large group of economically important plants. These are increasing demand for essential oils, aroma chemicals drugs and pharmaceuticals in the world market since two decades. Aromatic compounds are present in plants i.e. in root, wood, bark, foliage, flower, fruit, seed etc.

1. Aromatic plants produce essential oils, perfumes and flavours are in use with our civilization since several thousand years.

2. Due to Vast area and varied agro-climatic condition, it can be commercial cultivated in different part of India successfully.

3. Essential oils and aroma chemicals are indispensable in various human activities.

4. They are adjuncts of cosmetics, soaps, pharmaceutical preparation, perfumer confectionery, ice-cream, aerated waters, disinfectants, agarbatti etc.

5. Some of the important aromatic plants like Lemon grass, Citronella, Palmarose, Vetiver, Geranium, Lavender, Dawana etc. have great demand in our country.

Principles of Landscaping

A garden may be defined as An area embellished with plants, a valuable and pleasurable adjunct to a house.

A mere collection of plants will not make a garden. It is the skilltul arrangement and disposition of plants over the area making a design or pattern or picture as it were that forms a garden. Therefore, gardening warrants apart from a knowledge pf the Science of Plant growing, an artistic aste on the part of the gardener.

Before planning a design one must be used for what purpose the garden is Utility or Beauty or Both.

Initial Approach of Designing a Garden:

In theory, everyone would like to have a perfect plot of land, but in actual practice the plot available for gardening, in three out of five cases, either will not be in a good site or the shape and size will not be ideal. Whatever, may be the case, one should not throw one's hands up in despair even if the site appears to be not so good. A good designer is orte who will make best use of such a site-. As has already been stated, land with natural undulations should never be leveled, but rather the. differences in levels should be utilized with advantage.

The other terms and principles used in landscape design are briefly discussed below:

Axis :

This is an imaginary line in any garden around which the garden is created striking a balance. In a formal garden, the central line. is. the axis. At the end of an axis, generally there will be a focal point although another architectural features such as bird-bath or sundial can also be created at about the mid point,

Focal Point:

In every garden there is a center of attraction which is generally an architectural feature focused as a point of interest. A focal point is one of the elements of good landscape design.

Mass Effect:

The use of one general form of plant material in large numbers in one place is done to have mass effect To see that mass airangements do not become monotonous, the sizes of masses should be varied.

Unity:

Unity in a garden is very important as when this is achieved it will improve the artistic look of the garden. Unity has to be achieved from various angles.

First, the unity of style^ feeling, and function between the house and the garden has to be achieved

Secondly, the different components of the gardens should merge harmoniously with each other. The aim is to give the visitor an overall impression of the garden rather than blowing up some special features.

The last point, which is also very important, is to achieve some harmony between the landscape outside and the garden.

Space:

The aim of every garden design should be such that the garden should appear larger than its actual size. One way of achieving this is to keep vast open spaces, preferably under lawn and restrict the plantings in the periphery, normally avoiding any planting in the center.

Divisional Lines:

In a landscape garden, there should not be any hard and fast divisions] lines. But there is necessity of dividing or rather screening a compost pit or *a* mali's quarter or a vegetable garden from the rest of the garden, [n fact areas under lawn, gravel, stpne or cement path, and shrubbery border have their natural divisional lines from its immediate neighbour though these are not discreet. This is what is exactly needed. The divisional lines should be artistic with gentle curves and these should also be useful. Above all these lines should be harmonize with one another.

Proportion and Scale:

Proportion in a garden may be defined as a definite relationship between masses.

For example a rectangle having a ratio of 5:8 is considered to be of pleasing proportion. As this ratio comes down the form looks neither in square nor a rectangle, and the design becomes undesirable.

Texture:

The surface character of a garden unit is referred to as texture. The texture of the ground, the leaves of a tree or shrub will all determine the overall effect of the garden. The texture of rugged looking ground can be improved to an appreciable extent by laying metaculously chosen small pebbles from fee river beds, if establishing a lawn is out of the question.

Time and Light:

In a garden the time factor is very important There are three different categories of time in a garden.

First comes the dally time, which provides different quantities and qualities of light during the course of the day. As the morning Sun is vital for all flowers, the designer has to take this into account while planning.

Tone and Colour :

A tendency on the part of an amateur Gardner is to create a riot of colours by indiscriminately planting flowering annuals of all shades. This practice is not desirable. Moreover, such riot of colours has only temporary effect. In a landscape garden, the permanent backdrop is the green tones of the various trees and shrubs. It is possible to lay out a garden with subtle tone of the entirely white or yellow flowers, but at the same time making it charming also. Another important point is that it is better to have masses of a single colour against a mixture of colours. A bed of roses containing only a single colour of say red, yellow1 or pink has a much soften tone and beauty than a bed containing a mixture of colours.

Mobility:

In a temperate country, the "garden changes colour very sharply and contrastingly from one season to the other thus symbolizing mobility or movement. As for example, many trees ia the temperate regions attire themselves with wonderful hues due to the changes in their leaf colour in the autumn'. Then suddenly in the winter leaves fall and everything goes to rest bringing an atmosphere of melancholy and dullness-all around

Style:

Lastly, one has to decide about the style to be adopted for one's garden. Broadly speaking, every garden lover has to invent his own style of gardening commensurate with his budget, taste, and the nature of the site.

Flower crops

1) Rose

Scientific Name – *Rosa indica*
Family – Rosaceae
Origin – USA
Queen of Flower, King of Flower
Classes of Roses –
Hybrid Tea :-They bear large & highly scented flower.
Polyanthus :-Dwarf plants &small flower.
Floribundus :- Hybrid T X Polyanthus ,bear both character
Grandiflora :- Hybrid T x Floribunda, bear flower in cluster & large flower.
Miniature- Hardy plants , bear small leaves and flowers.
Climbers: They have bigger size flowers. The climbers are most suitable for arches, pergola, pillars e.g. Golden showers, Royal, gold, Delhi white pears.
Shrub: Plants smaller than climbers and provide continuous flowering. Suitable for hedge and shrubbery e.g. Fountain, Cock tail, Butterfly wings.
Types of Roses –

1. Long stemed roses (70-90 cm) – Large flower :-Hybrid tea
2. Medium stemmed roses (50-70 cm) – Intermediate flower :-Floribunda
3. Short stemmed roses (30-50 cm) – small flowers:- Sweet heart roses
4. Spray Roses –Spray:- Spray floribundas
5. Miniature roses- small flowered:- Sweet heart roses

Variety
Hybrid Tea :- Gladiator, Papameilland, Landora, First Prize, Superstar
Floribunda: Iceberg, Angleface, Queen elizabeth, Sea pearl
Polyanthus :- Anjani, Swati.
Pusa Mohit – Thornless variety.

Soil - It is generally suitable for higher elevation (1500 m and above).
Soil must be loose, depth upto 50 cm. It can also be grown in the plains under ideal condition of fertile loamy soils with salt-free irrigation water. Ideal pH is 5.5
Climate - Rose growing should have temperature with a min. of 15°C and max. of 28°C. Light is important factor which decides the growth. The growth is slowed by day length, i.e. > 12 hours and heavy overcast, cloudy/mist conditions. High relative humidity exposes the plant to serious fungal diseases. In tropics the ideal temperature is 25°C – 30°C on sunny day and on cloudy day 18°C – 20°C. The optimum temperature should be 15°C – 18°C. Proper aeration can control humidity under control in green houses. According to rose variety & growing season CO2 will kept within range of 500-1500 ppm.
.**Propogation** Method: T /shield budding
Rosa indica, *Rosa multiflora*, *Rosa indica var. Odorata*, *Rosa Edward* are used as rootstocks. Normally 16-18 months old plants are used as rootstock. Mostly rooted cuttings are used for budding. Sprouted cutting are budded with required varieties. For proper growth of budded

eyes upper portion is cut off after 3 weeks of budding.

Soil preparation:

Top soil& sub-soil tested separately. In salt condition , soil must flushed with water. 40-50 cm deep ploughing. A humus contain 10-12% is the optimum for light soil. Organic matter peat rice husk, oil cakes, coir dust, bark compost, FYM, are generally used.

Soil sterilization: It should be done with any one of following chemicals

1. Formaline1%
2. Chloropicrin etc
3. Basamid granuales@40g/m^2

Preparation of bed

Raised beds are prepared having 30-40cm height, 90 cm width, & 60 cm path in between two beds. Length of bed should be parallel to width.

Spacing –

Double row system: 50 cm between two rows & 15 cm between two plants.6-7 plants/m2

Hy. Tea:120x120cm

Floribunda : 60x90cm

miniature:30x60 cm

climber: 90x120cm

Planting –shallow planting roses seedling is done. Due to shallow planting there will be faster sprouting of roses. Excessive roots length should be cut before planting the seedling. Immediately after palnting watering is to be done.

Small plant are planted in April-May & bigger in Aug.-Sept.

Budded plants are in active growing stagr at the time of planting. Such plants needs the environmental humidity. Similarly the thin layer of polyethylene is applied as a mulch. Rose plants required nitrogen at early stage of development if the soil media is less content of nitrogen then it should be applied at the time of first irrigation.

Care after planting:

Once the plants are in place, the greenhouse should be kept warm and humid for a period of 1 month, so that the plants start to grow vigorously. Water loss immediately after planting is the serious problem. Therefore, sufficient moisture must be available in the soil to encourage the plant to form new roots. During strong sunshine hours the young plants must be frequently overhead spray with water to help establishment and reduce post planting losses.

Building up the plant:

Four weeks after plantation when the flower buds have reached the size of a pea, the flower bud is removed bud without removing any leaves. If lateral shoots are formed in the leaf axil below the removed bud, remove them, the plant is established and it is possible to cut the shoots down and start production of flowers.

Regulation of flowering:

when last flower of previous season is harvested the application of water and fertilizeris stopped. Depending upon the soil, this dry period should last 4-8 weeks. Most of the leaves will then drop. The plants are pruned 30-60cm above the soil. After pruning start irrigation and feeding slowly. This will give bottom break.

Irrigation - Two most widely used system are mist and Drip irrigation.

Initially less water is applied: 4-5 l per m2

Full growth condition water applied as per climatic conditions: 5-6 l (rainy reason), 6-8 l (winter reason), 8-10 l(summer season).

Nutrtion - After establishment fertilisers should be applied through fertigation**.**

Standard nutrition for roses:	N	K	Ca	Mg	S
(M Mol/L):	3.0	3.5	2.0	1.1	1.1

Harvesting & yield –

Harvesting should be early in the morning

Tight Bud Stage –for Distant Market.

Fully Open – Local Market.

Yield : 150-200 flowers/m2

Pruning : For development of frame work

For maximum flowers yield

Time

1. June to Sept.
2. Nov.- Dec to March

Type: Light pruning(June), Medium Pruning (Oct.), Hard pruning(Oct,)

Special cultural practices

Support of the plants

Post is placed at internals of 3m on both sides of the bed. Along the sides of the bed, galvanized wires or plastic string are fastened at the posts at 30cm – 40cm intervals to support the plant. Between the wires across the bed, thin strings can be tied to keep the width of the beds constant.

Disbudding

Varieties produce some side buds below the centre bud. These side buds have to be removed or disbudded. The disbudding must be done regularly and also as soon as possible in order to avoid large wounds in the upper leaf axil.

Bending

In first growth phase 1 to 3 weeks after planting 2-3 eyes buds per branch will sprout. They will grow until flowering in 5-6weeks. Since the plants do not have any roots to start with, this first growth will usally be no longer than 20 cms. When most of the buds show colour knock off the buds and left the suckers grow as they come.

After knocking the buds second growth will come to flower again in 4-5 weeks. By then vegetation will be 50-60cm high, which is necessary to have enough growing speed in the plant and to have enough foliage for bending. Wait until the majority of the branches are showing big buds, nearby colouring. Then bending has to be started.

Bending is necessary for keeping enough leaves on the plants .Leaf is a source of food for every plant. There should be balance between Source (Assimilation) and sink (Dissimilation). From each plant a minimum of 4 stems, either flowers or blind shoots must be bend. For blind shoot take out the growing tips to avoid the new growth on the top after bending. The place where to bend is very close to the original bush as possible (max. 5cm), without breaking the branches to avoid breaking, it is advisable to do the bending in the afternoon and to create two 45º bend rather than one 90º bend.

The bending should be such that the tops of the stems are lying below horizontal. This is important for the apical dominance of the plant. When the stem is not bend below horizontal, eyes on the end of the stems will sprouts. These ends are very unsteady. So these stems will sprout and will become thin and curve.

The stems mainly have to be bend in the direction of path because that is an unsteady place. One or two small branches may be bend into the middle of the bends. Make sure that the bend branches are not lying on the top of each other or on the base of other plants, for they catch away the light from the underlying branches.

Bottom break

Soon after bending the first bottom break or ground shoot will start coming from the base. These bottom breaks are most important for life time of plants, because they will carry the production. Strong ground shoots should be cut at 5th five pair of leaves and medium ground shoots should be cut at 2nd or 3rd five pair of leaves.

2) Carnation

Botanical name : *Dianthus caryophyllus*
Family : Caryophyllaceae

Importance and Uses:

Winter season flower
Important cut flowers
Used for bedding, pots, edging vase decoration and bouquets

Types of carnation

1. Border carnation : Large flower , double fragrant
2. Marguerite carnation: self coloured, round yr flushes, good vase life
3. Perpetual carnation :single, double, easy to cultivate

Varieties

Standard type varieties: Damingo, Master, Baltico, Algar, Fuente, Falico etc
Spray type varieties: Aveiro, Fancy, Foego, Osiris, Celebration, Abril, Belon

Variety as per colour of flowers

Red: Scania, Tanga, Red William, Granda, Espana, Master,Killer.
Pink: Pamir, Nora, Lena, Sharina, Pink Sim, candy, Manon,
Yellow: Pallas, Raggio di Sole, Candy, Yellow Dusty, Murcia,
White: White Sim, Roma, Candy, Calypso, Sonsara.
Orange: Tangerine Sim, Orange Triumph.
Others: Charmeur, Aurthor Sim, Toledo, Solar, Laurella, Vanessa.Indian cultivars: Arka Flame and Arka Tejas

Soil and Climate:

Light texture loam or sandy loam soil which is well drained and aerated. pH: 6-7
Photoperiod (long days over 13 hours). Temperature: 10-15^{o} C(night) & 20-25^{o} C(day) for excellent growth.

Relative humidity: 50-60% favour growth & production. CO_2 level should be 500ppm during day time.

Preparation of Media & Bed

To create suitable growing media pH should be 6-7 with good quantity of organic manure. It is recommended to work soil deeply upto 80-100 cm before bedding. Best ratio of soil mixture: 50%sand, 30% loam, 20% clayis used. Soil should be well drained. He media should be sterilized before use by steam or chemicals. Raised bed of 30cm height, 80cm width and as per requirement length is kept. A minimum distance in between two beds must be 50-60cm.

Propagation

1**. Terminal stem cuttings:** Terminal cutting of 8-10 cm long is taken in Nov.- Feb. Shear off lower most 1-2 leaf pairs. Give sharp cut below node. Dip the cuttings in a solution of Dithane M. 45 (0.1%) + Bavistin(0.1%) for 5 min. Put the lower end of cuttings in a solution of NAA or IBA 500 ppm for 5 sec. Plant the cuttings in sterile sand at a spacing of 3 x 3 cm. Spray water 4-5 times in a day so that 90% or more humidity is maintained. Rooting occur in 3-4 weeks

2. **Seed:** Sowing on raised bed in Sept.- Oct. Germinate within week. One month seedlings are use for transplanting. Seedrate is 400 to 500 gm/ha

Planting: Deep planting of cutting should be avoided.

Best time of planting-.Oct.- Nov.

Spacing - 15x 15 cm,20 x 20cm.

Irrigation: After planting spraying of water through mist has been found to be more effective than the surface watering. After 3 weeks of planting drip irrigation has been given. Through drip irrigation: 4-5 lits /sq. mt. /day. Stagnation of water should be avoided.

Nutrition Requirements:

5-10 kg FYM and 20:20:10 gm NPK per sq. mt. At the time of planting

250:80:200:125:40 gm N, P, K, Ca, Mg per Sq. mt every year in 20-24 split doses at 15 days interval will give good plant growth and production of quality flowers.

Special cultural practices

a) Pinching: In pinching terminal growing shoot about 2-3 cm long is removed to overcome apical dominance and to promote side branching when the plants are at 6-8 leaf pair stage.

TYPES OF PINCHING

1.Single pinching: In single pinching terminal growing shoot about 2-3 cm long is removed once in all the shoots.

2. Pinch and a half: First pinching is done in all the shoots. When the side shoots are 6-8 cm long and this stage occur at 40-50 days after pinching, then half of the shoots are again pinched. This increases the duration of flowering.

3.Double pinching: First pinching is done in all the shoots. When the side shoots are 6-8 cm long and this stage occur at 40-50 days after pinching, then again do the pinching in all the shoots. This delays the flowering and flower quality is also poor.

4. Pinch plus pull pinch: First pinching is done in all the shoots. Later on keep removing the shoots by pulling up to 2 months, so as to get single large peak flowering.

In marguerite and annual carnations pinching is done at 40 and 60 days after transplanting.

b) De-shooting: When the side shoots after pinching are 3-5 cm long then retain 3-5 shoots per plant in standard cultivars. When the side shoots after pinching are 3-5 cm long then retain 6-10 shoots per plant in spray cultivars.

c) Disbudding: Disbudding is the removal of visible (5-10 mm diameter) undesirable buds. In standard cultivars terminal bud is retained and all the lateral buds are removed. In spray cultivars terminal bud is removed and lateral buds are retained.

d) Staking : Wire mesh, plastic nets, string or bamboo canes are used to support plants.Wire mesh or plastic nets having inner size of 10-15 cm squares are placed on the squares are placed on the ground in three layers, which are erected at 20, 35 and 50 cm above the ground level with the growing plants.String or rope is erected in three rows at the same distance along the rows.

Harvesting & Yield:

Harvesting 4 months after planting

Standard varieties: Tight bud or cross bud condition

300 to 350 flowers / sq. mt /year

Spray varieties: At least two flowers are opened & other buds show colour

250 flowers / sq. mt /year

8-10 flowers per plant per year

Calyx splitting

The sepal beneath the flowers are united to form a cylindrical calyx which support the base of petal. As the buds open and petals approach their full size the calyx may plit down.

Causes:

1. Genetical : Epson, Palmir etc. are less prone
2. Environmental: High temp. a sharp drop in night temperature.
3. Nutritional: low, N, Boron deficiency, over feeding
4. Cultural

Control:

This can also be reduced by placing a rubber band or 6mm wide clear plastic tape is used around the calyx of the flowers which are just start opening.

Spray borax@0.1%

Insect pest

Aphids, Red spider mites, Heliothis caterpillar

Diseases

Wilt , Foot- rot , Stem rot, Flower bud rot , Bacterial wilt , Rust,Viral diseases

3) Marigold

Botanical Name : *Tagets erects,* (African Marigold)

***Tagets patula* (French marigold)**

Family : Compositae

Importance:

Marigold is one of the most commonly grown flowers for garden decoration and extensively used as loose flowers for making garlands for religious and social functions.

It has gained popularity amongst the gardeners on account of its easy culture and wide adaptability. Its habit of free flowering, short duration to produce marketable flowers, wide

spectrum of attractive colours, shape, size and good keeping quality has attracted the attention of flower growers.

Marigolds are ideal for cut flowers, especially for making garlands. They can be planted in the beds for mass display or grown in pots. The French Marigolds are suitable for hanging basket and edging. The demand for Marigold flowers during Dashara and Diwali is very high.

Soil and Climate:

It requires well drained loamy soil. It can be grown well in hot and dry as well as humid climate. It can not stand severe cold.

Types of Varieties of Marigold:

Varieties of Marigold are grouped in two groups :

A) African Marigold: Tall growing plant / big size flowers

B) French marigold: Dwarf plant with small flowers

Varieties:

A) African Marigold : Cracker jack. Climax, Yellow supreme, Hawai, New Alaska, Aapricot, Glitters, Happiness, Primrose, Fiesta

B) French marigold : Rusty red, Star of India, Red Bokardo, Flash, Petit spray, Harmony, Gypsy, Lemon drops

Propagation: By seed

Seed Rate: 1 to 1.5 kg per ha

Raising of Seedlings and Transplanting :

For raising seedlings, well dried flowers are crushed by hand and seeds are broadcasted on the raised bed during May – June and watered regularly. When seedlings will attend the age of one month or a height of 10-15 cm then those seedlings are transplanted in well manured and fertilized bed at the spacing of 60 x 60 cm or 45 x 45 cm.

Nutritional Requirements:

20 to 25 tones FYM + 25 kg N + 25 kg P + 25 kg K per hectare

Special Culture Practice:

Pinching:

Three weeks after transplanting earthing up is done and then one week after earthing up or 1 month after transplanting the seedlings, pinching is followed for bushy growth of the plant and development of lateral branches. Pinching results into production of more number of flowers.

Irrigation:

Constant moisture supply be maintained from bud formation to harvesting of flowers.

Harvesting of Flowers:

French Mangold starts flowering 1 to 1 *Vz* months after transplanting while African Marigold I 14 to 2 months after transplanting of seedlings. For Garland stalk less fully opened flowers (loose flowers) are picked, white for vase decoration also fully opened flowers with stalk are plucked.

Loose flowers are packed in a bamboo basket, while flowers with stalk are bunched in bundles and transported to market. From one plant near about 100 to 150 flowers are obtained. Blooming duration is near about 3 months.

Yield:

6000 to 8000 kg flowers per ha, 100 to. 150 qtl flowers per ha.

Pests and Diseases:

Thrips and Caterpillar : 0.1 % Nuvacron spray

Black spot, leaf spot : 0.2 % Dithane M 45

4) **Gladiolus**

Botanical Name: ***Gladiolus tristis***

Family : Iridaceae

Importance and Uses of Gladiolus

1. Gladiolus is one of the important Bulbous plants which is valued in the gardens for its beautiful flower spikes.
2. It is ideal as a cut flower, very good for beds, herbaceous border, for making bouquets and does well in pots.
3. Among the different bulbous plants, the gladiolus top the list in its beauty, glamour keeping quality, various colours and shades, shapes, hence it is called as "Queen of Bulb".

Soil and Climate:

Well drained fertile loamy soil is preferred for Gladiolus cultivation. Water logged, heavy sticky soil will result in decaying of corms.

Site selected for gladiolus planting should have a sunny situation protected from stormy winds. It produces bigger size flowers in areas with moderate humidity.

VARIETIES

MPKV, Rahuri

Phule Ganesh- Yellow colour variety, 2.08 lakh spikes/ha yield, long vase life

Phule Prerana: Pink colour early flowering variety, 1.65 lakh spikes/ha yield, less susceptible to wilt.

Phule Tejas- Purple colour,

Phule Neelrekha- Blue colour,

Others:

Suchitra, Pusa Suhagan, Sapana, Yellow stone, Hunting Song etc.

Propagation:

Gladiolus is propagated by Corms**.** A corm weighing 20-30 gm at least 4-5 cm diameter is best suitable. It should be healthy and disease free. Conical shaped corms preferred over flat one as it gives better flowers.

Seed treatment- Mancozeb @ 0.3 %

Planting:

Spacing : 45 x 15 cm on ridges and furrows or
30x20 cm in flat bed

Planting time: Oct-Nov**.** Shallow planting of corms i.e. at the depth of 5 to 10 cm is essential.

Seed Rate:

1,60,000 corms per ha or 3200 kg per ha.

Nutritional Requirements: 20 tons FYM/ha, 300:200:200 kg NPK/ha ,P & K at time of planting & dose of N is apply in 3 split doses at 2,4,6 leaf stage.

Irrigation: must not be allowed to suffer from water stress especially when spikes are emerging. Regular irrigation at the intervals of 7 to 10 days.

Over watering should be avoided.

Cultural Practices: Earthing up is essential after 6-8 weeks of planting. or before the emergence of spike. But if planted as ridges such operation will not be necessary.

These plants need staking for its satisfactory growth, if not staked may fall or break by high wind velocity. when plant will attend the height of 25 cm staking is done.

Harvesting and Yield-For internal market, they are cut when 1-2 lower most florets on the spike have opened and for external market when the colour has fully developed in mature unopened buds. Harvesting is done after 80-90 days after planting.

Yield- 2-2.5 lach spikes/ha

20,000 kg corms per ha

5) Gerbera

Botanical Name: ***Gerbera jamesonii***

Family : Asteraceae/Compositae.

Soil and Climate: A well drained, rich, light, neutral or slightly alkaline soil is most suitable for gerbera production. The growth of plants is adversely affected in ill-drained soil. pH:5.5-6.5

Moderate climate, Day temp: 22-25oC and night temp:12-15o C, Photoperiod: 8 hours

CO_2 level: 700ppm

Variety- Amber, Winterqueen , Flamingo, Dusty, Salmarosa, Valentine etc.

Propagation- Seeds propagation, however is not always satisfactory.

Vegetative Propagation:

Division: This method involves in dividing large clumps into smaller units.

Cutting: The buds in the axils of the leaves are detached and rooted in rooting medium. They are ready for transplanting in 2 or 3 months. Approximately 40-50 plants can be produced in 2-3 months form a single mother plant.

Micro-propagation : drip

Bed preparation:

Soil mixture: FYM, sand, and paddy husk(2:1:1)

30cm height, 1 mt. Width, Path distance 30-45 cm

Planting

Gerbera grows on raised beds : 30 -40 cm. Row distance

25-30cm plant distance

Manures and Fertilizers- 10 kg FYM ,20:20:15 gm NPK /Sq.m at the time of planting,10:15:20 gm NPK/sq.m for three months at one month interval.

Harvesting and Yield- Harvesting is done 3 months after planting. Crop can retain 3 – 4 years in protected condition. Harvested when outer two rows of disc floret perpendicular to stalk.

Yield- 200 – 250 Flowers /sq.m /Year.

6) Jasmines

Jasminum sambac **(Mogra)**

J. auriculatum **(Jui)** ***J. grandiflorum*** **(Jai)**

J.officinale **(Chameli),** ***J.pubescens*** **(Kunda)**

Family : Oleaceae

Importance:

Jasmine flowers are white, scented and preferred for making Veni. Garland and Floral decoration. These are also used for making attar or essential oil for perfume. Among the various fragrant species of Jasmines - Mogra has a high commercial value.

Soil and Climate:

It requires well drained, porous and fertile soil. It requires hot and dry climate for higher yield. pH:6-7

Varieties:

1. Mogra :Motia, Madanban, Ramban,, Bela, Virupakshi, Rai
2. Jui :Co-1,Mullai, Parimuiii, Large round, Short point
3. Chemali or Jai : Co-1, Coimbatore, Pink pin.

Propagation:

Jasmines are generally propagated by cutting of almost mature wood and also by layers. The best time for propagation is rainy season.

Planting:

A jasmine plantation remains productive for 10-15 years. So land should be prepared thoroughly by addition of manures. The planting is usually done in **rainy season.**

Planting distance:

1. Mogra :75cm x1m
2. Jui :1.8 mx 1.8 m
3. Chemali or Jai:1.8 meter x 1.8 meter

Irrigation: Irrigation should be given at an interval of 3-4 days till the establishment of sampling if no rains in rainy season. Afterwards, the jasmines may be irrigated at the interval of 15 days.

Nutrition Requirements :

15 ton FYM/ha + 100:50:50 kg NPK per ha.

This dose split up in 2 doses

First: at the time of pruning during January — February and

Second: at the time of flower bud formation i.e. during March.

Special Cultural Practices:

1. Bahar Treatment:

Bahar treatment is essential for flowering in jasmines and accordingly withholding of water is done for 40-50 days prior flowering or till the plant shed its leaves and go into dormancy for rest. Withholding of water is usually done in the month of November December. After shading of the leaves, irrigation is started i.e. it will be started from January - February.

2. Pruning: Pruning is a regular practice of inducing flowering in Mogra. In Mogra flowers are borne only on new growth and thus, pruning stimulates the new growth, secondly it keeps the bushes in manageable size.

For commercial crop, pruning is usually done after 2 years of its planting and followed in the month of January - February. Generally pruning is done 45 to 50 cm from ground level.

Harvesting of Flowers:

Jasminum species start flowering from first year of planting but commercial yield starts after second year.

Mogra is having a very short post harvest life. The unopened-fully developed flowers buds are picked very early in the morning and transported within 2 to 3 hours, to the market.
For Gajara and Veni fully developed unopened buds are picked while for extraction of oil fully opened flowers are picked.

Yield:

Mogra**:** 10-12tons/ha,
Jai& Jui : 3-4 tons/ha
Kunda: 5-6 tons/ha

7)Lilium

Botanical name : ***Lilium candidum***
Lilium longiflorum

Family : Liliaceae

Soil: Well drained sterile medium (preferably leaf mould, cocopeat and FYM in equal parts) with pH 5.5 to 6.5 is ideal. Fumigate the beds with Dazomet @ 30g/m^2.

Climate: Liliums are best grown in green houses. Day temperature of 18-22°C and night temperature of 10-15°C are ideal.

Varieties:

Asiatic hybrids :

Dreamland (yellow), Brunello (orange), Novona (white), Pollyanna (yellow), Yellow Giant (yellow), Vivaldi (pink), Black Out (Deep red)

Oriental hybrids:

Star Gazer (Pink & white), Nerostar, Siberia, Acapulco and Casablanca

Eastern lily (*L. longiflorum*): Elegant Lady, Ace, Snow Queen, White, American, Croft and Harbor

Propagation: Liliums are commercially propagated through bulbs. A six week cold storage period at 2^o C to 5^o C is needed to break dormancy.

Spacing: 20 x 15 cm, 15 x 15 cm or 15 x 10 cm
(plant density varies between 30 and 60/m^2 depending on cultivar and bulb size)

Irrigation: 6- 8 litres/m^2/day during summer and
5 - 6 litres/m^2/day during winter

Nutrition:

The following fertigation schedule can be adopted.

Nutrients Quantity (g/m^2/week)

Nutrients	**Quantity (g/m^2 /week)**
Calcium Nitrate	2.5
19:19:19	0.5
Potassium Nitrate	2.2
Micronutrient mixture	1.2

Crop support: Supporting plants with nylon mesh is advisable.

Harvest: Harvesting is done when lower most bud shows colour (colour breaking stage) but is not open.

Crop duration:

Asiatic hybrids : 8 - 10 weeks

Oriental hybrids : 14 - 16 weeks

Yield: The average yield is 30 - 40 flower stems/m^2

8) Chrysanthemum

Botanical name- *Chrysanthemum indicum*

Family: Asteraceae/ Compositae

Soil and Climate- Well drain , sandy loam

It is short day plant, it require 20 – 28 ^{o} c temperature with 70- 75 % humidity

Variety- Raja, Zipri, Sonali Tara ,Yellow Gold,Pusa Anmol ,Pusa Sentevary,Arka Swarna,Arka Ganga, Bindiya, Co-1 (Yellow coloured) Co-2 (Purple colour) Indira ,Ravi Kiran ,Pankaj etc

PKV Shubra - (PDKV Akola) Sweet Heart

Types of chrysanthemum

1. Incurved: These are the giant blooms of the chrysanthemum genus. The florets (petals) loosely incurve and make fully closed centers. The lower florets present an irregular appearance and may give a skirted effect.
2. Reflexed: The florets in this class curve downward and overlap, similar to bird plumage. The tops of these blooms are full, but somewhat flattened. Doreen Statham (1995) Flower Size: 4-6 inches.
3. Spider type: Spiders have long tubular ray florets which may coil or hook at the ends. The florets may be very fine to coarse.
4. Korean single
5. Korean Double
6. Decorative: A flattened bloom with short petals. As in classes 1-3 the center disk should not be visible. The upper florets tend to incurve, but the lower petals generally reflex.
7. Anemone: These blooms are similar to the semi-doubles, but have a raised cushion-like center.
8. Pompon

Propagation:

It is propagated vegetatively by suckers, terminal cutting or by micro propagation.

1. Suckers: In this method of propagation, after flowering the stem should be cut back just above the ground level. This induces the formation of side suckers which should be separated from the mother plant and should be planted in sand bed. Apart from this, well rooted suchers can be directly transplanted in the field. Generally, 1,10,000 suckers should be required to cover the 1 ha. Area. To protect against wilt diseases, roots of the suckers should be dipped in fungicudal solution. These suckers should be planted during rainy season at 30 cm x 30 cm spacing on one side of ridge. Pinching should be carried out once in a month after planting to induce more lateral branches on the plants.
2. Terminal stem cutting: These terminal cutting should be taken from a healthy stock plant. Length of cuttings should be about 5-7 cm. the cuttings should be dipped in 2500 ppm IBA. These cutting should be put in sand beds in shade conditions.

Spacing and Planting- 30 x 30 cm
Season- April- May, 1 to 1.25 lac cuttings /ha
Manures and Fertilizers- 10 to 15 ton /ha
100:50:50 kg /ha half dose of N is apply 30 DAP
Intercultural operation- Pinching, Disbudding, deshooting, staking
Harvesting and yield- 5 – 6 months after planting, fully open flowers are harvest
70-80 quts /ha
Standard types - Flowers are harvested when 2 - 3 rows of rays florets are perpendicular to the flower stalk.
Spray types - When 50% flowers have shown colour for distant markets; when two flowers have opened and others have shown colour for local markets

9)ORCHID

Botanical name : *Dendrobium sp.*
Family : Orchidaceae
Important genera:
1.Dendrobium 2. Cattleya,
3. Phalaenopsis 4. Cymbidium

Importance and Uses:

- Important cut flower, more vase life
- They exhibits wide range of diversity in form, size, colour, & texture of flower.
- On plot it remain good for 1-3 months.
- Good indoor plant, grown in garden, pots, basket etc.
- Flowers are use in special functions

Types of orchid:
1. Sympodial type: Prostate rhizome whose growth terminates periodically with an upright pseudobulb, leaf & flowers eg **Dendrobium, Cattleya, Cymbidium**
2. Monopodial type: Form aerial roots from the stem as they are produced in their upward growth. Eg. **Phalaenopsis**
Varieties
Sonia 17, Sonia 28, Emma White, Sakura Pink.
Climate
75% green shade net with 70 - 80% humidity, 18 - 28ºC temperature and light intensity of 1500-2000 foot candles is ideal for growing this tropical orchid. In high rainfall zones, the shade net house should be provided with a rain shelter.
Growing media:
Most common potting mixture consists of charcoal, broken pieces of bricks and tiles, coconut husk and fiber.
Propagation:
Division of clumps, back bulbs and tissue culture plants.
Containers and support : perforated earthen pots are ideal and the plants are staked with bamboo sticks

Irrigation:
Mist or overhead sprinkler to provide water and to maintain humidity.
Nutrients:
Foliar application of NPK 20:10:10 @ 0.2% at weekly intervals starting from 30 days after planting.
Growth regulators
Foliar application of GA3 50 ppm at bimonthly intervals starting from 30 days after planting.
Orchids need repotting regularly, usually every two to three years.
Splitting or division of plants: Plant grown to a large clump with 2 or 3 old canes and new shoots, - divided before repotting. Each division - at least one old cane of two years' growth, one new shoot & some new roots.
Harvest: Dendrobium flower fully matures only 3 or 4 days after it opens. Harvesting the spike when 75 per cent of the flowers are open and remaining buds are unopen.
Yield:
8 - 10 spikes/plant/year
Insect pest
Mites, thrips, scales. Plant bugs, aphids, mealy bugs,
Diseases
Leaf spot, pythium black rot, root rot, wilt

10) Tuberose

Botanical name : *Polianthes tuberosa*
Family : Amaryllidaceae
Importance and Uses:
It is one of the important cut flowers used for vase decoration and bouquets**.** The flowers stalk is 75 to 100 cm long bearing white colour. The spikes or tuberose are used as a cut flowers due to its delightful appearance, sweet fragrance and good keeping quality.
Varieties
1.Single flowered: 5 petals
Calcutta single, Phule Rajani, Bangalore single, Coimbatore single
2**. Semi double**: 10 petals
3. Double: more than 10 petals ,Pearl
4**. variegated**: leaves with yellow on margin
5. **Variegated single**: Rajat (White margin)
6**. Variegated double**: Dhawal (Golden margin)
Other: Shrungar,Prajwal,Suhasini, Vaibhav.
Soil and Climate:
Medium sandy loam with good drainage is best for production of flowers and bulbs. For luxurious growth of the crop moderate humidity with mild temperature is essential. Very high temperature or frost may damage the crops.
Propagation and planting: The tuberose is propagated by **bulb** having a diameter of 1.5 to 2.0 cm and weight above 30 gms. And healthy free of pests and diseases. Before planting bulb should be treated with 0.1 % Carbendazine for 30 minutes.

Planting:
Best time of planting- April - May .
Spacing - 30 x 30 cm,30 x 20 cm.
Sees Rate: 5000 - 6000 kg bulb /ha;
1,60,000 -2,50,000 bulbs /ha
Nutrition Requirements: 20 to FYMha 200:150:200 kg NPK/ha N apply in two split doses i.e. 45and 90 DAP.
Harvesting of Flowers: 3-4 months after planting
For Cut flower-, the spikes are to be cut when the lower most 1-2 florets have opened. Immediately after cutting the spike the base of spikes are immediately placed in a bucket full of water.- After the harvesting of flowers, flowers are placed in shade in wet cotton cloth or in a gunny bag.
Yield: Bulb once planted gives the commercial yield upto 3 year, 7-8 lack spikes/ ha or 7-7.5 ton loose flower.
(For preaparation of Veni ,Garlands,Gajara)

B. MEDICINAL CROPS

1) Periwinkle

Botanical name: Catharanthus roseus
Family : Apocyanaceae
Plant part : Leaves, seeds, roots

Importance:

Periwinkle is a perennial ornamental herb found throughout India on waste lands and sandy tracts. It has medicinal importance owing to the presence of indole alkaloids raubasin (ajmalicine) and serpentine in its root which have anti-fibrillic and hypertensive properties.

The leaves contain two alkaloids viz., Vinblastine and Vincristine which form the constituents of patented cancer drugs and vincristine alkaloids are distributed in different parts of the plant but the roots contain the maximum (0.75 t to 1.20%) followed by the leaf (0.60 to 0.65%).

Uses

1. Leaves used in curing blood cancer
2. Leaves useful in treating menstrual disorders, diabetes mellitus.
3. Decoction of leaves & roots active on hypertension.
4. Roots control high blood pressure.

Botany:

It is a perennial herb, often grows in garden for its pink and white flowers which bloom throughout the year.It bears flexible long branches with simple opposite leaves. Flowers 2-3 in cymes, axillary and terminal clusters. Fruit is a cylindrical follicle with many black seeds.

Varieties:

There are no recognized varieties but there are three local types based on the colour of the flowers viz., alba with white flowers roseus with pink rose coloured flowers and ocillata with white flowers having rose purple spot in the center are recognized.

Climate and Soil:

The cosmopolitan distribution of the plant shows that it has no specific climatic requirements. Its natural environments are, however, tropical and sub- tropical areas. A well distributed rainfall of 100 cm or more is considered ideal for raising it as commercial crop under rainfed conditions.

Similarly, it grows on any type of soil except those which are highly alkaline or waterlogged. It grows wild in coastal area. Light sandy soils rich in humus are preferred for large scale cultivation of the plant. Ph should be upto 8.5.

Propagation:

Method of propagation: Seeds

Fresh seeds are preferable as they lose viability on long storage.

1. **Direct sowing method**

About 2 to 3 kg seed is required for raising one hectare.

The seeds are mixed with sand about 10 times its weight for even distribution and are sown during beginning of monsoon.

2. Seedling Transplanting method

Seedrate: 500 grams/ hectare.

The seeds are sown in well prepared beds during March or April in rows about 1.5 cm deep, covered with light soil and leaf mould mixture and are watered to keep the bed moist.

In about 10 days time the seeds germinate and in 2 months time (height 6-7 cm) they become ready for transplanting. 200 square meters bed is required for producing seedlings for one hectare.

Planting: Seedling are transplanted at a spacing of 45 cm x 30 cm or 45 cm x 45 cm during monsoon season.

Weeding: The crop requires two weedings, the first one about 60 days after sowing or transplanting and the second one in another 60 days.

Irrigation: The plant do not require much water as they have drought resistant capacity. In areas, where rainfall is evenly distributed throughout the year, no irrigation is required, but in areas where monsoon is restricted, 4 to 5 irrigations are required during the life of the plant to get good yield.

Manuring:

They are not generally manured, however, for getting a good yield of both leaves and roots, farm yard manure at about 15 tonnes per ha should be applied and a fertilizer mixture of N (20 Kg), P_2O_5 (40 Kg) and K_2O (40Kg) per hectare is applied as a basal dose and 6 kg N is further drilled in rows in 3 spits at thinning, 90days and 120 days after plantig.

Harvesting:

The crop becomes ready for harvest of roots after one year. But two leaf strippings can be taken, the first one after 6 months and the second after 9 months of sowing. Third stripping of leaves can also be taken when the whole plant is harvested after one year. For seed collection, matured fruits are hand picked and dried in shade and threshed lightly. This method ensures mature seeds with even germination. But the usual practice is to uproot the plants, dry them in shade and thereafter thresh lightly for seeds. The seeds obtained by this method, are not uniform and their germination is poor.

For harvesting of roots, the crop is cut about 7.5 cm above the ground and dried for stems, leaves and seeds and then the whole field is copiously irrigated and ploughed and the roots are collected. The roots are washed well and dried in shade and later made into bundles for marketing.

Yield:

Under rainfed conditions about 0.75 tonne of roots, 1.0 tonne of stems and
2 tonnes of leaves (all dry basis) may be obtained from one hectare. But under irrigated conditions, 1.5 tonnes each of roots and stems and 3 tonnes of leaves per ha can be obtained.

2) ISABGOL

Botanical name: Plantago ovata
Family : Plantaginaceae
Plant part used : Seeds and husks

Introduction:

Isagbol or Psyllium is important for its seed and husk which have been used in the indigenous medicine for many countries. The husk yields a colloidal mucilage consisting mainly of xylose, arabinose and galacturonic acid.

Botany:

It is a stemless annual herb often attaining a height of 30 – 40 cm, with rosette leaves. The plant bears erect ovoid or cylindrical spike with minute white flowers about 45 – 68 protogynous. Fruit is capsule, each seed is encased in a thin, white, translucent membrane, the husk, which is odourless and tasteless. Climate and soil:

It requires cool and dry weather and hence in India, the crop is grown in winter i.e. from November – December to March-April. Humid weather at maturity results in shattering of seeds. A light well drained sandy loam to rich loamy soil with a pH of 7 – 8 is ideal.

Uses

1. . It has the property of absorbing and retaining water (40-90%) and therefore it works as an anti- diarrhoea drug.

2. The seed has also cooling and demulcent effect and is used in ayurvedic, unani and allopathic medicines.
3. It is beneficial in cronic dysenteries of amoebic and bacillary origin, constipation, also control inflammatory condition of mucocus membrane of gastro intenstinal and urinary tracts.
4. Used as stabilizer in ice cream, as ingredient in chocolates & basefor cosmetics.

Varieties:

Gujarat Agricultural University has released two improved varieties viz., Gujarat Isabgol – 1 and Gujarat Isabgol -2 which have a yield potential of 800 –900 kg and 1000 kg per ha respectively. Niharika, IR-89, rrl-011, sel-10 etc.

Climate and Soil:

Require cool & dry weather with bright sunshine during its growth period hence grow in winter. Strong wind, humid weather 7 rainfall at maturity result in shettering of seeds.

Light, well drained sandy loam to loamy soil rich in organic matter with pH of 7.0-8.5 is ideal.

Preparation of land:

Field must be free of weeds and clods and should have fine tilth for good germination.The land is laid into flat beds of convenient sizes i.e. 1.0 m x 3.0 m or 2.5 m x 2.5 m

Sowing:

Fresh seeds from the preceding crop season should be sown for getting high per cent germination. Sowing is done inNov.-Dec. The seed rate varies from 4 – 5 kg and is sown after pretreatment with thiram @ 3 g per kg of seed to protect the seedlings from the possible damage of damping off. The seeds, being small and light are mixed with sufficient quantity of fine sand before sowing. The seeds are sown broadcast and are swept lightly with a broom in one direction to cover them with some soil. Light irrigation will give to facilitate germination. Seed germinate 6-7 days after sowing.

Weeding : Timely weeding is important to encourage good growth of the plants. After 20-25 days of sowing, first weeding is done and 2-3 weeding are required within 2 months of sowing.

Manuring: 25 kg N/ha and 25 kg P/ha are applied as basal dose at the last Ploughing and another dose of 25 kg N/ha is top dressed 30 days after sowing.

Irrigation: Immediately after sowing light irrigation is essential. First irrigation should be given with light flow of water. The seeds normally germinate in 6 – 7 days.If the germination is poor, second irrigation may be given. Later on, irrigations are given as and when necessary.Last irrigation should be given at the time when maximum number of spike have reached the milk stage.

Harvesting and processing:

The crop will be ready in about 110-130 days after sowing. When mature, the crop turns yellowish and the spike turns brownish. The seeds are shed when the spikes are pressed even slightly. At the time of harvest, the atmosphere must be dry and there should not be any moisture on the plant. The plants are normally cut at the ground level or are uprooted if the soil is loose textured. The harvested plants are threshed and winnowed, and the seeds repeatedly sifted until clean. The seeds may be marketed whole or the husk may be sold separately. Seeds are fed to a series of shellers, in each sheller the grinding pressure is so adjusted to remove only the husk. This is separated by fans and sieves at each sheller and the ungrounded material is sent to the next sheller.

The **husk: seed ratio is 25:75** by weight.

The average yield is about 500-1000kg/ha

3) Asparagus

Asparagus officinalis
Family: Asparagaceae
PART USED: Tuberous Root

Medicinal use of Asparagus:
Asparagus has been cultivated for over 2,000 years as a vegetable and medicinal herb. Both the roots and the shoots can be used medicinally,

1. They have a restorative and cleansing effect on the bowels, kidneys and liver.
2. The plant is antispasmodic, aperient, cardiac, demulcent, diaphoretic, diuretic, sedative and tonic. The freshly expressed juice is used.
3. The root is diaphoretic, strongly diuretic and laxative.
4. An infusion is used in the treatment of jaundice and congestive torpor of the liver.
5. The strongly diuretic action of the roots make it useful in the treatment of a variety of urinary problems including cystitis.
6. It is also used in the treatment of cancer.
7. The roots are said to be able to lower blood pressure.
8. The roots are harvested in late spring, after the shoots have been cut as a food crop, and are dried for later use.
9. The seeds possess antibiotic activity. Another report says that the plant contains **asparagusic** acid which is nematocidal and is used in the treatment of schistosomiasis.

SOIL AND CLIMATE
Plant usually grows in a variety of soils including medium black having pH 7-8.
It can be easily grown in sub-tropical & Sub-temperate agro-climatic regions up to 1400 m.

LAND PREPARATION
The soil is given 20-30 cm deep ploughing followed by 2-3 harrowings after few days. Grasses and weeds are removed. The land is properly levelled and 40-45 cms broad ridges are prepared for plantation, leaving 15-20 cms furrow space as a channel for irrigation.

Method of propagation: Seeds, Division

1. Seed propagation
Seed - pre-soak for 12 hours in warm water and then sow in spring or as soon as the seed is ripe in early autumn in a greenhouse.
It usually germinates in 3 - 6 weeks at 25^{o}C.
Prick out the seedlings into individual pots when they are large enough to handle and grow them on in a sunny position in the greenhouse for their first winter.
Plant them out into their permanent positions in late spring or early summer.

2. Vegetative propagation
Vegetative propagation is by division of rhizomatous disc present at the base of the aerial stem. The rhizomatous disc develops several vegetative buds around the aerial shoots. The disc is divided in such a way that each piece possessed at least two buds along with 2-3 tuberous roots. These pieces are planted conversing the buds with 1 cm of soil followed by irrigation. The sprouting commenced in 8-10 days after plantation.

WEEDING

Two weedings are carried out during the rainy months, thereafter one in next 2-3 months.

IRRIGATION: Irrigation is given after the rainy season is over, at the rate of two irrigations in winter season and one per month in summer season.

MANURES, FERTILISERS AND PESTICIDES

The medicinal plants have to be grown without chemical fertilizers and use of pesticides. Organic manures like, Farm Yard Manure (FYM), Vermi-Compost, Green Manure etc. may be used as per requirement of the species. To prevent diseases, bio-pesticides could be prepared (either single or mixture) from Neem (kernel, seeds & leaves), Chitrakmool, Dhatura, Cow's urine etc.

Harvesting/Post Harvesting

The plant are harvested after 40 months in winter. The roots are dugout collected and cleared. The roots are peeled off with the help of sharp knife immediately after harvesting. It is observed that in case the roots are not peeled off within a few days, it is a bit difficult to remove the skin as such. In such a condition the roots are kept in boiling water for about 10 minutes, followed by cold-water treatment to facilitate peeling. After removing the skin, it is cut transversely into small pieces and dried in shade.

Yield

Estimate yield of 5-7 tons/hectare dry roots is reported Precaution may be taken for rodents and rats which occasionally eat tender shoots.

4)Costus

Latin name: Saussurea costus

Family: Compositae

USED PLANT PART: Roots contain **Diosgenin and steroidal sapogenins**

Medicinal use of Costus:

3. Costus is a commonly used medicinal herb in China and is considered to be one of their 50 fundamental herbs.
4. It is also used in Ayurvedic medicine where it is valued mainly for its tonic, stimulant and antiseptic properties.
5. It is said to be aphrodisiac and to be able to prevent the hair turning grey.
6. The root is anodyne, antibacterial, antispasmodic, aphrodisiac, carminative, skin, stimulant, stomachic, tonic and vermifuge.
7. It is used internally in the treatment of abdominal distension and pain, chest pains due to liver problems and jaundice, gall bladder pain, constipation associated with energy stagnation, and asthma.
8. The root is harvested in the autumn or spring and either dried for later use or decocted for the essential oil. It is normally used with other herbs.
9. The root is also used in Tibetan medicine where it is considered to have an acrid, sweet and bitter taste with a neutral potency.
10. It is used in the treatment of swelling and fullness of the stomach, blockage and irregular menses, pulmonary disorders, difficulty in swallowing and rotting/wasting of muscle tissues. An oil from the root is very beneficial in the treatment of rheumatism.
11. An essential oil obtained from the roots is used medicinally, in perfumery, incenses and as a hair rinse when it is said to darken grey hair.

12. It has a strong lingering scent. The smell is at first like violets, but as it ages it can become more fur-like or eventually become unpleasantly goat-like.
13. The roots are cut into lengths about 8cm long and then dried before being exported. Smaller pieces of the root are ground into a powder and then used to make incense sticks.
14. The longer clean pieces are cut into very thin slices and then burnt at shrines or used as a tonic in hot baths.

Climate:

A casual in irrigated areas, 2000 - 3300 metres from Pakistan to Himachel Pradesh. Usually found in moist shady situations in Kashmir, sometimes forming the undergrowth in birch forests. . The plant grows in temperate and sub-alpine region. High humidity and minimum temperature 13^{o} C is best for cultivation.

Soil: Sandy textured loam soil, rich in moisture and organic carbon is best for germination as well as better survival of seedlings and productivity. pH- 5.7-7.5

Method of propagation: Seeds, stem cutting and rhizomes

Commercially it is being propagated only through **rhizomes c**uttings. Selection of rhizomes for planting is however important. The rhizomes have a number of nipple shaped buds most of them being concentrated around the stem scar and the tips. The formation of buds on the rhizomes is poor during April. Cuttings of rhizome pieces weighing around 40 g should be selected. Seedrate: 2000-2400kg Rhizomes per ha

Seed: Suggest sowing the seed in a cold frame in the spring. Surface sow, or only just cover the seed, and make sure that the compost does not dry out. Prick out the seedlings into individual pots when they are large enough to handle and grow them on in the greenhouse or cold frame for their first winter. Plant them out in late spring after the last expected frosts. Division in spring might be possible.

PLANTING

The seeds are sown in April or May in nursery. When the seedlings are 15 cm long, it is transplanted in field.

Ridges and Furrow

Spacing when rhizomes used: 50 x50 cm with 8-10 cm sowing depth

IRRIGATION The crop requires 5-6 irrigations between May-September. The land is irrigated when seeds are sprouting.

MANURES, FERTILISERS: 15 tonnes/ ha FYM

45:30:30 NPK kg/ha intwo spit doses

IRRIGATION:

2-3 irrigation per month

HARVESTING/POST-HARVESTING: Usually in 2-3 years well grown mature root tubers are developed. However, yield is obtained form 3 years old crop. Root is harvested in early September or October or early spring. The roots are cleaned with water and dried for processing.

YIELD

After 2-3 years of planting about 200-300 kg. of dry tuberous roots per hectare can be obtained (28-30tonnes fresh rhizomes per ha.).

5) Cinnamon

Botanical Name : *Cinnamomum verum, Cinnamomum zeylanicum*

Origin- Sri Lanka and Malabar Coast of India

Family: Lauraceae,

Plant Part use – Bark and Leaves

Uses: Leaves of cinnamon also yield oil, main constituent of which is Eugenol. The oil possesses strong odour .

- Soil:The quality of the bark is greatly influenced by soil, Well-drained, . Sandy loam soil rich in humus content is most suitable. Red dark brown soils free from rock, gravel are also good for cinnamon cultivation.
- Climate:Cinnamon requires hot and humid climate. Average temperature of 27°C are ideal.
- Varieties of Cinnamon
- Navashree - It has high and stable regeneration capacity (6-7 shoots/year), high yield
- Nithyashree.
- Konkan Tej:.Released by BSKKV Dapoli in 1992. Variety has high volatile oil in bark (3.2%)
  Sweet Cinnamon and Honey Cinnamon.

Propagation: Cinnamon is commonly propagated through seed, cuttings and air Layers.Cinnamon flowers in January and fruits ripen during June-August. The fully ripe fruits are either picked up from the tree or fallen ones are collected from the ground. Seeds are. removed from fruits, washed free of pulp and sown without much delay, as the seeds have a low viability. The seeds are sown in sand beds or polythene bags .The seeds germinate within 10-20 days. The seedlings require artificial shading till they become 6 months old.

Planting: Pits of 50 cm are dug at a spacing of 3 x 3 m. They are filled with compost and-topsoil before planting. Cinnamon is planted during June-July to take advantage of monsoon for the establishment of seedlings. One-year old seedlings are planted. Partial shade in the initial years is advantageous for healthy and rapid growth of plants.

Manuring and Fertilization:

1 st year: 20 g N, 18 g P205, and 25 g K20/seedling.

Three years after planting: 30 kg F.Y.M., 4 kg neem cake, 150 g.N, 75 g P2O5 and 150 g K2Q per plant.

The fertilizers are applied in two doses during first week of September and in March.

Training and Pruning:

When the seedlings become 2-3 years old, the shoot is cut back to a height of 30 cm from ground level to produce side shoots. This is called 'Coppicing'.

Harvesting: Harvesting is done 2- 3 year after planting. Ideal time for harvesting shoots is from September to November. Side shoots having finger thickness and uniform brown colour are ideal for bark extraction. A ‘test cut’ can be made on the stem with a sharp knife to judge the suitability of time of peeling. If the bark separates easily, the cutting can be commenced immediately. The stems of 2-3 cm diameter thickness and 1.0–1.25m length are cut close to the ground. Harvested shoots are bundled together and transported to the pack house for further post harvest procedures.

Peeling is done with a small knife having a round edge at the end. Harvesting and Peeling should be done on same day. Cut stem earthen up with soil to encourage growth of new shoot.

Yield:

a. 3-4 year and onwards' - 62 to 125 kg quills/ha.

b. 10-11 year and onwards - 225 to 300 kg quills/ha.

1 ton /ha leaves which yield 1 to 1.25 kg of oil are obtained per year.

6) ALOE

Botanical Name : ***Aloe vera or Aloe barbadensis***

Origin- Eastern and South Africa

Family: Liliaceae

Plant Part use –Leaves, roots, seeds

Uses:

1. Anthelmintic-used for helminthaiases in children and used as purgative.
2. Used for local applications in painful inflammations, chronic ulcers and ophthalmic
3. Juice is used for flatulence, constipation, abdominal tumors, piles, sciatica, lumbago
4. Used for curing skin diseasesand uterus disorders.

Soil: Aloe is a hardy crop which can be grown on wide variety of soils. It growth well in sandy coastal and loamy soils with pH up to 8.5 water logged, problematic soils not suitable.

Climate: Wide adaptability, hence cultivation is possible throughout the country and prefers dessert and dry situations. Grown in hot and dry climate with 35-40 cm annual rainfall.

Varieties: IC- 111266, IC-111267, IC-111271, IC-111273

Propagation:

Method of propagation: Root suckers or rhizome cuttings

Planting: 15-18 cm long root suckers, rhizome cuttings are planted with a spacing of 60 x 30 cm or 60 x 45 cm and buried 2/3 portion under the ground. To get seedlings a nursery may also be raised through seeds. One year old seedlings may be planted in the field.

Planting: The field should be ploughed 3-4 times and soil is brought to fine tilth. 15-20 tonnes of FYM is added to the field at the time of land preparation. 15-18 cm long root suckers or rhizome cutting are planted in flat beds or ridge and furrows with a spacing of 60x30cm or 60x45 cm. during planting the 2/3rd portion of suckers/cutting is buried in the soil.

Manuring and Fertilization:

50 g N, 25 g P205, and 25 g K20 /ha.

Irrigation: Very hardy crop resistant to drought. Immediately after planting needs one irrigation and 4-5 irrigations are given during summer at 15-20 days interval.

Harvesting: leaves are cut manual with sickle or plant are harvested with tractor sfter 8-12 months after planting. Commertial yield are obtained from second year up to five years.

Yield:

Fresh leaves: 10,000-12,000 kg/ha.

C. AROMATIC CROPS

1) Lemon Grass

Cymbopogon flexuosus

Family: Graminae

Plant part use: Leaves

Three types of lemon grasses viz.

1. East Indian lemongrass (C *flexuosus):* C. flexuosus grown commercially in Kerala and nearby adjacent state, its oil is popularly known as **"Cochin oil"** as it is shipped mainly through Cochin port. 90% oil is exported.

2. West Indian lemon grass *(C. citrates):**Origin-Malaysia/ Shrilanka, cultivated in West Indies*** and

3. Jammu lemongrass *(C. pendulus)*

India is annually producing nearly 1000 MT per year while the world demand is much more. Annually, we are exporting lemon grass oil in a tube of about Rs. 5 crores. Our country is facing a critical competition from Gautemaja in the International market.

Uses of Lemon Grass:

1. The chief constituent of the oil is the citral. It is the starting material for the preparation of important ionone viz. A – Ionone, used in flavors, cosmetics and perfume and P – Ionone- used in the manufacture of synthetic vitamin A.
2. Oil has bactericidal, insect repellent and medicinal uses.
3. The spent grass *is* a source of good cattie feed and can be converted into good silage.
4. Spent grasses are also useful for the manufacture of card boards and papers or as fuel.
5. In culinary flavouring in alcoholic & non-alcoholic beverages, frozen dairy dessert, candy, baked foods, gelatins & pudding, meat & meat products
6. Use in preparation of soap and detergent making

Climate and Soil:

Tropical plant. The plants are hardy and grow under a variety of conditions. The most ideal conditions are a warm and humid climate with, plenty of sunshine and rainfall of 250-280 cm per annum, uniformly distributed. Day temp. 25-30^{o}C is optimum for good oli production. Regarding the soil, it can be grown from poor soils, in the hill slopes. Soil pH ranging from 4.5 to 7.5 is ideal. As it has good soil binding nature, they can be grown as vegetative cover over naked, eroded slopes.

Varieties of Lemon Grass:

Varieties of East Indian lemongrass :

1.Sugandhi(OD-19): by The Medicinal and Aromatic Plants Research Station, Odakkali (Kerala), Odakkali, Kerala,
herbage yield: 50-55 t/ha, oil: 80-85kg/ha
oil recovery:1.2-1.5%
citral content:80-85%
suitable to all soil types & climate

2. SD-68: by CIMAP, Lucknow
using ionising radiation
oil yield:375kg/ha/year
Citral content: 90-92%

3. Pragati (LS-48): by CIMAP, Lucknow
Through clonal selection from OD-19
Oil contain63-86% citral

4. kavery,
5. Krishna

Varieties of Jammu lemongrass

1. RRL-16
2. Praman
3. VKP-25

Chirharit

Method of Propagation:seeds, slips.

Slip propagation is better in Andhra Pradesh. Seed propagation covers larger area.

a) Seed propagation: Nursery:

Seeds are formed in November – December. Seeds are collected in January – February.

Seeds are sown at 10 kg per 25 cents nursery per ha. Nursery beds are prepared and sowing is done during April – May. After sowing nursery beds are lightly irrigated.

Seedlings will be ready in 60-75 days when hey attain 5-7 leaf stage and height of 12-15 cm.

b) Slips: Mature clump is divided. Slips are treated for rooting. Rooted slips are used for propagation.

Field Preparations:

The land is cleared of the underground vegetations and pits of 5 cm cube are made. Splits from old clumps can also be used for propagations.

Layout: Ridges & furrow

Season: June-July

Spacing :60x45 cm.

Place 2-3 slips per hill

Manures and Fertilizers:

100:50:50 NPK kg/ha

Irrigation: only in low rainfall area one day interval upto one month after planting and then 7-10 days interval

Harvesting of Lemon Grass:

Harvesting of Lemon Grass:

Harvest 90 days after planting and subsequently it is harvested at 50-55 days interval.

The grass is cut 10 cm above the ground level and 5-6 cuttings can be taken in a year.

Depending upon the soil and climatic conditions, the crop can be retained in like field for 5 to 6 years.

Average oil yield on 1st yr: 25 kg of oil /year /ha

on 2nd 80 to 100 kg oil /year /ha

Rainfed condition: 80-100 kg of oil /year /ha

Irrigated condition; 150 -200 kg of oil /year /ha

Oil is extracted by steam distillation method

Oil constituents: Citral: 80-85%

2) Citronella

Java citronella : *Cymbopogon winterianus*

Ceylon citronella *: Cymbopogon nardus*

Family : Gramineae

Plant part used; leaves

Uses :

1. Starting material for production of Geraniol & citronellal.
2. Perfumery, soap & cosmetics
3. Preparation of detergent, household cleaners, insecticide, polishes
4. In pharmaceuticals
5. In flavouring industries
6. As an ingredient in deodorants, mosquito repellent cream & allied products.
7. Also spent grass in paper preparation & as fuel.

Soil:

Soils rich in humus having good water holding capacity and good drainage sandy loam should be preferred. pH: 5.0-7.5 Alkaline water logged soils are detrimental for crop growth.

Climate:

Humid climate with warm temperature with well distributed rainfall favours growth of Citronella. Abundant sunlight well distributed rainfall of 200-250 cm with 75-90% RH. Under shade growth is poor.

Improved Varieties:

RRL JOR-3-1970: oil%-46.2%
IW 31243, IW 31245 (NBPGR, Delhi)-Java
CIMAP/Bio 13
Manjusha,
Mandakini.

Method of Propagation: Slips.

Due to irregularities in Meiosis, viable seeds are not formed. Therefore citronella is propagating through slips, obtained by dividing healthy mature clumps. Each slip should have 2-3 tillers. At the time of planting trim fibrous roots and leaves. 0.05 ha of 1- 4 year old plantation is enough as planting material i.e. slips for planting in 1 ha of main field.

Planting Time:

Onset of monsoon or at the middle of rainy season i.e. June – July

Spacing:

Transplanted on ridges and furrows.

Spacing:60 x 90 cm (Plant population:18,000 plants/ha)
60x60cm (Plant population:28,000 plants/ha)

Weeding: Weeding is necessary for the first 2-3 months till the planting material get established. Earthing up: done up to 4 months

Manuring:

Recommended dose: 200:80:80kg NPK/ha per year

Usually 8-10 tons of compost mixed with 60 kg P205 and 50 kg K20 per hectare before plantation. N should be applied in 4 split doses.

Irrigation:

For healthy crop growth it should be irrigated frequently.

Irrigation interval of 15 days in winter and 10 days in summer is required for good yield.

Harvesting:

Three cuttings may be obtained in the first year commencing 6 months after planting. Leaf blades contain more oil than sheath and hence harvesting is done 15-20 cm above the ground level.

Optimum oil yield is obtained when the sixth leaf is well developed.

After 1 year the harvesting is needed at 2.5 months interval.

Crop is economical for4-5 years

Yield: a) Herbage yield
First year: 25-30 t/ha/year
Second year: 40-45 t/ha/year,

b) Oil yield

First year: 200 - 300 kg/ha,

Second year: 320 - 450 kg/ha,

Oil constituent: Citronellal-32-45%, Geraniol-12-18%, citronellol-11-15%, geranyl acetate-3-8% .

3) Palmarosa

Java citronella : *Cymbopogon martini varmotia*

Family : Gramineae

Plant part used; Tender stem, leaves and flower stalk

Uses :

1. Essential oil from palmarosa is used to extract Geraniol.
2. Used for incenting soap, perfumes, toiletries and flavoring tobacco.
3. The oil impacts rose like aroma due to Geraniol which is a perfume itself hence heavy demand.
4. It is also used as an adulterant in Turkish attar of roses.

Soil:

Fertile Soils rich in humus having good water holding capacity and good drainage sandy loam should be preferred. pH: 6-8 Sensitive to water stagnation.

Climate:

Hardy and drough resistant tropical plant . grow well in warm and humid area receiving 100-150cm rainfall. Susceptible to frost and low temperature. Ecposure to sunlight is essential. It does not perform well under shade condition.

Improved Varieties:

IW31244, IW3244, IW 3629, RRL(B)-77 and RRL(B)71, Trishna, Jam Rosa (RRL-82), Vaishnavi, CIM Harsha

Method of Propagation: by seeds and rooted Slips.

First a nursery is raised. Beds are raised well prepared and well manured.

a) By seeds:

Method of Propagation:Slips.

Due to irregularities in Meiosis, viable seeds are not formed. Therefore citronella is propagating through slips, obtained by dividing healthy mature clumps. Each slip should have 2-3 tillers. At the time of planting trim fibrous roots and leaves. 0.05 ha of 1-4 year old plantation is enough as planting material i.e. slips for planting in 1 ha of main field.

Seeds @ 2.5 kg per ha is sown at 15-20 cm spaced lines. Sowing is done during May – June. Nursery beds are irrigated daily. Germination will be completed within 2 weeks and seedlings ready in 30-40 days (15-20 cm height).

b) By Slips:

Slips: Slips are collected from elite clump. They are separated and planted during April – May. Ready for transplanting after 3 months during June- July or August - September.

Oil yield is higher with clonal propagation. Per cent of establishment is higher with seedlings.

Planting Time:

Onset of monsoon or at the middle of rainy season i.e. June – July

Spacing:

Transplanted on ridges and furrows.
Spacing:60 x 45 cm 60x30cm and 45 x 45cm
Weeding: Weeding is necessary for the first 2-3 months till the planting material get established.
Earthing up: done up to 4 months
Manuring:
10t/ha FYM
Recommended dose: 20:50:40kg NPK/ha per year- Basal dose and
40 kg/ha N for Top dressing in 4 split doses.
Irrigation:
For healthy crop growth it should be irrigated frequently.
Irrigation interval of 15 days in winter and 10 days in summer is required for good yield.
Harvesting:
First harvest is taken in 6 months after planting. Leaf blades contain more oil than sheath and hence harvesting is done 15-20 cm above the ground level. Subsequently harvest the crop at 3-4 months interval. Yield increase up to 4th year with an economical life is 8-10 years.
Yield :a) Oil yield
First year: 20 kg/ha,
Second year: 60 kg/ha,
Oil constituent: **Geraniol-90-5%,.**

4) OCIMUM

B. N. : *Ocimum sanctum*
Family : Labiatae
Plant part used; Leaves, Seeds and roots
Uses :

1. Oil is used for flavouring food stuffs, bekary products, confectionary, condiments and in toiletry products like mouth washed and dental cream.
2. Anticancer, antibacterial, antifungal properties.
3. Aromatic carminative, antipyreo, expectorant, diaphoretic
4. Effective in viral encephalitis in children
5. Recongnized as a febrifuge and antimalarial plant
6. Used in snake bite, mosquito bite, and scorpion sting.
7. Dropped into ear in ear ache and malarial fever.
8. Used in bronchitis, gastric disorders
9. Cures skin diseases and destroys intestinal worms.
10. Seeds used in disorders of genitourinary system, for treatment of constipation and piles.

Soil: can grow in wide range of soil. From rich loam to poor laterite soil. Fertile Soils rich in humus having good water holding capacity and good drainage sandy loam should be referred. pH: 4.3-9.1.
Climate: Favourishes well under tropical and subtropical region with medium rainfall and humid climate upto 1800 m above main sea level. Long day and high temperature favors plant growth and higher yield. It can tolerate drought.
Improved Varieties:

RRL-OC-9, RRL-OC-11

Method of Propagation: by seeds

Generally seeds are mixed sand(1:10 proportion) and are sown in March-April in nursery on raised beds with seed rate 125-200 gm seeds/ha. Seed germinate within 10 days and seedlings are ready for trsplanting in 7 weeks or at 4-5 leaf stage with height of 8-10cm.

Planting Time: Onset of monsoon or at the middle of rainy season i.e. June – July

Spacing: Transplanted on ridges and furrows.

Spacing:60 x 45 cm 60x60cm

Weeding: Weeding is necessary for the first 2-3 months till the planting material get established.

Earthing up: done up to 4 months

Manuring: 10t/ha FYM, Recommended dose: 40:40:40kg NPK/ha per year

Irrigation:

For healthy crop growth it should be irrigated frequently. Irrigation interval of 15 days in winter and 10 days in summer is required for good yield.

Harvesting:

Harvesting is done when plant is in full bloom stage and lower leaves starts turning yellow. Crop is harvested on bright sunny day by cutting he plants 15-20 cm from ground level. First harvest at 85-100after planting and subsequent harvests after 65-75 days intervals crops gives economical yields for 6-7 year.

Yield: 15-20 tonnes of herbage/ha, 65-70 kg of oil /ha, Whole herb contains 0.1 – 0.23% essential oil.

Oil constituent: **Chavicol-70-80%**

5) MINT

B. N. : *Mentha spp.*
Family : Lamiaceae
Plant part used: Roots
Uses :

1. The oil and its principle aroma compound menthol have cooling and gastro-stimulant properties, for which it is used in pharmaceuticals in pain balms, cough syrup, cough lozenges, tablets and oilment.
2. Oil enhances the shelf life of edible products and grains because of anti microbial property of menthol.
3. Mint oil is extensively used in flouring toothpastes, candies, beverages, confectioners, chewing gums, pan parag, mouth washes and betal related products.
4. Mints are also used in shaving creams, tobacco, cigarettes, aerosols, polishes hair lostions.
5. Mint oil is used as a soothing ingredient in cosmetics, colognes, deodorants, aftershave lotion, perfume bases, etc.
6. Spent grass is used as a manure or mulch and also utilized in making paper boards and paper.

Soil: Well drained, deep, Fertile Soils rich in humus having good water holding capacity. Sandy loam should be preferred. pH: 6.0-7.5. since it is shallow feeder can not withstand the water stagnation.

Climate: Long day , temperature, annual crops grown upto 1000 m elevation in subtropical region of North India. 1000-1200 mm rainfall well distributed all aroung the growing season

with bright sunshine during harvest is ideal for higher herbage and oil yield. Shade and frost are unsuitable for mint.

Improved Varieties: Shivalik (oil has high menthol content-75-80%), Kosi, CIMAP/Hybrid-77, RRL-118/3, Himalaya, Saksham, Kushal, Gomati, Kiran, EC-41911.

Method of Propagation: by stolons/suckers

Commertial propagation is clonally by stolon/suckers. 400-500 kg fresh juicy stolon/suckers from 0.1 ha healthy, vigorous plantation are enough as a planting material for 1.0 ha area.

Planting Time:

Mid January- early February .

Stolon of 6-10 cm length with 2-4 growing points formed during winter are planted either in flat beds or on ridges and furrow layout at 2 cm depth at **40x10 cm, 45x15** cm spacing. Hey should be dipped in 0.1% Captan or Bavistin solution for 2 minutes. A day temperature of 20-25^{o} C and light showers favours rapid growth.

Weeding: Weeding is necessary for the first 2-3 months till the planting material get established., Earthing up: done up to 4 months

Manuring:

20t/ha FYM,

Recommended dose: 50:75:37kg NPK/ha per year: Basal dose

Remainging 75kg N as Top dressing dose splits into 3 doses.

Irrigation:

For healthy crop growth it should be irrigated frequently.

Irrigation interval of 15 days in winter and 10 days in summer is required for good yield.

Harvesting:

Harvesting is done at floering stage on dry sunny days. First harvesting is done after months with appearance of flowers and yellowing of lower leaves. It should be done the onset of monsoon. Subsequent 2 harvests are made in Sept. an Nov. orDec. The crop cut 5-10 cm above the ground with sharp sickle. Harvesting on cloudy or rainy day deceases menthol content in its oil significantly.

Yield: 25-30 tonnes of herbage/ha per year

150-200 kg of oil /ha.

Oil constituent: **Menthol-70-80%**

6)GERANIUM

Botanical Name : *Pelargona graveolens*

Family : Geraniaceae

Plant part : Terminal stem with 6-12 leavese

- Chief constituents are Geraniol (68-75%)and citronellol (23-24%)
- Oil demand is 40-50 tonnes per year.
- Internal production is only 20 tonnes. So, India import geranium oil at higher cost.

Uses:

- Widely used in perfumery and cosmetic industries due to its agreeable and very profound rose like odour.
- In expensive soaps, perfumes.
- Used for production of Rhodinol which forms part of most high grade perfumes.

Tannins obtained as a byproduct from stems and leaves after extraction of oil.

Types of geranium

1. Rose geranium:
2. Ornamental geranium: only use as ornamental plant

In rose geranium two types

1. Algerian or Tunician:

Produce dark pink flower
Not suitable for wet soil
Grown in Nilgiri hills

2.Bourbon or Reunion:

Produce light pink colour flower
Suitable for wet soil
Oil quality is superior.
Grown in Nilgiri and Annamallai hills

Varieties: Kodaikonal-1, Hemanti, Kunti,

Soil:

Well drained , deep porous, slighly calcareous
Good drainage
Ph: 5.5-7.0

Climate :

mild climate
Opt. Temp: 20-25^{0}C
Resistant to drought
Susceptible to frost.

Propagation: Terminal Stem cutting
Period : November

Land preparation: Crop stand for 3-10 yrs so land is prepared thoroughly.
Layout: Ridges and Furrow Spacing: 60 x 60 cm
Period June- July / Dec.- Jan. 30,000 cutting / ha is needed
In close planting: 45 x45 cm maintained PP: 57,000/ha gives higher herbage yield
Manuring: farm yard manure at about 10-20 tonnes per ha
40-60 Kg : N, P2O5 and K2O per hectare as basal dose
200 kg N: in 6 split doses for top workinh
Irrigation: weekly interval

Harvesting

First harvest: 4-6 months after planting

Maturity indices:

- Apperance of flowers
- Leaves turn light green in colour with lower leaves turning yellow
- Lemon like odour of leaves changes to that of **rose**.

Harvesting once in 3-4 months
Yield: 20-30 tonnes /ha: Herbage yield , 20-30 kg/ ha: Oil yield

6) Vetiver

Botanical Name: ***Vetiveria zizanioides***

Family: Gramineae

Plant part: Roots

Contain: Vetiver oil

Uses:

- Vetiver oil is a perfume by itself.
- In expensive soaps, perfumes.
- Used in perfumes, soaps, attars, and skin care products.
- Tobacco, pan masala and cold beverage industries.
- Roots used with cloth in cupboard to repel insect
- Roots are cooling, bitter, stomachic, stimulate the immune system, relieve headache, burning sensation, ulcers and blood diseases.
- Soil and water errosion
- Dry roots: mats, mattresses, fans, screens, pillows, baskets, bags etc articles
- leaves : fodder and bedding for horses and cattles, substrate for mushroom cultivation, composting, mulching

Soil:

It withstand under prolong drypell and water stagnation. Loose well drained sandy loam should be preferred. pH: 6-8. Compact heavy soil restrict root growth and harvest off roots is difficult..

Climate:

Long day with plently of sunlight. It prefer warm and humid area. Cultivated in 60-400cm in South India as well as in Bharatpur area in Rajasthan receiving scanty rainIt does not perform well under shade condition.

Improved Varieties:

1. Seeding type: growth in North India, set seed, Having superior oil aroma

Eg. Akhila, Bharatpur, Musanagar, Dharini, Gulabi, Khesai

2. Non-seeding type: in South India, do not set seed, more root and oil yield.

Eg. Nilambur, ODV-3, Hybrid-7, Hybrid-8, CIMAP/KS-2, Sugantha, KH-8, KH-40

Method of Propagation: tillers and slips

Tillers take long time, hence slips are preferred. Collect slips from previous crop with rhizome portion intact having 15-20 cm aerial portion. Seeds take long time and having dormancy of 3 months. Seeds propagation is limited to breeding purpose only due to heterozygous nature hence slips are preferred.

Planting Time:

Onset of monsoon or at the middle of rainy season i.e. June – July

Spacing:

Transplanted on ridges and furrows. Plant 2-3slips per hill

Spacing:22.5x 22.5 cm (Plat population2-2.5 lack /ha), 60x25cm (Plant population 60000/ha)

Weeding: Weeding is necessary for the first 2-3 months till the planting material get established.

Earthing up: done up to 4 months

Manuring:

10t/ha FYM

Recommended dose: 80:50:50kg NPK/ha per year- Basal dose and

N in 4 split doses.

Irrigation:

For healthy crop growth it should be irrigated frequently.

Irrigation interval of 15 days in winter and 10 days in summer is required for good yield.

Harvesting:

Roots ready for harsting 16-18 months after planting.

Maturity indices:

1. Roots should expose a hard surface when the skin is peeled off.
2. They should be thick hard long and wiry
3. Should give bitter taste when chewed

Oil content and yield are less during rainy season as the oil is diffused into soil. Harvesting roots during dry period is more preferable.

Above ground portions are cut to 15-20 above the ground. Clump are uprooted by digging forks or by disc plough. Soil I dug up to 30-40am to get 50% roots. Clumps are then shade dried for 7-10 days to reduce moisture content, beaten to remove adhering soil and roots are separated from the stem portion with sharp knife. Clean the roots thoroughly in running water and send for distillation.

Yield :5-6 tonnes fresh roots per ha.
a) Oil yield:15-20 kg/ha, and 1-105% oil on dry weight basis.
Oil constituent: **Veteverol: 65-75 %**

Processing and value addition in ornamental crops

A) DRY FLOWERS

Definition : 'Dry flowers' refer to dried or dehydrated flowers or plant part or botanicals (roots, leaves, stem, bark or whole plant) that can be used for ornamental purposes. Dried flowers are also known as everlasting flowers or dehydrated flowers.

Economic importance:

Economic importance:

- The dry flower industry is a Rs. 100 crore industry in India and such dry decorative materials are globally accepted as natural, eco-friendly, long lasting and inexpensive.
- India is one of the major exporters of dried flowers to the tune of 5% world trade in dry flowers. This industry is growing at 15% annual growth rate.
- Easy and year-round availability of a wide range of raw materials from forests and availability of manpower for labour intensive craft making are the reasons for development of dry flower industry in India.
- This industry provides direct employment to around 15,000 people and indirect employment to around 60,000 people.

The Indian dried flower export market is classified into four main product segments as detailed below.

1. Dried flowers and plant parts in bulk.
2. Potpourri
3. Arrangements
4. Floral handicrafts

Tips for collecting plant materials for dry flower making

- Avoid collecting plants when they are wet or moist from dew.
- Use a sharp knife or pruning shears to cut flowers and plant materials.
- Select plant materials that are without insect or disease problems.
- Place stems in water while harvesting to prevent wilting. Some flowers may hold coluor better if allowed to stand in water for a few hours.
- Start the drying process as soon as possible after cutting.

Processes in dry flower making

A) DRYING

i. Air drying

Tie the flowers in loose bunches and hang upside down until they are dry in a room with good ventilation and darkness. It is the ideal method for seedpods, grasses and many flowers having more cellulose material. Crisp textured flowers like Helipterum, Helichrysum and Limonium could easily be dried either by hanging or positioning them erect in containers for 1-2 weeks. Gomphrena flowers from half to full bloom maturity take 7-9 days for air drying and roses take 5-10 days.

Acacia, amaranths, castor flowers, citrus leaves, cockscomb, corn flower, fennel, fern, golden rod, gypsophila, grasses, herbs, ear heads of wheat, oat and rye, hydrangea, lavender, protea, marigold, poppy seed pods, physalis, peppers, roses, statice, thistle, yarrow and yucca can be dried by this method.

ii. Sun drying

Plant material is embedded in drying medium (sand) in a container and exposed to the sun daily to facilitate rapid dehydration. In India, open sun drying is followed for drying

many flowers. Flowers like small zinnias, marigolds, pansies, and pompon chrysanthemum embedded in sand upside down fashion and kept in the Sun would dry in a day or two. For Gomphrena, Zinnia and French marigold it would take 3-4 days. Open sun drying is followed for corn flowers, custard apple (small), Casuarina pods, mini coconut, eucalyptus, evergreen cones, gomphrena, gourds, pomegranates, poppy pods, lotus pods, typha heads, palm leaves, grass ear heads.

iii. Oven drying

Electrically operated hot air oven at a controlled temperature of 40-50 °C is used for drying flowers in an embedded condition. Chrysanthemum, dombeya, gerbera, and limonium take 48 hours at 45-49 °C, French marigold takes 72 hours, African marigold takes 96 hours and Nymphaea takes 120 hours for drying. China aster, delphinium, rose buds and small flowers, and zinnia take 48 hours at 40 - 44 °C, medium and large roses take 72 hours and very large flowers take 96 hours in 40 - 44 °C.

iv. Embedding method

Embedding the flowers in a granular, desiccating material is probably the most commonly used method and many consider it the best all around method. Several materials may be used, and they vary in cost and the results that they produce. To cover a flower, put about an inch of desiccating material at the bottom of the container; cut the flower stem to about a half an inch and stick this into the center of the material at the bottom to hold the flower. Next, pour the desiccating material along the perimeter of the container, away from the flower, building up a continuous mound of about an inch. Then tap lightly on the container and the material will move to the flower, not altering the form of the petals. Continue adding the material, tapping on the container, etc. until the flower is completely covered. Lastly, add an inch of the material above the top of the flower. Sand, borax, silica gel, saw dust, perlite and combination of these materials are used in this method. Sand and Borax methods though relatively cheap, take longer time and labour for drying. Silica gel is the ideal drying agent for delicate flowers such as roses, carnation, dahlia etc. It takes less time and can be reused indefinitely after removal of moisture from the silica gel crystals by drying them in an oven at 250 °F for 1 hour. French marigold and zinnia (half to full bloom stage) take 4 days for drying by silica gel embedding. Wiring of flowers before drying is essential for which 20-24 gauge florist wire is used. Chrysanthemum takes 5 days for drying in silica gel. Ageratum, anemone, amaryllis, bleeding heart, baby's breath, bachelors button, chrysanthemum, calendula, clematis, crocus, daffodil, dahlia, daisy, delphinium, gloriosa lily, gaillardia, geranium, gladiolus, hyacinth, hibiscus, lily, marigold, pansy, petunia, poinsettia, poppy, rose, salvia, snap dragon, stock, tulip, verbena and zinnia are the flowers suitable for embedding method of drying.

v. Microwave oven drying

Electronically produced microwaves liberate moisture from organic substances by agitating the water molecule. It is fast and the results are good. The flowers has to be embedded in silica gel medium in a microwave safe open container along with a small cup with water nearby. Standing time of 10 minutes to few hours is needed after the drying for best results.

vi. Glycerin drying (glycerinization)

'Glycerinizing' is the term used in the ornamental cut flowers and foliage industry to describe the treatment of fresh plant materials with a hygroscopic (water attracting) chemical with the objective of retaining the suppleness of the plant materials. Foliage treated with glycerin keeps almost indefinitely and remains pliable. Glycerin preserves foliage by replacing the natural moisture present in the leaf with a substance that maintains the leaf form, texture and sometimes the colour. Fresh and fairly matured foliage is ideal for glycerining. About 50 per cent of most plant fresh weight is water, but brittleness is usually only a problem if the water content falls below 10 per cent.

vii. Freeze drying

Freeze dried flowers are fresh flowers that have been specially dried to preserve their natural shape, colour and beauty. Freeze drying is accomplished by a process called sublimation. It requires a special freeze-drying machine. It involves first freezing the flowers at (-) 10 °C for at least 12 hours. A vacuum pump slowly pulls the water out of the flowers as a vapor in one chamber, and then the vapor condenses as ice in another chamber. Because of this process, the shape and natural color of the flower is maintained. For Roses it takes 15 – 17 days and for other flowers normally 10 – 12 days. Major flowers dried by this method are roses, carnation, bridal bouquets etc.

viii. Press drying

Flowers and foliage are placed in-between two folds of newspaper sheets or blotting paper and these sheets are kept one over other and corrugated boards of the same size are placed in between the folded sheets so as to allow the water vapour to escape. The whole bundle is then placed in the plant press, its screws tightened. After 24 hours the bundle is removed to an electric hot air oven for 24 hours at 40-45 °C. The following flowers and foliage are dried by this method. Flowers: Candytuft, Chrysanthemum, Euphorbia, Lantana, Larkspur, Mussaenda, Pansy, Pentas, Rose and Verbena, and Foliage: Thuja, Taxodium, Marigold, Grevillea, Rose, Ferns, Casuarina, Silver oak and Grasses

(B) Bleaching

Bleached ornamental plant material provides a striking contrast when arranged with dried or dyed flowers. Bleaching also allows the use of dyes for colouring. Oxidative (Hypochlorite, Chlorite and Peroxide) and reductive bleaching chemicals (Sulphite and Borohydride) are used for bleaching ornamental flowers and foliage. Profitability is depended upon attainment of high white quality and on cost efficient utilization of expensive bleaching chemicals. Sodium Chlorite is an excellent bleaching agent because it is relatively selective for lignin without damaging fibre. Optimum pH (4.5-3.5) and temperature (70 °C) is to be maintained for effective chlorite action. Hydrogen Peroxide may be more practical for some plant materials because it is less expensive.

Sodium Chlorite 10 % solution at 70 °C is ideal for complete colour removal of pink Gomphrena flowers in to pure white flowers at 7 hours of immersion. Hydrogen peroxide 30% also takes 7 hours for complete colour removal of Gomphrena.

(3) Dyeing

Though preserving flowers with their natural colour is more appealing, some plant parts need artificial dyeing to improve the colour. Systemic dyes are available for use. They are acidic-anionic dyes, which are combined with water and glycerin to form a preservation solution that is absorbed by fresh cut flowers and foliage through the stem of the plant. As the water evaporates, it leaves behind the dye and glycerin for our desired colour. Normally 1.5 ml to 5 ml dye/l of solution is prepared. Colour take and preservation will take 2-8 days.

(B) FLORAL PATTER/ FLOWER RANGOLI

Floral pattern or '*rangoli'* with flowers is a common practice in India. Generally, the petals of different flowers are taken out and are arranged in various patterns. Intact flowers of small-flowered chrysanthemums and other flowers can also be used for this purpose.

(C) BOUQUETS

A flower bouquet is a collection of flowers in a creative arrangement. Flower bouquets are often given for special occasions such as birthdays or anniversaries. They are also used extensively in weddings. Traditionally the bride will hold the bouquet, and the Maid of Honor will hold it during the ceremony. A wedding bouquet of flowers or roses is an idea that was brought up years ago and then became a tradition.

Line flowers

Line flowers are tall, and give your bouquet height, width, and a balanced look. Branches and tall foliage can serve as line flowers. Most line flowers have buds growing up a center stalk. Examples of line flowers are gladiolus, liatris, snapdragon, delphinium, tuberose, veronica, curly willow, bells-of-Ireland and stock.

Mass flowers

Mass flowers will give the bouquet weight or mass and are generally round and full faced. Sometimes they are referred to as face flowers. They are usually the focal point of color and interest in a bouquet. Most mass flowers come with only one flower on the end of the stem. Examples of mass flowers are rose, carnation, gerbera, sunflower, lily, daffodil, tulip, iris, freesia, zinnia, alstroemeria, protea, chrysanthemum.

Types of bouquets

Generally bouquets are a circular in shape with the flowers tied together in a specific structure. In recent days, various styles of bouquets have become popular. Some types are described below.

Posy: A posy is a round bouquet. The stems may be removed and wired or left as it is. The posy is round and small and can easily be held in one hand.

Crescent bouquet: A crescent bouquet can be symmetrical or asymmetrical. Both left and right side of the bouquet is seen to be flowing down. A symmetrical crescent bouquet has

flowers and greenery arched at same lengths on both sides, whereas the asymmetrical, has one side longer.

Arm bouquet: The arm bouquet is also referred to as presentation bouquet or pageant bouquet. Flowers suitable for this bridal bouquet type often have long stems, like calla lilies, orchids and also long-stemmed roses. The flowers are left at its natural state, with a big ribbon tied to bundle them together. Popular floral choices for arm bouquets are calla lilies, gladiolus, orchids, long-stemmed roses, delphiniums, and larkspur.

Freeform/Contemporary bouquet: A freeform bouquet does not have a specific or defined shape. In fact, most freeform bouquet has foliage coming out of the bouquet. Tropical flowers are usually used for this type of wedding bouquet. Uniquely shaped flowers are often used. It is popularly used for elegant or contemporary style weddings.

Single stem bouquet: A single stem bouquet is for someone who loves simplicity. This bridal bouquet type often has its flower stem wrapped or a big ribbon tied to it to add more attention.

Pomander: A pomander is a ball of flowers carried by a ribbon attach to it.

Cascade bouquet: Also called a fountain or waterfall bouquet, this has an abundance of blossoms at the top of the bouquet then tapers downwards with flowing foliage or ribbons at the bottom.

Fan: This is simply a bouquet of flowers attached to a plastic fan. Popular in the late eighties, they were embellished with carnations, baby's breath and plenty of ribbon.

Hand-tied bouquet: Hand-tied bouquets give off a casual feel. A grouping of flowers tied together with ribbon. It looks as if they were picked fresh right out of the garden. This is perfect for casual or garden weddings.

Oval bouquet: This bouquet is a combination of both a cascade and a round. Generally the bottom is narrower than the top, but the overall shape resembles an oval. This can be used in almost any style wedding.

Heart bouquet:

A romantic, shaped bouquet featuring two full arched shapes at
the top while tapering down to a point at the bottom of the bouquet.
Typically the traditional shape, often seen at Valentine's Day,
symbolizing love and romance.

Mixed flower bouquets: These can be made the same way as the rose bouquet. Substitute smaller flowers for the rosebuds, and use larger flowers towards the center of the bouquet.

Fruit bouquet: A fruit bouquet is a fruit arrangement in the form of bouquet. The fruit is cut in the shape of flowers and leaves and are arranged in the container with the help of sticks. A complete arrangement looks like a bouquet of flowers. Fruit bouquets generally have seasonal themes, such as Christmas, graduation, birthday, anniversary, housewarming and Valentine's Day.

Flower Arrangement – Principles

lower arrangement is an art of arranging flowers in different styles.

Principles of flower arrangement

Emphasis / Focal point

Balance

Scale / Proportion
Rhythm
Harmony and Unity

Emphasis / Focal point

 Central portion of arrangement from where flowers and foliage appear to be emerging.

 Larger and brighter flowers or flowers with unique shape are suitable as focal points.

 Focal point draws attention of viewer.

 One focal point is enough for a small arrangement while 3 or more focal points are important for a large one.

Balance

 A balanced arrangement has a distinct focal point.

 Balance may be symmetrical (geometrical) or asymmetrical.

Scale / Proportion

 Achieved by scaling the flowers from the focal point i.e. the smallest buds are placed farthest from the focal point.

Rhythm

 Rhythm is achieved through colour and gradation (size) of flowers

 The colour may be darkest at focal point and gradually lighter at the rims.

Harmony and Unity

 Blending of all the components is called harmony

 It is created when all the parts of the design blend together to form a single idea

 It is created by repetition of the components in the arrangements.

Ikebana

Definition / Concept: Ikebana is the Japanese art of flower arrangement. It's also known as the 'Eastern style of flower arrangement'. Ikebana is more than simply putting flowers in a container. It is a disciplined art form in which the arrangement is a living thing in which nature and humanity are brought together.

Ikebana = Ike+bana; Ike = to live, bana = flower; it signifies life and freshness

Ikebana is believed to have been introduced/ conceived by a Buddhist Monk 'Semmu'.

Principles

1. Spiritual basis of Ikebana:
2. Ikebana involves spiritual significance
3.Closely associated to all aspects of life
4. It is associated with the philosophy of developing closeness with nature.
5. One becomes quiet when one practices Ikebana.
6. One becomes more patient and tolerant of differences, not only in nature, but also more generally in other people.
7. It helps to "live in the moment" and to appreciate things in nature that previously had seemed insignificant.

Rules of construction of Ikebana

Its materials are living branches, leaves, grasses, and blossoms, anything can be used and even a small weed can be given an important place in an arrangement.

Its heart is the beauty resulting from colour combinations, natural shapes, graceful lines, and the meaning latent in the total form of the arrangement.

The three main components of Ikebana: Heaven, Man and Earth.

In Ikebana empty space plays an essential part of the arrangement. The elements placed asymmetrically, are given emphasis by the spaces.

Thus, the totality of a well-done arrangement brings about a state of serenity and peace to the viewer.

Processing and value addition in MAPs produce

Distillation of Essential Oil

1. WATER DISTILLATION

This is simple method in which plant material is distilled comes in direct contact with boiling water in a distillation unit. This method is advantageous for certain material when they are in powered form. But this method is not good for material containing saponifiable or high boiling point constituents.

Delicate flowers such as roses and orange blossoms would clump together when introduced to steam in the distillation process. The water protects the extracted oil from overheating. The condensed liquids cool down and separate from each other. The remaining water, which can sometimes be fragrant, is referred to by several names including *hydrolate, hydrosol, herbal water, essential water, floral water,* **or** *herbal distillate.*

2. STEAM DISTILLATION PROCESS

A large container called a *Still*, which is usually made of stainless steel, containing the plant material has steam added to it. Through an inlet, steam is injected through the plant material containing the desired oils, releasing the plant's aromatic molecules and turning them into vapor. In this method steam does not penetrate the cell membranes and the essential oil i vapouried only after diffusing out as an aqueous solution through the cell membrane. The vaporized plant compounds travel to the condensation flask or the *Condenser*. Here, two separate pipes make it possible for hot water to exit and for cold water to enter the Condenser. This makes the vapor cool back into liquid form. The aromatic liquid by-product drops from the Condenser and collects inside a receptacle underneath it, which is called a *Separator*. Because water and oil do not mix, the essential oil floats on top of the water. From here, it is siphoned off. Quality of oil is also good in this method. (*Some essential oils are heavier than water, such as clove essential oil, so they are found at the bottom of the Separator.*)

1. SOLVENT EXTRACTION

This method employs food grade solvents like **hexane and ethanol** to isolate essential oils from plant material. It is best suited for plant materials that yield low amounts of essential oil, that are largely resinous, or that are delicate aromatics unable to withstand the pressure and distress of steam distillation. This method also produces a finer fragrance than any type of distillation method.

Through this process, the non-volatile plant material such as waxes and pigments, are also extracted and sometimes removed through other processes. Once the plant material has been treated with the solvent, it produces a waxy aromatic compound called a "concrete." When this concrete substance is mixed with alcohol, the oil particles are released. The aforementioned chemicals used in the process then remain in the oil and the oil is used in perfumes by the perfume industry or for aromatherapy purposes.