CHRYSANTHEMUM

Botanical Name: *Dendranthema grandiflora*

Family: *Asteraceae*

Origin: Northern hemisphere in China
National flower of Japan

Area in HP during
2010-11: 145 ha
2009-10: 119 ha
2007-08: 72 ha

2012-13: 315 ha
2011-12: 209 ha
2008-09: 83 ha
Uses of chrysanthemum

- Cut flowers
- Loose flowers
- Pot mum
- Hanging baskets
- Bedding
- Border plant
Different bases of chrysanthemum classification

- Inflorescence
- Photoperiod
- Temperature
Classification based on inflorescence

- Single
- Anemone
- Korean
- Double
- Decorative
- Pompon
- Incurved
- Incurving
- Reflexed
- Quill
- Fuji
- Spider
Classification based on Temperature

- **Thermo-positive:** low temperature between 10-27°C inhibit or delay bud initiation which occur more consistently at 16°C. High temperature over 27°C accelerates bud initiation but delay flowering.

- **Thermo-negative:** Bud initiation occurs at low to high temperature (10-27°C) but high temperature delays development of buds.

- **Thermo-zero:** Flowering occurs at any temperature between 10-27°C, more consistently at 17°C night temperature.
Important cultivars

**Standard:** Snow ball, Snow Don White, Mountaineer, Sonar Bangla, Bright golden, Anne, Lehmans, Sonali Tara, Poornima, Tata Century, Thai Ching Queen, etc.

**Spray:** Ajay, Birbal Sahni, Chandrama, Flirt, White Bouquets, Nanako, Surf, Surf, etc.
Off-season cultivars

- April-June: Himanshu, Jawala, Jyoti
- July-Aug.: Phuhar
- Sep.-Oct.: Ajay, Sharda
- Oct.-Nov.: Makhmal, Megami, Mohini, Sharad har
- Nov.-Dec.: Normal season cultivars
- Jan.-Feb.: Jaya, Lilith, Suneel, Vasantica.
- Feb.-Mar.: Maghi.
Factors affecting growth and flowering

- Genotype
- Soil: Sandy-loam, pH: 6.2-6.7
- Light (Intensity: 1.2-1.6 MJ/m²/day, Quality: 600-800nm, Photoperiod: less than 9.5 hours)
- Temperature (night: 10-16°C, day: 18-21°C)
- CO₂: 500-1000ppm
- Nutrients
- Pinching (Twice after 4 and 8 weeks of transplanting)
- De-shooting (retain 4-5 shoots in standard and 8-12 shoots in spray cultivars)
- Disbudding (remove lateral buds in standard and terminal bud in spray cultivars)
Propagation

- Terminal stem cuttings (4-5 cm) during June-July
- Suckers during February to April
- Micro-propagation
- Seeds (Problems of self-incompatibility and heterogeneity)
Optimum planting density and spacing

- Greenhouse cut flowers: 40-54 plants/m²
- Loose flowers: 30 x 20 cm or 20-25 plants/m²
- Standards: 20 x 20 cm
- Sprays: 30 x 30 cm
- Pot mums: 3-5 cuttings/pot (15 cm)
Optimum level of nutrients

- N (4.5-6%), P (0.26-1.2%), K (3.5-10%), Ca (0.5-4.6%), Mg (0.14-1.5%), S (0.30-0.75%), Mn (195-260ppm), B (25-200ppm), Cu (10ppm) and Zn (7.3ppm).
Optimum dose of nutrients

- FYM: 3-5 kg/m²
- N:P:K::30:10:15 (50-60g/m²)
- Loose flowers: FYM: 10-15 ton, N: 150kg, P: 100kg, K:120 kg/ha)
- Spray of light solution of cake + SSP at bud developing stage is very beneficial.
- Apply nitrogen through CAN source as urea causes phyto-toxicity.
Important Diseases

- Wilt (*Fusarium oxysporum f. sp. chrysanthemi*)
- Stem and foot rot (*Rhizoctonia solani*)
- Root rot (*Pythium, Phytophthora spp.*)
- Bacterial rot (*Erwinia chrysanthemi*)
- Powdery mildew (*Oidium chrysanthemi*)
- Lleaf spot and flower blight (*Alternaria, Septoria spp.*)
- Gray mould (*Botrytis cinerea*)
- Viral diseases (chrysanthemum stunt, tomato spotted wilt, tomato aspermy, flower distortion, chrysanthemum mosaic and chrysanthemum rosette)
Important Insect-pests

- Aphids
- Red spider mites
- Hairy caterpillars
- Thrips
- Grubs
- Leaf miners
- Nematodes
Aphids most serious pest
Important Disorders

- Premature budding
- Quilling of florets
- Crown bud formation
- Heat delay
- Petal burn
Stages of Harvesting

- **Standards**: When outer row of florets start unfurling for distant market and for local market half opened flowers.
- **Sprays**: Harvested for local market when two flowers have opened and others have shown colour, while for distant market when 50% flowers have shown colour.
- **Loose flowers**: Fully open flowers
- **Pot mums**: 50% buds have developed colour.
# Grades of Chrysanthemum Flowers

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Grade</th>
<th>Grade</th>
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<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blue</td>
<td>Red</td>
<td>Green</td>
<td>Yellow</td>
</tr>
<tr>
<td>Stem length (cm)</td>
<td>75</td>
<td>75</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Flower diameter (cm)</td>
<td>15</td>
<td>12.5</td>
<td>10</td>
<td>----</td>
</tr>
<tr>
<td>Stem strength</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
</tr>
</tbody>
</table>
Packaging of Cut flowers

- In bunches of 10, 20 or 25.
- In corrugated cardboard boxes of 91 x 43 x 15 cm (L x W x H) accommodates about 80-100 cut flowers of chrysanthemum.
- Wrap flower bunches in cellophane sleeves.
Optimum yield of chrysanthemum

- Standard: 2.5 to 4.5 lakh/ha
- Spray: 1.5-1.75 lakh/ha
- Loose flowers: 8-15 ton/ha
- Greenhouse yield 150-250 flower stems/m²/year.
Botanical Name: *Alstroemeria* species
Family: *Alstroemeriaceae*
Origin: Chile, Brazil, Bolivia, Peru, Paraguay, Venezuela and Argentina
Different uses of *Alstroemeria*

- Cut flower
- Pot plant
- Herbaceous border
- Garden flower, as it is regarded as herbaceous perennial in warmer climatic regions.
Prospectus of *Alstroemeria* cultivation in India

- In India, so far it has not gained popularity and no effort has been made to popularize it as either cut flower or pot plant.

- Recently, Directorate of Horticulture, Himachal Pradesh has made an attempt to popularize it among the flower growers after importing few cultivars from the Netherlands.

- Mid and high hill areas are very suitable for growing Alstroemeria.

- Its cut flowers are finding good market in the adjoining flower markets in Delhi and Chandigarh and lucrative price of Rs. 200-300 per dozen is being earned.
Prospectus of *Alstroemeria* cultivation in India

- Individual plant of this is sold by nurserymen @ Rs. 75-100.
- The flower lovers or consumers prefer to keep it in their homes or offices because of its uniqueness and longer vase life up to 2-3 weeks in ordinary tap water in comparison to lily or other cut flowers.
- There is also significant prospectus for export, as demand in international market for the last one decade showed progressive increase in its marketing.
Cultivars of Alstroemeria

- Pluto, Serena, Piantium, Alladdin, Reena, Caperi, New Pink, Rosita, Tiara, King cardinal, Sangria, Mona Lisa, Jessica, Gold finger, Victoria, Diana, Ursula, Azula, Amanda, Jupiter, Purple sensation and Granada.
New Pink
Rosita
Pluto
Reena
Serena
Caperi
Piantium (No. 14)
Tiara
Soil/ Growing Medium

- Cool well drained rich in organic matter medium is good for Alstroemeria.
- The optimum soil pH is 6 to 7.
- The ideal medium has one part each of sphagnum peat-moss, soil and sand or Soil, perlite, expanded clay and gravel.
Climate

- Alstroemeria prefers cool climate with partial shade.
- The control of flowering process requires thermo and photo-phase and thermo-phase requirement must be fulfilled before photo-phase.
- The optimum temperature in greenhouse during night and day is 15 and 18°C, respectively.
- The newly planted rhizomes/plants should not get more than 13 hours light at least for 6-8 weeks, which will allow the roots to develop sufficiently before flowering.
- After which supplementary light of more than 16 hours a day ensures early, profuse flowering for longer duration.
- During summer, when the air-temperature exceeds 30°C and soil temperature exceeds 18°C, the plants become dormant and should normally be divided.
Propagation

• The traditional method to propagate Alstroemeria is by division of rhizomes preferably during dormancy.
• However, continuous division after 10 to 12 weeks in greenhouses is practiced.
• The plants are cut back to 10 to 15 cm height several days before division.
• At the time of division older part of rhizomes are removed.
Planting Time and Planting Methods

**Planting Time:**
- September-October or February-March

**Planting Methods:**
- Alstroemeria is planted in the field and greenhouse conditions in the beds which should be 15 to 20 cm deep allowing the roots to grow during the three- four year production cycle.
- The growing-point of rhizomes is planted 7 to 10 cm deep.
Spacing

• The spacing varies with cultivar and purpose whether cultivation is for cut flower or planting material production or both.

• The optimum spacing between plant to plant and row to row is 40 to 50 cm.

• For growing Alstroemeria in pots the rhizomes should be plated shallow with growing tips 2.5 to 3 cm deep from the surface of soil, which allows plants to produce more branches, therefore, the pot looks filled.
Nutrition

- As Alstroemeria prefers soil with rich in organic matter, therefore, leaf mould or well rotten farm yard manure @ 3 to 5 kg/m² should be added to the soil.
- The recommended dose of nutrients is N (3.8-5.6%), P (0.3-0.7%), K (3.7-4.8%), Ca (0.6-1.8%) and Mg (0.2-0.4%).
- The mixture of (20N: 8.8P: 16.6K) @ 2.5g per litre is also ideal for growing Alstroemeria.
- The nitrogen should be applied in nitrate form.
- The soluble salt reading should always be less than 1.5m mhos/cm.
Irrigation

- Irrigation depends upon the prevailing weather condition.
- However, to keep the soil/medium moist is beneficial for better growth, flowering and development of rhizomes for which irrigation at 7-10 days interval is ideal.
- Nutrients can also be applied with the irrigation water.
Staking

- Galvanized or plastic wire mesh having a square of 20x20 cm should be erected in three rows at 30 cm height from one another.
- Bamboo sticks along with string can also be used in the beds in three rows for supporting Alstroemeria plants.
Diseases and Insect-pests

Diseases:
- Root rot (*Rhizoctonia* and *Pythium*)
- Plant or flower rot (*Botrytis* spp.)

Insect-pests:
- Thrips (These thrips also carry Tomato Spotted Wilt Virus)
- Caterpillars
- Spider mites
- Slugs
- Snails
- Aphids, and
- White fly
White Flies
Disorders

Flower abortion or blasting:

- May occur due to low light or when roots are damaged by excessive salts or over-watering.
- The aborted florets appear as small brownish bumps on the tip of shoot within the whorl of cymes.
- Fluctuating humidity as very high or very low within 24 hours causes blasting in which fully developed flower buds senesce before reaching complete development, which is even not reduced by increasing light intensity as well as duration.
Harvesting Stages

- Harvesting of spikes depends upon cultivar, market and consumer preference.

Local market:
- The shoots/spikes are cut when 4-5 florets have opened.

Distant market:
- When first floret has started opening and others have developed 50% colour. Shoots/spikes should be pulled rather cut which will encourage further shoot production.
Post-harvest Handling

- Flowers are very sensitive to ethylene injury, therefore, spray of 0.5 mM Silver Thio-sulphate (STS) before harvesting protect the plants from wilting.
- The 0.5mM STS + 2% sucrose is ideal vase solution. Normally in fresh water the shoots/spikes remain presentable for 2-3 weeks and vase life further increases a week by using preservative solution.
- The flowers can be stored as wet at 4°C for 2-3 weeks in water buckets.
- These are packed in bunches of 10/20 in corrugated cardboard boxes.
- The boxes should be transported vertically to avoid negative geotropism of spikes.
GERBERA

Botanical name: *Gerbera jamesonii*

Family: *Asteraceae*

Origin: Natal and Transvaal in South African and Asian regions
Important species in genus *Gerbera*

- *asplenifolia*
- *aurantiaca*
- *jamesonii*
- *kunzeana*
- *viridifolia*
Cultivars of Gerbera

- Diana, Thalsa, Sonsara, Paganini, Anneke, Nette, Rosetta, Gloria, Ginna, Ingrid, Pricilla, Alexias and Monique
Balance
Salvadore
Dune
Dana Ellen
Zingaro
Rosalin
Sunway
Intense
Cacharelle
Shimmer
Factors affecting growth and flowering of gerbera

- Light (Long days are good)
- Temperature (Day: 16-22°C and night: 12-15°C)
- Growth regulators (GA₃ and CCC)
Propagation

- Seeds
- Division of plants
- Cuttings
- Micro-propagation
Ideal planting density and spacing in gerbera

- 8-10 plants/m² or
- 30 X 30 cm or
- 40 x 25 cm
Nutrients Status

- N: 2.7-3.1%, P: 0.19-.0.35%, K: 3.06-3.64%, Ca: 1.66-2.18% and Mg: 0.3-0.48%.
Fertilizers

- Vegetative stage: N: P: K: Ca: Mg:: 3: 2: 3: 1: 1 @ 75g/m²
- Flowering stage: N: P: K: Ca: Mg:: 3: 2: 4: 1: 1 @ 75g/m²
Diseases

- Root rot (*Pythium irregularae, Rhizoctonia solani*)
- Foot rot (*Phytophthora cryptogea*)
- Sclerotium rot (*Sclerotium rolfsii*)
- Blight (*Botrytis cinerea*)
- Powdery mildew (*Erysiphe cichoracearum, Oidium crysiphoides*)
- Leaf spots (*Phyllosticta gerberae, Alternaria spp.*)
- Tobacco rattle virus
Insect-pests

- White fly
- Leaf miner
- Mites
- Aphids
- Nematodes
Red Spider Mites
White Flies
White Flies
Caterpillars feeding on gerbera
Harvesting stage of flowers

- Before outer row of ray florets show pollen
- When outer row of petals is perpendicular on stalk.
Packaging of flowers

- In insulated boxes to avoid freezing injury
- Plastic coated metal grids 50 x 70 cm with mesh size of 2 x 2 cm.
Yield of gerbera

- Greenhouse: 200-250 flowers/ m²/year
- Open field: 120-150 flowers/ m²/year
LILIUM

Botanical Name: *Lilium* spp
Family: Liliaceae
Origin and Distribution of Lilium Species

- Asia (49)
- Europe (12)
- North America (24)
Important characteristics of Oriental lilium

- Derived from species *Lilium aurantium*, *L. speciosum* and *L. rubellum*.
- These are late flowering lilies.
- Flowers are mostly white and pink.
- Flowers are mostly fragrant.
- Leaves are broader and almost parallel to ground.
- Bulbs are large 16-22 cm.
Important characteristics of Asiatic lilium

- Derived from hybridization of 12 species viz., *Lilium amabile*, *L. bulbiferum*, *L. concolor*, *L. dauricum*, *L. davidii*, *L. hollandicum*, *L. maculatum*, *L. leichtlinii*, *L. pumilum* and *L. tigrinum*.
- These have extended range of flowering period.
- Flower colour varies from orange, red, yellow, etc.
- Flowers are mostly odourless
- Leaves are narrow and upward growing
- Bulbs are small 10-16 cm.
Important cultivars of Lilium for export

- Asiatic- Connecticut King, Elite, Pollyana, Prato, Solemio, Cordellia, Grand Paradise, Brunello, Dream Land, Mercedes, Novcento, etc.
- Oriental- Star Gazer, Macropolo and Casablanca.
Lilium are preferred by most of consumers

- Those cultivars which do not stain clothes and table with their pollen.
- Cultivars like Tiara (pink single), Aphrodite (pink double) and sphinx (red double).
Propagation of Lilium

- Seeds (plants raised are free from viral diseases)
- Bulblets
- Scales
- Bulbils (L. bulbiferum, L. sargentiae, L. tigrinum and L. wallichianum)
Ideal soil or growing medium

- Soil which is well drained and very rich in organic matter having pH 6.5-7.5
- Adequate growing medium is soil: peat moss:: 1:1 or soil: peat moss: perlite:: one part each.
Ideal Climatic requirements

- Temperature (Day: 18-25°C and Night: 12-18°C)
- Partial shade (40-50%)
- Good aeration/ ventilation
Planting Time

Planting density and spacing of Lilium

- Planting density and spacing depends upon group of Lilium, bulb size and place of cultivation.
- In open planting density is 20-40 bulbs/m² and spacing is 40 x 15 cm.
# Planting density in Lilium

<table>
<thead>
<tr>
<th>Bulbs size (cm)</th>
<th>16-18</th>
<th>18-20</th>
<th>20-22</th>
<th>&gt;22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oriental Bulbs/ m²</td>
<td>40-50</td>
<td>35-45</td>
<td>30-40</td>
<td>25-35</td>
</tr>
<tr>
<td>Asiatic Bulbs/ m²</td>
<td>65-90</td>
<td>55-80</td>
<td>45-70</td>
<td>40-65</td>
</tr>
</tbody>
</table>
Nutrition schedule for Lilium

- NPK:: 30: 20: 20 g/m² and for liquid feeding of NPK::14: 10: 14.
Weeding in Lilium

- Three-four hand weeding
- Propyzamide @ 2.25kg/ha and chloropham 3.5 l/ha as pre-emergence.
Important diseases of Lilium

- Gray mould (*Botrytis elliptica, B. cinerea*)
- Soft bulb rot (*Rhizopus stolonifer*)
- Fusarium bulb rot (*Fusarium oxysporum f. lili*)
- Brown scale (*Colletotrichum lili*)
- Root rot (*Pythium splendens*)
- Bacterial soft rot (*Pseudomonas spp.*)
- Viral diseases (mosaic)
Important insect-pests of Lilium

- Aphids
- Thrips
- White flies
- Mites
Important disorders of Lilium

- Leaf scorch (Due to deficiency of Mn, Al which occur at over dose of nitrate level and add lime @ 10 ton/ha)
- Bud blast (Due to storage of water at top of plant, competition for nutrients, fluctuating carbohydrate level, low light intensity and high nitrate level)
- Puffy foliage (Due to frost injury and stunting of plants)
Stage of harvesting Lilium flowers

- Local market: When 1-2 florets open
- Distant market: When 1-2 florets show colour.
- Store flowers at 1-2ºC
- Cut stems few centimeter above ground level which increases bulb size.
Harvesting of Lilium bulbs

- After 40-50 days of flowering
- Foliage start turning yellow.
- Store bulbs in moist sand at -2°C for initial three weeks and later on at 0-2°C.
- In hilly areas, bulbs can be stored in moist moss/ saw dust and sand.