



Importance and uses

- ❖ The word **Chrysos** means ‘the gold’ and **anthemum** means ‘**flower**’.
- Known as the ‘Queen of the East’.
- ❖ In India too, chrysanthemum occupies a place of pride both as a commercial crop and as a popular exhibition flower.
- Second largest cut flower grown all over the globe.
- It has a wide range of **type**, **size** and **colour** and also ‘**forms**’.
- Short day plant – ‘Photo sensitive’ (10 hours day light)
- ❖ The erect and tall growing cultivars are suitable for background planting in borders or for use as cut flowers.
- ❖ The cultivars with the dwarf and compact growing habit, on the other hand, are suitable for front row plantation or pot culture.

Importance and uses

- ❖ The decorative and fluffy bloomed small-flowered cultivars are ideal for garland making and hair decoration.
- ❖ The extra large-bloomed cultivars for their exhibition value.
- ❖ Tall growing type suitable for background planting in borders.
- ❖ Dwarf growing for flower beds and pot culture (pot mums)
- ❖ Loose flowers – garland, veni, worship etc.
- ❖ Long stem flowers – cut flowers for Bouquet, Vase etc.
- ❖ *Chrysanthemum morifolium* is also an important source of essential oil and sesquiterpenoid alcohol.
- ❖ Certain species like *Chrysanthemum cinerariifolium* and *C. coccineum* are also cultivated as sources of pyrethrum, an important insecticide.

Origin and History

- ♣ Chrysanthemum is native to Europe and Asia
- ♣ It originated in China.
- ♣ Species involved in the development are *C.sinense*, *C.indicum*, *C.japonicum*, *C.ornatum*.

In China

- ♣ The earliest mention of chrysanthemum was recorded by Confucius.

In Japan

- ♣ Chrysanthemum was proclaimed as the National Flower by emperor Uda in the year 910 AD
- ♣ At present cherry blossom is the National Flower and chrysanthemum the symbol of Royalty in Japan.

In Europe

- ♠ In 1690, Rheede described a Holland – grown type from India called Gool – doodi.
- ♠ In France, it primarily remained as cemetery flower.
- ♠ In England, the emphasis was on exhibitions
- ♠ National Chrysanthemum Society of England lists more than 5000 cultivars.

In USA

- ♠ The first chrysanthemum known to the USA was ‘Dark Purple’ imported by a scientist John Stevens in 1798.
- ♠ The National Chrysanthemum Society of America was founded in 1890, consisting exclusively of commercial growers, at New York.

In India

- ◇ In North India, chrysanthemum is primarily grown for landscape gardening either in the ground or in pots.
- ◇ In Southern part of the country, it is mostly grown as loose flowers for garland, hair decoration by women and offerings to god.

Classification



- ◇ The species of the genus *Chrysanthemum* are annual, perennial herbs, sometimes partly woody.
- ◇ The genus *Chrysanthemum* belongs to the family Compositae / Asteraceae.
- ◇ *Class 1. Single*
- ◇ Ray florets in a single row at right angles to the stem.
- ◇ Disc is flat to slightly rounded and may be of contrasting colours, e.g., Potomac.

Class 2. Semi-double



Ray florets in more than one row at right angles to the stem but may curve downward at the tips.

Disc as in class 1.

Class 3. Anemone



Ray florets variable, from flattened, broad and equal in length to reflexing, pointed at tip and unequal in length.

Disc florets are numerous tube-like and elongated so as to form a prominent disc which may range from flat to hemispherical in form.

Class 4. Pompon



Bloom globular, somewhat flat in young stage or small button type. Ray florets broad, incurved, smooth and firm with good substance.

Class 5. Incurve



Breadth and depth should be equal to produce a globular bloom.

Ray florets narrow to broad, smooth and incurve in a regular to an irregular manner without producing an open centre, e.g., Snow Ball, Mountaineer, Nob Hill.

An Irregular Incurve chrysanthemum, or 大輪菊 *ogiku* in Japanese, meaning "big chrysanthemum". The size of this flower is around 20cm (about 8 inches).



Class 6. Reflexing incurve



Ray florets usually broad and smooth. Breadth and depth nearly equal to form a globular bloom, sometimes flattened, may be less compact than incurve.

All mature florets not completely incurving and not all completely reflexed.

The lower florets sometimes reflexing to give a skirted effect, e.g., Dream Castle, Indianapolis.

Class 7. Decorative



Ray florets from short and broad to narrow, long and pointed, they generally reflex, although upper florets may tend to incurve.

Blooms more flattened than globular,

e.g., Otome Pink, Princess Anne.

Class 8. Reflex



Bloom globular with equal depth and breadth and a full centre, or somewhat flattened. Ray florets narrow to broad, gracefully overlapping in either a regular or in an irregular manner and reflexed.

e.g., Coronation Pink.

Classification

- Based on the size, shape of flower, arrangements of florets and purpose used, the chrysanthemums are classified into several groups.
- I. Small flowered types.
- II. Large flowered types
- III. Classification based on plant growth
- IV. Based on usage.

I. Small Flowered

■ **Singles** – The petals are arranged in one or not more than five rows with prominent central disc.

■ **Anemones** – Prominent centrally raised hemispherical cushiony disc florets surrounded by short rounded or flat or twisted or quilled ray florets. Ex. Golden sands, White sands.

■ **Korean single** – Small flowers with a prominent central disc, ray florets are flat, number of whorls or ray florets are five and less than five. Ex: Cardinal, Gul-e-Sahir, Chairman.

■ **Korean double** – The number of whorls of ray florets are more than five and the central disc is open. Ex: Flirt, Man Bhawan.

■ **Spoon** – The outer ray florets are tubular with a spatula or spoon like opening at the tips. Ex: Anokha.

■ **Decorative** – Fully double flowers with flat petals and central disc is generally absent or not seen, ray florets are longer. Ex: Aretic, Elegance, Blue chip, Dolly.

■ **Quilled** – Small flowers, ray florets are tubular. Ex: Golden crystal, Snow crystal.

■ **Button** – Very compact, small flowers, produce numerous flowers. Ex: Golden dust.

■ **Pompon** – The flowers small, freely opened, compact, hemispherical or ball shape, the central disc is concealed or absent, florets neatly arranged. Ex: Apsara, Jayanthi, Lameo, Dandy, Eve.

II. Large flowered types

- **Incurved regular** – The outer ray florets curve upwards and inwards towards the disc florets to form a globular shape. Ex: Snow ball, Sonar Bangla, Chandrama.
- **Incurve irregular** – The outer ray florets incurve loosely and irregularly and do not form a ball as in case of regular.
- **Refluxed** – The outer ray florets curved outwards and downward away from the centre so that only their upper surface is seen. Ex: Cresta, City Beauty, Golden Rule, Day dream, Peach blossom, Sweet Heart.
- **Intermediate** – The inner florets incurved and outer florets are refluxed, they are intermediate in shape to incurved and refluxed. Ex: John Reid, Lady Hope town.
- **Spider** – The outer ray florets are large, elongated, tubular and curved to form a hook or coil like structure at the tip of the petals. Ex: Rupasi Bangla, Mahatma Ganthi.
- **Quill** – The outer ray florets are elongated, straight and tubular like a quill with tips open but not flattened.
- **Exhibition** - The outer florets are refluxed and inner florets incurved, the ray florets are generally twisted, irregularly overlapped each other and looks attractive.
- **Ball type** – Ray florets are straight and radiated in all directions to give a complete ball shape.

III. Classification based on plant growth

- **Standards** – plants with single flower, other buds are removed if arise from the laterals and produce big flower.
- **Spray** – The main apex bud is removed and lateral buds are allowed.
- **Pot mums** – Small flowered mums with 6-9” height are beautiful in decorating the places.

IV. Based on usage.

- 1. Cut flowers –
 - i) Disbudded inflorescence
 - ii) Spray inflorescence
- 2. Loose flowers
- 3. Potted/bed plants

Species and cultivars

■ Some important species of chrysanthemum are:

■ $n=9$ ($2n=18$ to 90)

- *Chrysanthemum boreale* : Abura – Giku
- *C. carinatum* : Tricolour
chrysanthemum
- *C. coronarium* : Garland
chrysanthemum
- *C. cinerariifolium* : Dalmatian pyrethrum
- *C. rubellum*
- *C. satsumense* : Satsuma-nogiku
- *C. sibiricum*

Cultivars

Spray cultivars



White	:	Super white, White spider
Yellow	:	Sunbeam, Super yellow
Pink	:	Blue Marble, Blue Winner
Pale pink	:	Pink Marble, Snapper
Red	:	Red Fandango, Red Nero, Red,
Bronze	:	Bronze Nero, Tuneful
Light bronze	:	Apricot Marble, Orange Aglow
Purple	:	Fandango, Flamenco
Salmon	:	Coral Marble

Red Mums



Spider mums

Standard cultivars

White	:	Giant Indianapolis White
Yellow	:	Bright Golden Anne
Pink	:	Cassandra, Deep Champagne
Red	:	Red Anne
Bronze	:	Resilient
Light bronze	:	Gay Anne
Purple	:	Purple Anne

Standard cultivars

White	:	Altis, Bonnie Jean
Yellow	:	Yellow Tuneful
Pink	:	Always Pink
Pale Pink	:	Distinctive
Red	:	Red Torch
Bronze	:	Red Anne
Light bronze	:	Gay Anne
Purple	:	Royal Purple

Standard cultivars

White	:	Snow Ball
Yellow	:	Chandrama
Red, Bronze	:	Alfred Wilson



Small-flowered for pot culture

White	:	Mercury, Honeycomb
Yellow	:	Aparajita,
Mauve	:	Megami



Small-flowered for cut-culture

Yellow	:	Sujata
Mauve	:	Nilima



Small-flowered for garland

White	:	Birbal Sahni, Sharad Shobla
Yellow	:	Basanti

Environmental factors

- ❖ The major factors which constitute the environment of a plant are light, temperature, relative humidity and air composition.

Light

- ❖ Light affects the growth of chrysanthemum quantitatively by influencing the photosynthetic activity and qualitatively due to the phenomenon of photoperiodism.

Temperature

- ❖ Effects of temperature on growth and development of chrysanthemum varies during the different stages.

According to **Cathey (1955a)**- chrysanthemum cultivars are classified into three groups as given below:

1. Thermo-zero

Cultivars which flowered at any temperature between 10° and 27°C but, most consistently at 16°C night temperature, e.g., Shasta.

2. Thermo-positive

- Cultivars in which continuous low temperatures between 10° and 13°C inhibited or delayed bud initiation.
- Minimum temperature required for bud initiation is 16°C and it is rapid at 27°C, but flowering is delayed, e.g., Cameo.

3. Thermo-negative

- Cultivars in which bud initiation occurred at any temperature between 10° and 27°C but the bud development will be delayed at higher temperature, e.g., Defiance.

Air Composition

- Oxygen and carbon dioxide played important roles in the growth and flowering of plants grown extensively in greenhouses in the temperate regions.
- During day time, the required amount of oxygen is available as a result of photosynthesis. During night proper ventilation is necessary for ensuring sufficient oxygen supply.

Carbon dioxide

- CO₂ becomes a limiting factor in winter months in greenhouses because the ventilators are closed to keep the inside warm. By artificially enriching the greenhouse atmosphere with CO₂, production has been found to increase significantly.

Propagation

- Chrysanthemum can be propagated both by vegetative and sexual methods.
- Maintain the purity of cultivar seeds are used to develop hybrids.

Vegetative Propagation

- Sucker
- Cutting
- Grafting
- Micro-propagation
- Seed propagation

Among these, propagation through cutting is the most common and popular method.

Open cultivation

Soil Requirement

- ✓ Chrysanthemum with a shallow but fibrous root system is sensitive to water-logging and prone to attack by diseases, such as root rot and wilt due to lack of aeration.
- ✓ Clay and clay loam soils retain too much of moisture and thereby hinder proper aeration, resulting in rotting of roots.
- ✓ Sandy soils, drain too quickly and require frequent irrigation and also suffer from loss of nutrients due to leaching.
- ✓ Sandy loam soils are ideal for chrysanthemum growing.
- ✓ pH ranging between 6.2 and 6.7

✓ Contd...

Open cultivation

Soil requirement

Levels of nutrients in the soil should be

1. Nitrogen (nitrate) – 10-50 ppm
2. Phosphorus – 5-10 ppm
3. Pottassium – 30-40 ppm

Calcium, another essential macronutrient, is required to be @ 100-150ppm in soil.

- ✓ The critical levels of some micronutrients in soils are:
 - ✓ Manganese 3 to 4 ppm,
 - ✓ Zinc 6 to 8 ppm,
 - ✓ Boron 20 ppm and
 - ✓ Copper 5 ppm.

Climate

- Light and temperature are the two important environmental factors influencing the growth and flowering.
- As far as light is concerned, both photoperiod and the intensity have profound effects on growth and flowering of chrysanthemum.

Soil preparation and planting

- Chrysanthemum requires well prepared soil for proper growth and development.
- Addition of organic matter in the form of peat or rotten manure improves the soil structure.
- Soil should be well drained.
- Solar sterilization of soil is effective to prevent soil borne diseases.
- May-planting resulted in well developed plants with good flowers.
- Cut flower production was the highest from may plantings. 33

Substrate

- ✓ Commercially desirable plants with highest number of flower buds were produced in a 1:1 mixture of spent compost and Speedle (commercially potting mixture) medium.

Planting density

- ✓ The best plant population was 32 cuttings/m².
- ✓ For cv. Chandrama, a large flowered cultivar,
- ✓ Spacing of 30 x 30 cm.

After care

Irrigation

- ❖ The plants need adequate water during active vegetative growth when new leaves are formed.
- ❖ After the formation of flower buds
- ❖ Less amount of water is needed by the plants.
- ❖ Chrysanthemum roots are very sensitive to water logging but tolerate water stress appreciable.
- ❖ Different systems of irrigation are prevalent in various part of the world.
 - ❖ These include overhead mist spray lines.
 - ❖ Sprinkler and self-travelling sprayers.

Manuring and fertilization

- Chrysanthemums are heavy feeders and hence they are to be adequately manured.
- They are applied with 25 t of FYM along with 250,120, 25 kg NPK/ha.
- Half of the N and the entire quantity of P and K are to be applied basal by just before planting.
- The other half of N is to be applied 30 days after planting the suckers.
- The same dose can be repeated if a ratoon crop is raised and hoeing should be done once in a month.

Micronutrient application

- Coated fertilizers
- Liquid feeding
- Foliar feeding

Pinching

- The operation of removal of terminal growing portion of stem pinching reduces plant height and promotes axillary branches.
- Time and severity of pinching depend on the type of chrysanthemum and the desired objectives.
- After planting, the growth is mostly upward with very little branching.
- To arrest such tall growth, a simple procedure called ‘pinching’ is used. It is also called ‘stopping’.
- Only soft vegetative shoot tips 1.5 to 3 cm long are removed.
- Pinching is one of most important operations in chrysanthemum culture.
- Pinching is most essential for small flowered chrysanthemum.

Pinching

- Pinching increases the number of flowering stems in each plant; it can indirectly control flowering date and bloom quality; and the number of stems to a plant can easily be controlled.
- Two types of pinching are performed:
 - (a) Soft pinching: By this pinching the top soft tips of the shoot along with 2-3 open leaves are removed;
 - (b) Hard pinching: It means removing a longer portion upto hard shoot.

Disbudding

- Disbudding, the practice of removing undesirable immature flower buds to provide either a small number of large flowers or large number of small flowers is an important operation in the production of high quality plant and blooms.
- Buds are removed when they are amenable to be rolled out between the thumb and forefinger.
- **In standard types**-the terminal bud is retained and all axillary buds removed as soon as they are large enough to handle.
- **In Spray cultivars**- only the large apical bud is removed and the axillary buds allowed to develop.

De-suckering

- During the vegetative growth phase, plants grow upward.
- New suckers continue to develop from base of plants.
- For proper and vigorous growth of plants, suckers are removed from time to time.
- It is practiced to allow single stem to develop up to a certain height.
- Without de-suckering the main plant will lose vigour and becomes weak.

Staking of plants

- Staking is necessary to keep plants erect and to maintain proper shape of plants and bloom.
- Stakes are prepared mostly from bamboo sticks.
- Staking of plants is required for vertical support of the plants.

Harvesting and yield

Harvesting

- Decorative types are harvested when the petals in the centre of the topmost flower is almost fully developed.
- In standards, harvesting is generally done when outer ray florets ceases to further develop.
- Pot-mums are sent to the market with half to fully opened flowers.
- Spray mums are generally harvested at the two thirds to three-fourths open stage; standard mums at the three-fourths to full open stage of development.

Yield

- Yield start from 3-4 months after planting.
- Main crop duration 6 months.
- Ratoon crop 4 months. Total duration (6+4) 10 months.

Yield

- Main crop : 7.5 to 15 t/ha
- Ratoon crop : 4-5 t/ha.
- Sprays- 1,00,000 stems can be obtained from one ha.

Postharvest technology

Grading

- A metric grade specification for sprays.

Packing

- Most often standard chrysanthemum are placed in sleeves and packed in display boxes measuring 91 x 43 x 15cm.

Storage

- Chrysanthemum cut flowers can be wrapped in plastics and stored dry for 6 to 8 weeks at a temperature of 0.5°C.
- Temperature for truck shipments across the country ranged between 2° and 4°C.

Vase – life

- ❖ The use of proper preservative solution throughout the period of post-harvest handling is very important to prolong the life of cut flowers.
- ❖ Dipping of the stem for a very short period (5 seconds) in 1200-4800 ppm silver nitrate or soaking the stems in 1000 ppm silver nitrate for 10 minutes.
- ❖ Addition of 2 % sucrose to silver nitrate was found beneficial.
- ❖ It increased the vase-life from 12 days to 20 days.

Export standards for chrysanthemum

Parameter	Standard	Spray	Dwarf
■ Stem Length	88-100 cm	75-88 cm	25-38 cm
■ Weight 30g/stem of 90 cm	30g/stem of 85 cm	15g/stem of 30 cm	
■ # flowers	Only 1 flower	10 flowers	10-12 flowers
■	With 5 buds		with 5-8 buds