Chrysanthemum

- **Scientific Name:** *Dendranthema grandiflora*
- **English Name:** Chrysanthemum
- **Hindi Name:** Guldaudi) / Guldawari
- **Marathi Name:** Shevanti

❖ Introduction

Chrysanthemum (*Dendranthema grandiflora***)** is an important ornamental flower crop cultivated for **cut flowers, loose flowers, and potted plants**. It belongs to the **family Asteraceae** and is popularly known as the **"Queen of the East."** Chrysanthemum is a **qualitative short-day plant**, meaning it flowers only when exposed to **short photoperiods** (less than 12 hours of daylight).

To achieve off-season production and uniform flowering, controlled environmental conditions and **hydroponic cultivation using the Nutrient Film Technique (NFT)** can be adopted. NFT provides **precise nutrient management, better aeration, and enhanced root growth**, leading to **healthier plants and superior flower quality**.

❖ Botanical description

It belongs to family Asteraceae. The species of chrysanthemum have fibrous root system (shallow rooted plant), herbaceous perennial plant growing to 50-150 cm tall, with deeply lobed leaves and large flower heads, white, yellow or pink.

❖ Climate Requirement

Chrysanthemum requires **long days for good vegetative growth** and **short days for flowering.** The most important environmental factors influencing the growth and flowering of these plants are light and temperature. The rate of vegetative growth and flowering are also affected by temperature.

❖ Environmental Requirements

Parameter	Ideal Range	Remarks
pH	5.8 – 6.2	Maintain daily
EC	1.8 – 2.2 mS/cm	Slightly higher in flowering
Water Temp	18 – 22 °C	Oxygen-rich root zone
Air Temp	18 – 25 °C (day), 15 – 18 °C (night)	Optimal for growth
Humidity	60 – 70%	Maintain airflow
Light Duration	12 h (short day for flowering)	Use blackout cloths

Detailed justification of each NFT parameter for chrysanthemum

1. pH — 5.8–6.2

Why:
Nutrient availability is pH-dependent. Most macro- and micro-nutrients (N, P, K, Ca, Mg, Fe, Mn, Zn ...) are optimally available in a slightly acidic range. For chrysanthemums in hydroponics, 5.8–6.2 balances availability and reduces risk of micro-nutrient lockout (e.g., iron at high pH) or toxicities at very low pH.

Effects if out of range:

1. pH > 6.5 → micronutrient deficiencies (Fe, Mn, Zn, B) → chlorosis, poor flowering.
2. pH < 5.5 → some nutrient toxicities or root irritation; beneficial microbes less

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2. EC (Electrical Conductivity) — 1.8–2.2 mS/cm (Slightly higher in flowering)

Why:

EC reflects the total dissolved salts (nutrient strength). Chrysanthemum prefers a moderate EC: enough nutrients for active growth and flower formation but not so high as to cause osmotic stress.

Stage differences:

1. Vegetative: aim lower end (1.8 - 2.0 m S/ cm) for steady root development.
2. Pre-flowering & flowering: increase toward 2.0–2.2 to support bud development and bloom quality.

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3. Water Temperature — 18–22 °C

Why:

Root-zone temperature affects oxygen solubility, root respiration, and nutrient uptake. 18–22 °C keeps dissolved oxygen reasonably high while allowing active root metabolism.

Effects if out of range:

1. Too low (<15 °C) → reduced nutrient uptake, slow growth.
2. Too high (>24–25 °C) → lower dissolved oxygen, root diseases (Pythium), reduced vigor.

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4. Air Temperature — 18–25 °C (day) , 15–18 °C (night)

Why:
Chrysanthemum performs best in mild temperatures. These ranges optimize photosynthesis, vegetative growth, and flower quality. A modest night drop promotes bud set and plant metabolism.

Effects if out of range:

1. Too cool (<12–14 °C) → slow growth, poor flower development, chilling injury.
2. Too warm (>28–30 °C) → elongated stems, reduced flower quality, poor bud set.

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5. Humidity — 60–70% (Maintain airflow)

Why:

Relative humidity in this range reduces excessive transpiration stress while limiting fungal disease risk. Chrysanthemum benefits from moderate humidity for turgor and transpiration-driven nutrient flow.

Effects if out of range:

1. High humidity (>80%) → increased risk of fungal diseases (Botrytis, powdery mildew).
2. Low humidity (<50%) → excessive transpiration, smaller leaves, stomatal closure and reduced photosynthesis.

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6. Light Duration (Photoperiod) — 12 h (short day for flowering)

Why (photoperiod & chrysanthemum):

- Chrysanthemum is a **qualitative short-day plant** — it initiates flowering when nights are long enough (i.e., daylength is shorter than a critical value).
- For **off-season flowering** (e.g., to bloom for festivals), growers artificially manipulate daylength:
- **Shorten day (longen night)** with blackout curtains to simulate short days → induces flowering.
- **Prevent flowering** (for vegetative production) by nightly lighting (night-break lighting) to maintain longer photoperiod.

Blue Light

1. Promotes Vegetative Growth

- Blue light (around 450 nm wavelength) is essential for leaf and stem development.
- It encourages compact, sturdy growth — plants become shorter, stronger, and bushier, which is desirable before flowering.
- In the vegetative phase, blue light increases leaf thickness, chlorophyll concentration, and overall photosynthetic activity.

2.Regulates Photosynthesis

- Blue light directly controls the **opening of stomata** (tiny pores on leaves), allowing more **CO_2 intake**.
- This increases the **photosynthesis rate**, resulting in faster growth and greener leaves.
- It also helps in **chlorophyll formation**, improving plant color and vigor.

Red Light

1. Promotes Flowering (Short-Day Response)

- Chrysanthemum is a **qualitative short-day plant**, meaning flowering is triggered when day length is short.
- **Red light (around 660 nm)** plays a major role in this process by activating **phytochrome**, a light-sensitive pigment that helps the plant detect day and night length.
- Proper red light exposure encourages **flower bud initiation** and improves flowering uniformity.

2. Enhances Flower Color and Size

- Red light boosts the production of **anthocyanin pigments** and increases **chlorophyll activity.**

3. Controls Growth and Stem Elongation

- Red light promotes **stem elongation**, helping plants grow taller. However, if **blue light** is too low, plants may become **leggy (too tall and weak)**.
- That's why an ideal **Red:Blue ratio of 4:1** (about 80% red and 20% blue) is recommended.

Growth Stage	Light Combination	Purpose
Vegetative Stage (first 4–5 weeks)	Red (660 nm) + Blue (450 nm)	Enhances leaf and stem growth, improves photosynthesis
Flowering Stage (after 5–6 weeks)	Higher Red (70–80%)	Promotes bud formation, flower color, and size

Tips:

- Use **LED Grow Lights** that provide both **Red (660 nm)** and **Blue (450 nm)** spectrum.
- Keep lights **30–40 cm above the plant canopy**.

Photoperiod control:

- Vegetative phase → **13–14 hours of light**
- Flowering phase → **10 hours of light + 14 hours of darkness**

❖ Nutrient Management

Nutrient Concentration (ppm)

Nutrient	Vegetative Stage	Flowering Stage	Role
N	150	120	Leaf & stem growth
P	50	40	Root & bud development
K	200	250	Flower color & strength
Ca	120	150	Stem strength & quality
Mg	50	50	Chlorophyll synthesis
S	60	60	Protein synthesis
Fe	2.5	2.5	Prevents chlorosis
Mn	0.5	0.5	Enzyme activation
Zn	0.05	0.05	Hormone regulation
Cu	0.05	0.05	Enzyme cofactor
B	0.3	0.3	Flower formation
Mo	0.05	0.05	Nitrate metabolism

Key Nutrient Adjustments by Stage:

1) **Vegetative (Leaf/ Stem Growth):** High N 150 ppm and P 50 ppm are prioritized for maximum vegetative biomass and initial root development.
2) **Flowering (Bloom/Quality):** N is reduced 120 ppm while K 250ppm and Ca 150 ppm increase to support flower development, color, and structural integrity.
3) **Micro- nutrients:** Remain stable, with Fe 2.5ppm for chlorophyll and B 0.3 ppm for flower formation crucial throughout.

Fertilizer Source Table

Nutrient	Source Fertilizer	Remarks
N, Ca	Calcium Nitrate ($Ca(NO_3)_2$)	Provides Nitrate N & Ca
N, K	Potassium Nitrate (KNO_3)	Main N & K source
P, K	Mono Potassium Phosphate (KH_2PO_4)	Phosphorus + Potassium
K, S	Potassium Sulfate (K_2SO_4)	For K boost in flowering
Mg, S	Magnesium Sulfate ($MgSO_4 \cdot 7H_2O$)	Supplies Mg & S
Micronutrients	EDTA / DTPA Chelated Mix	Fe, Mn, Zn, Cu, B, Mo

❖ Nutrient Formulation (for 20 L stock solution)

Fertilizer	For 1 L	For 20 L	Purpose
Calcium Nitrate	0.74 g	14.8 g	N + Ca
Potassium Nitrate (13:0:45)	0.50 g	10 g	N + K
Mono Potassium Phosphate (0:52:34)	0.10 g	2 g	P + K
Potassium Sulfate (0:0:50)	0.30 g	6 g	K + S
Magnesium Sulfate	0.53 g	10.6 g	Mg + S
Micronutrient (Fe-EDTA mix)	0.1 mL	2 mL	Fe + trace elements

- Maintain **EC: 1.8–2.0 mS/cm (vegetative)** and **2.0–2.2 mS/cm (flowering)**.
- Adjust pH to **5.8–6.2** using phosphoric acid (H_3PO_4)

❖ Growth Stages and Crop Management

Stage	Duration	Management Practices
Rooting	0–2 weeks	High humidity, low EC (1.0 m S/cm).
Vegetative	2–6 weeks	Maintain 14–16 h light; pinch once to promote branching.
Flower Induction	6–10 weeks	Shift to short-day (12 h); increase K in nutrient mix.
Flowering & Harvest	10–14 weeks	Maintain EC 2.0–2.2; harvest when blooms are fully open.

❖ Common Deficiencies and Remedies

Nutrient	Deficiency Symptom	Corrective Measure
N	Pale lower leaves	Add Calcium Nitrate
P	Stunted growth, dark leaves	Add KH_2PO_4
K	Marginal leaf burn	Supplement with K_2SO_4
Ca	Tip burn in young leaves	Increase $Ca(NO_3)_2$
Mg	Interveinal chlorosis	Add $MgSO_4$
Fe	Yellow new leaves	Add Fe-EDDHA chelate
B	Brittle new growth	Add Boric acid (very low dose)