

GARDEN MUMS

Chrysanthemum x morifolium



Dümmen Orange provides the brightest cultivars that require less effort for growers while providing high value with various colors. Key strategies include varieties that match growers' requirements, proper lighting, and sufficient fertilization at the correct stage. Below is a list of recommendations for growing high quality garden mums.

ROOTING

Stick unrooted cuttings as soon as they arrive into pre-moistened, well-drained media. Hold unstuck cuttings in a cooler at 35-40°F (2-4°C) for maximum of 1 to 2 days, as needed. Open and inspect all boxes immediately.

- Cuttings may be stuck directly into final containers or in plug trays
- Plant cuttings 1-1.5 inch (2.5-3.8 cm) deep and remove chlorotic lower leaves as needed
- Apply a rooting hormone spray the next morning at 150-200 ppm IBA to improve root uniformity or apply as a dip at 1000-1500 ppm.
- Water cuttings immediately after sticking

Maintain media temperature of 70-74°F (21-23°C) with bottom heat after sticking.

- Maintain air temperature between 70-85°F (21-29°C)
- If air temperature at night falls below 68°F (20°C), apply Ethephon (3.9%) at 500 ppm once roots are about 1 inch (2.5 cm) in length (approximately 10 days) to prevent premature bud set

Apply mist as needed to keep cuttings turgid and reduce frequency as roots form.

- Generally, end mist programs 10 days after stick for a 105 cell tray
- Mist duration and cycles are dependent on greenhouse environment conditions, cultivar, along with plant and root development. An environmental controller to adjust mist schedule based on weather and root development stage is recommended. Below is a guideline for a traditional mist time clock and should be adjusted accordingly:

Suggested misting schedule		
Day 1 to 3	10 sec every 10-15 mins	Apply sufficient night mist to keep cuttings turgid
Day 4 to 7	10 sec every 15-20 mins	Callus starts to form, start fertilizer application
Day 8 to 14	10 sec every 25-45 mins	Stop mist after cuttings are rooted

**Decrease mist as soon as possible to increase rooting and reduce stress*

Fertilize with 150-300 ppm nitrogen using 17-5-17 (or similar feed) every 3-4 days after callus form.

Light intensity is best at 3200-3800 fc (34400-40900 lux)

- Light shading may be required the first 1-2 weeks until root formation on extremely sunny days
- Provide long days (>16 hours) using a 4-hour night interruption from 10pm-2am at a minimum of 10-15 fc (108-161 lux) at plant height to prevent premature bud set.

Allow 14 to 21 days for rooting depending on cell size.

Avoid stretch in cell trays by planting on time. Use larger plant cells if longer rooting time is needed.

PLANT MANAGEMENT

Plant rooted cuttings of similar grade as soon possible after rooting or upon arrival for maximum plant quality

- Fill all containers and moisten the media prior to transplant. Planting into dry media will impact plant growth and quality
- Over-rooted, dried out, and crowded plugs will reduce plant quality
- Plant cuttings deep enough to cover the root ball. Deep planting is not recommended as this method can lead to disease.
- Immediately after planting, fertilize with 300-400 ppm N using 20-10-20 (or similar feed) for establishment and rapid growth

Growing media for garden mums should be loose, well-drained and support the root system. The growing media must retain sufficient moisture and nutrients to sustain the plant between irrigations and fertilizations. It should provide proper aeration to allow for air flow and drainage of excess moisture.

- Media supplements/substitutes such as bark, rice hull, and coir may require adjustment for pH and EC levels.
- Starting pH in soil-based mix should be at 6.0-6.5 and in soilless mix at 5.8-6.4

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PLANT MANAGEMENT (cont.)

Optimum temperature range at 75-84°F (24-29°C) for day and 68-75°F (20-24°C) for night

Proper irrigation is critical for successful production. Always thoroughly and evenly irrigate so that the water or feed soaks down through the pot and drains from the bottom to prevent salt buildup.

- Never allow crops to wilt during the early stages of production. Syringe watering may be needed to prevent wilting.
- Avoid having crops sit in water to prevent root rot.
- Always check containers and roots to avoid over-watering especially in hot weather.
- Drip or tube irrigation systems are highly recommended.
- Overhead irrigation can promote the development of foliar leaf-spot diseases such as Pseudomonas, Botrytis, Septoria and Alternaria. Keep foliage dry overnight.
- Water restriction during the final stages of production can prevent overgrowth, harden the plant off, and promote uniform flowering.

pH optimum range is 5.8-6.2. Periodic testing of water source, fertilizer, hormones, and plant media is recommended to maintain proper levels.

Fertilize using a complete N-P-K with trace elements fertilizer with a 2-1-2 or 3-1-1 ratio. A high level of fertilizer (300-400 ppm N) is suggested during the first 4-5 weeks of vegetative growth and adjusted as plants reach mature size. See suggested schedule below for additional details.

Plant Growth	Feed Rate (N)*	Duration	Notes
Vegetative bulking	300-400 ppm	First 4-5 wks for natural season, 2-4 weeks for West Coast natural season	Start with ammonium based nitrogen (2-4 wks) then switch to nitrate based fertilizer.
Vegetative finishing	200-250 ppm	2-3 wks for natural season, 2 weeks for shade and West Coast natural season	Irrigation frequency will increase as plant size increase, therefore less fertilizer is needed.
Flowering	100-125 ppm	2-3 weeks for natural season, 2 weeks for shade and West Coast natural season	Used to maintain foliage color and prevent overgrowth or delay in flowering.
Crop finishing and shipping	0 (clear water)	1-2 wks	When color appears, finishing with clear water can improve post-harvest shelf life.

*A constant feed program containing 100-125 ppm N with minor nutrients can be successful with a reliable injection system to deliver a balanced fertilizer at each watering.

- If multiple irrigations are needed per day, use low rates (i.e. 100-125 ppm N) for every irrigation instead of one high rate (i.e. 200-250 ppm N) and clear water.
- Bark media will require application at the higher end of this range (sometimes especially high if there is high N fixation by the bark); peat media at the lower end.
- To promote leaf expansion without added elongation, apply 1-2 applications of 300 ppm N from ammonium nitrate, potassium nitrate, calcium nitrate or 15-0-15.
- To promote overall plant sizing with elongation, apply 1-2 applications of 300 ppm N from 20-10-20 or a similar high phosphorus fertilizer.
- After application of fertilizer (as needed), return to the lower rate listed above.
- If feeding at lower rates, additional minor nutrients may need to be supplemented. Additional minor nutrients from a balanced blend should be added to the fertilizer solution to deliver about 1ppm Iron, 0.5ppm Copper, 0.25ppm Boron, and 0.1ppm Molybdenum.
- Irrigate with fertilizer immediately following a heavy rain to recharge the growing media. There is no need to dry the media before recharge.

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PLANT MANAGEMENT (cont.)

- During the flowering stage, nutrient demands are lower and fertility levels should be reduced by half.
- Constant liquid feed is recommended over the use of controlled-release fertilizer (CRF). But CRF containing trace elements can be used if constant liquid feed is not available or in conjunction with liquid feed.
- Be careful of some CRF that may release too quickly due to high media temperatures which could impact root quality.
- CRF is recommended for growers using overhead irrigation to reduce fertilizer runoff and waste.
- In general, northern growers use 3-4 or 5-6 month CRF while southern growers use 5-6 or 8-9 month CRF
- Follow label instructions and apply additional top dress as necessary.
- High application rates may be required to provide sufficient nutrition for fertilizer program with CRF only.

Containers for garden mum production will differ depending on sale time.

- Spring sales generally offer cell packs, handle baskets, and 3-6" pots.
- Summer and fall sales include 6-14 inch (15-36 cm) fiber and plastic pots, 1 and 2 gallon containers, and 6-12 inch (15-30 cm) hanging baskets.

Space plants to avoid foliar spread into adjacent pots for a rounded habit. Inadequate spacing can result in chlorotic lower foliage, lopsided growth, increase disease risk, and stretched and weak plants.

Suggested spacing recommendation		
Pot Size	Plants Per Pot	Spacing (on center)
6 in. (15 cm)	1	16-20 in. (41-51 cm)
8 in. (19 cm)	1	18-24 in. (46-61 cm)
10 in. (22 cm)	1 to 3	22-26 in. (58-66 cm)
12 in. (30 cm)	3 to 4	26-30 in. (66-76 cm)

Light intensity is best at full sun and ideally at 3200–3800 fc (34400-40900 lux) for indoor production to maintain vegetative growth. Lower light levels can result in weaker plants.

- Reduce light intensity and control heat with shading.
- Night interruption is needed during vegetative bulking to reduce premature bud set. Provide a minimum of 10-15 fc (108-161 lux) at plant height from 10 pm-2 am for photoperiodic extension.
- Short days are required for flower initiation and development.

Pinching is not necessary nor is it recommended, regardless of chosen pot size or photoperiod.

Heat delay can occur in daytime temperatures above 90°F (32°C) and in night temperatures above 77° (25°C). This is a general guideline and will differ based on cultivar and growing environment.

- Consider starting crops in the greenhouse in order to maintain ideal temperature and avoid production delay.
- In shaded production, ensure black cloth is pulled after sun is low to avoid heat buildup – evening or prior to sunrise is preferred. Use cooling pad and fan systems to enhance air circulation under black cloth.

INSECT & DISEASE

Insect and disease management starts with a proactive IPM program that includes regular scouting and proper cultural and sanitation practices. Minimize infestations with these strategies combined with biological and chemical controls to prevent outbreaks in the crop.

- Early detection with scouting or sticky cards and proper diagnosis will aide insect and disease management.
- Proper sanitation of the production systems from the previous year, such as containers, weed mats, irrigation lines and tube, is recommended to reduce common diseases found on garden mums.
- Remove crop debris and weeds around plants that can harbor pests and diseases.
- Inspect all plants upon arrival for insects or signs of disease before introducing to plant areas
- Minimize environmental conditions that favor disease development and reduce plant stress with proper care
- Destroy virus infected plants, disinfect tools used to handle them, and avoid handling healthy plants after contact with infected plants

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INSECT & DISEASE (cont.)

Potential pests include aphids, fungus gnats, shoreflies, leafminer, caterpillars, mites, thrips, and whitefly.

Potential diseases include bacterial leaf spot (*Pseudomonas*), fungal leaf spot (*Alternaria*, *Botrytis*, and *Septoria*), *Fusarium*, *Phytophthora*, *Phythium*, *Rhizoctonia*, and white rust.

HEIGHT MANAGEMENT

Height management is important for successful garden mum production.

- Short plants generally develop when plants receive inadequate long days before the start of short days, or if plants prematurely set flower buds.
- Tall plants develop when the long-day period before short days is too long, or if plants are grown crowded.
- Two rules of thumb useful for producing garden mums (These are guidelines that may not always apply to all cultivars and situations.):
 - A plant not receiving a growth regulator will elongate about 1 inch (2.5 cm) per week following the start of short days.
 - Plant height (including the height of the pot) should be about 60% of the final height at the start of short days and reproductive development.

Plant growth regulators (PGRs) can be used for height control if needed.

- See product labels for usage guidelines and test with a small-scale trial.
- PGR application after buds are pea-sized can delay flowering
- Late season PGR sprays can be used to hold crops at a desired height, but with risk of flowering delay.
- Additional applications may be needed for more vigorous cultivars depending on desired size.
- Effective application of plant growth regulators can depend on stage of the crop, growth regulator concentration, application method, weather and environmental conditions. Active and accurate record keeping to track yearly application will be helpful for planning next season's crop needs.

Suggest PGR application schedule													
Week of production	0	1	2	3	4	5	6	7	8	9	10	11	12
Stage	S	P	P	TP	V	V	R	R	R	R	R	R	SH
PGR		*		*			°						

S=stick, P=prop, TP=transplant, V=vegetative, R=reproductive, SH=ship

*PGR application for height control. °PGR application to hold crop

Suggested PGR application rate		
Active Ingredient	Chemicals Available	Rate (ppm)
0.0264% Ancymidol	Abide®, A-rest®	Spray: 15-50 Drench: 1-4
11.8% Chlormequat chloride	Citadel®, Cycocel®	Spray: 200-1500 Drench: 1000-1500
85% Daminozide	B-Nine®, Dazide®	Spray: 500-2500
0.038% Flurprimidol	Topflor®	Spray: 7-15 sensitive cultivars Spray: 15-25 tolerant cultivars
0.4% Paclobutrazol	Bonzi®, Paczol®, Piccolo®	Spray: 30-125 Drench: 2-4
0.055% Uniconazole	Concise®, Sumagic®	Spray: 2.5-10 Drench: 0.1-1

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PREMATURE BUDDING AND FLOWERING

Premature buds initiate easily and develop rapidly when plants are stressed.

- Utilize a combination of the following to discourage premature bud set:
 - Maintain night temperatures above 68°F (20°C).
 - Ensure plants are under long days. Critical daylength required to maintain vegetative growth for most cultivars is 16 hours or longer. Supplement with a minimum of 10-15 fc (108-161 lux) at plant height between 10pm-2am as needed.
 - Note: high fertility is not effective to discourage premature bud set

Early bud set is promoted in mums by low temperatures and/or short daylength.

Risk of flower initiation		
	15 hours daylength	<15 hours daylength
>65F (18C)	Low risk	Moderate risk
<64F (17C)	Moderate risk	High risk

Ethephon (Collate®, Florel®) can also be utilized to discourage reproductive growth, beginning 7-10 days after stick.

Suggest Ethephon application schedule													
Week of production	0	1	2	3	4	5	6	7	8	9	10	11	12
Stage	S	P	P	TP	V	V	R	R	R	R	R	R	SH
PGR		*	o	*	o	*	o						

S=stick, P=prop, TP=transplant, V=vegetative, R=reproductive, SH=ship

*Ethephon application suggested. °Ethephon application as needed

- Depending on the cultivar, *Ethephon* applications alone under short days and/or low temperatures may not be adequate to prevent early bud set.
- Keep *Ethephon* solution in the acidic range (pH 4.0-4.5) to prevent chemical deactivation.
- All applications should stop 2 weeks prior to pulling shade cloth or 5-6 weeks prior to ship.
- Pre-mixed blends of GA₄A₇, 6-BA (Fascination®, Fresco®) can be tank-mixed at rates of 1:100 (GA₄A₇, 6-BA to *Ethephon*) to avoid brittle plants and overly compact plant habit.

Suggest Ethephon application rate			
Temperature	Rate (ppm)	Frequency (days)	GA ₄ A ₇ , 6-BA to <i>Ethephon</i> (1:100)
>65F (18C)	500	7-10	^
55-65F (12-18C)	500-750	5-7	*
<55F (11C)	750-1000	5	*

When under short days, apply Ethephon at higher suggested rate

*GA₄A₇, 6-BA application suggested, ^GA₄A₇, 6-BA application as needed

Early season cultivars include selections from the Daybreak & Sunbeam families, naturally finishing between weeks 33-36. These cultivars provide an ideal option for non-shaded, early season production.

- Critical photoperiod for early cultivars is relatively long, meaning plants will initiate flowering under long days.
- Night interruption is required during propagation and vegetative bulking to reduce premature bud set. Provide a minimum of 10-15 fc (108-161 lux) at plant height from 10 pm-2 am for photoperiodic extension.
- Alternatively, *Ethephon* should be applied weekly to prevent early bud set.

Shading crops to shorten the daylength allows flowering times to be more closely controlled. Artificial short days are created by covering plants with a black cloth that is impermeable to light. See back cover for recommendations on producing shaded crops.

- A support structure is recommended to protect plant canopy.

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SHADED PRODUCTION

A shade production program can extend the garden mum season and provide early sales for July and August. Selecting a well-rounded assortment of colors with matching vigor ratings and timing can improve a quality shade production program. Contact us today for assistance in developing your custom shaded production program!

- Refer to the 'Shaded Response Time' column in the product tables of our catalog to identify the cultivars recommended for shaded production. NR indicates cultivars not recommended for shaded production.

Begin shading when crop height (pot plus plant) is 50-60% of desired finish size

- Cover crop every night for 4-5 weeks to initiate flowering
 - Provide 12-15 hours of continuous darkness

- Avoid heat delay when temperatures exceed 80°F (24°C) with a combination of strategies. Choose from the list of strategies below to fit your needs:

Cool at night with a pad and fan system that pulls air under the black cloth

Open the cloth to release heat after it is dark and close again before civil twilight

Close black cloth late at in the day at 7-8pm and leave until 8am

Cover before sunrise versus evening

Cover plants in the morning to extend the night

Start cooling very early in the morning

Material used should be tightly woven and allow air and rain to pass through, but not allow more than 2 fc (26 lux) of light transmission

- **A support structure is recommended to protect plant canopy**

- Plastic that is white on the outside and black towards the plants is an option if woven blackout fabric is not available

- If used outside, plastic should be avoided when there is a threat of rain to avoid damaging plants

End shading when buds are well-formed or begin to show color (typically 4-5 weeks after shading began)

