

Fall Garden Mum Production In Alabama

Introduction

Garden mums (*Dendranthema × grandiflora*) are a traditional fall-flowering greenhouse or outdoor container crop. The bright, colorful flowers provide a wide range of sales opportunities to garden centers, supermarkets, home improvement stores, and mass market outlets. However, profitable production of garden mums depends upon knowledge and control of production costs and proper cultural practices to achieve a quality product.

The term garden mum refers to *Dendranthema* cultivars that naturally flower outdoors early enough in the fall to be enjoyed well before the first heavy frost in most parts of the United States. This contrasts with pot mum cultivars which are designed to be produced in a greenhouse and flower too late outdoors to avoid the first killing frost. The terms 'Hardy' and 'Fall' Mums have also been used for garden mums. However, the outdoor hardiness of garden mum cultivars can vary by cultivar, region of the country, and from season to season.

Cultivars

Garden mum cultivars are available in a wide assortment of flower colors and forms, plant shapes and sizes, and flowering response in the fall. The basic color classifications are yellow, pink, lavender, white, bronze, red, salmon, and orange. These classifications are useful for production and marketing purposes, yet an amazing range of color tonalities and combinations can be found within each color group. Yellow is the most popular color, representing 26 percent of the market followed by pink and lavender at 22 percent, white, bronze, and red at 14 percent each, salmon at 6 percent, and orange at 4 percent. Garden mum flowers are typically smaller (1 to 3 inches in diameter) and more numerous than those on pot mum cultivars.

Garden mum cultivars may also be classified by flower form which refers to the shape, number, and arrangement of ray and disk flowers composing the flower head. The major flower forms in garden mum cultivars are:



Daisies—composed of one or two rows of outer ray flowers surrounding a tight group of short disk flowers with inconspicuous petals.

Quilled—similar to daisies except the petals are narrow at the base and flair toward the end to form a "spoon" shape.

Anemones—similar to daisies except the disk flowers have more conspicuous, elongated and tubular petals forming a cushion.

Spider—similar to the anemone except the petals of the ray and disk flowers are long and tubular.

Pompons—a globular head formed by many short ray flowers of about equal length covering the disk flowers. Small-flowered pompons are called "buttons."

Decoratives—the head is composed of many ray flowers covering the disk flowers, but the outer rows are longer than the inner rows so the flower head is flat and open.

Decorative and daisy flower forms are by far the most popular among garden mum cultivars accounting for 76 percent and 22 percent of the market, respectively. Many plant forms are also available among garden mum cultivars, from tall and upright to low, spreading mounds. Recent trends

Table 1. Fall Garden Mum Cultivars Suitable For Warm Climates.

White		Yellow		Pink	
Encore	E	Anna	M	Barbara	E
Frolic	M	Bright Tracy	M	Crown Jewel	M
Hekla	E	Cream Nicole	E	Debonair	E
Illusion	E	Dreamy Tracy	M	Emily	E
Linda	M	Donna	M	Felicia	E
Nicole	E	Golden Grace	M	Heather	M
Stephanie	E	Goldmine	M	Kimberly	L
Spotlight	M	Janice	M	Lynn	M
Tracy	M	Jessica	E	Megan	M
Bronze		Julie	L	Naomi*	M
Autumn Denise	L	Legend	E	Rhapsody	M
Dark Triumph	E	Lisa	M	Rosepink Debonair	E
Denise	L	Sunny Denise	L	Royal Lynn	M
Jennifer	E	Sunny Linda	M	Soft Lynn	E
Laurie	L	Target	E	Stargazer	M
Remarkable	L	Yellow Illusion	E	Sundoro	M
Robin	E	Yellow Nicole	E	Symphony	E
Sandy	M	Yellow Sandy	M	Valerie	E
Shelly	E	Yellow Triumph	E	Orange	
Triumph	E	Red		Glowing Lynn	M
Coral		Bravo	E	Grace	M
Blushing Emily*	E	Cherry Emily*	E	Harvest Emily	E
Christine*	E	Fiery Barbara	E	Peachy Lynn	M
Grenadine*	E	Helen	E	Viking	M
Radiant Lynn	M	Raquel	M	Warm Megan	M
Stunning Lynn	M	Red Remarkable	L		
Zesty Barbara	E				

E, M, and L = Relative early, medium or late season response.

* Flowers fade more rapidly in high temperature conditions.

Yoder Brothers, Inc., 1996

for landscape and garden application range from spherical plants used as bed fillers and accents to low mounds for edging.

Breeders are actively developing new cultivars with emphasis on plant growth habit, flower color and form, plant flexibility for improved handling, disease resistance, and flowering response in the fall (early, mid, and late season). For this reason, growers should develop a base of one to several cultivars that perform well within each color group and production season to meet customer demands. In addition, a small portion of production should be set aside to trial new cultivars for possible inclusion in the mix to maintain customer interest. Garden mum cultivars that have been shown to be suitable for production in the warm climate of the Southeast are indicated in Table 1.

Containers

Generally, a knowledge of the market is key to choosing containers. The major portion of garden mum production and marketing is in the 8- by 5-inch plastic 'mum pan'. However, many retailers and their customers can be attracted to a wider range of container sizes and styles. Alternative containers can improve product image, product offering, price points, perceived quality, sales, and profitability. These containers might include 1-, 1.5-, or 2-gallon nursery pots, 5- to 6-inch decorative pots, 10- to 12-inch specimen pots, or 4- and 4.5-inch pots. Many of the low, spreading cultivars make attractive 8- or 10-inch hanging baskets. Each container size can be selected for sale to a different market. Often small size containers are for the price conscious customer, the 8-inch mum pan is for the bulk of sales, and larger containers are for the quality conscious buyer.

Propagation

Nearly all commercial garden mum growers order either rooted or unrooted cuttings from specialized propagator/breeders. Specialized propagators maintain mother stock that is true to type, use culture-indexing to eliminate diseases, and grow and harvest large areas of stock to supply the market. Purchasing rooted cuttings from specialized propagators is probably the easiest method for most growers, especially those with no or limited propagation space. The cost per cutting may be slightly higher than unrooted cuttings and the grower may have less control over cutting quality, but the cost of facilities and risk required to root cuttings can be prohibitive. The propagation choice then becomes whether to purchase rooted cuttings shipped bare root (wrapped in moist peat moss) or cuttings rooted in cell packs or plugs.

Bare-root cuttings are a fairly perishable product that should be potted into final containers upon arrival. The fact that roots are disturbed for shipping and must re-establish in the new container means that there will be a delay before the cutting resumes growth, that is 'transplant shock'. Cuttings rooted and shipped in cell packs can be watered, fertilized, and pinched in the packs and then transplanted with little or no transplant shock. This does not exclude planting plugs according to schedule and that plugs cost more than bare root cuttings. Rooted cuttings whether bare root or in cell packs should be inspected for insects and disease upon arrival and transplanted into final containers as soon as possible. If this is not possible, bare root cuttings can be stored in a refrigerator at 33 to 40°F for several days.

Growing Media

Many different combinations of components can be used in a growing medium or substrate for producing garden mums. However, the media should be coarse, loose, and well-drained with high moisture holding and cation exchange capacities. The first decision about a growing medium is whether to purchase a commercially prepared medium or to mix your own. Commercially prepared media are generally excellent quality but may cost more than mix your own if needed in large volumes.

Mix your own substrates are generally composed of an organic, water and nutrient holding component(s) and an inert drainage promoting component(s) in close to equal proportions. The most common organic component is coarse sphagnum peat moss, though composted bark or other by-products may replace at least part of the peat.

The drainage promoting component may be perlite, sand, calcined clay, vermiculite or polystyrene beads. An example of a growing medium for garden mums is indicated in Table 2.

Table 2. Growing Medium For Garden Mums.

Component	Amount (per cubic yard)
Coarse peat moss	25%
Aged pine bark (1/16-1/2" particle size)	25%
Perlite (coarse horticultural grade)	25%
Course river sand (washed)	25%
Dolomitic limestone	5 to 10 pounds*
Superphosphate	4.5 pounds
Micronutrients (Micromax or Esmigram)	Manufacturer's recommendation
Calcium nitrate +	1 pound
Potassium nitrate	1 pound

*Amount based on soil test.

The pH of the medium should be adjusted to 5.7 to 6.2 using dolomitic limestone which also supplies calcium and magnesium. The amount of dolomitic limestone to add depends on the pH of the initial components and should be determined by soil testing. However, a good starting point is 5 to 10 pounds per cubic yard. Phosphorus is often supplied in the mix using superphosphate at 4.5 pounds per cubic yard and a micronutrient fertilizer is also added according to the manufacturers directions. Many growers add an initial macronutrient charge to the medium at the time of mixing. This often consists of 1 pound per cubic yard each of calcium nitrate and potassium nitrate.

Planting

Rooted cuttings should be graded by size so that individual pots receive the same size cuttings. Unequal cutting size in the same pot inevitably results in an uneven, poor quality product. This can be compensated for only to a limited extent by pinching. Cuttings of each cultivar may be graded into:

- short—thin stem diameter and not well rooted
- average—medium stem diameter and fairly well rooted
- tall—thick stem diameter and well rooted.

Cuttings should be planted shallow with roots just covered by substrate. They should be planted in a moist substrate and watered twice soon after planting. The first watering should be clear water followed by a complete N-P-K fertilizer solution at a rate of 200 to 250 ppm nitrogen. The cutting may require mist or syring four to five times per day

in the first few days after potting. Do not allow the cuttings to wilt or plant quality may be adversely affected. Planting rooted cuttings generally occurs around the end of May in the Southeast (Table 3).

Table 3. Example Garden Mum Production Schedule For Fall Finishing.

Date	Two-pinch Schedule
May 20	Pot-rooted cuttings
June 3	First pinch
June 17	Second pinch
July 1	B-Nine application
July 15	B-Nine application*
July 29	B-Nine application*
Mid-September to mid-October	Flowering

* Additional applications only as needed.

Growing Area And Spacing

Many growers produce fall garden mums in prepared outdoor growing areas, though many are produced in greenhouses. An outdoor growing area should be in full sun and have easy access for production work and shipping. The area should be as level as possible and be covered with black plastic or gravel to control weeds. Garden mums require a lot of water, therefore an abundant, dependable, high quality water supply should be close by. Avoid an area with night lighting from street lights, security lights, or a busy street with frequent automobile lights. Artificial lighting during the night period can delay flowering.

Pots should be spaced in straight rows that allow ample room for growth. The amount of space is determined by the pot size as follows: space 6-inch pots 12 to 15 inches apart, space 8-inch pots 18 to 24 inches apart, or space 10-inch pots 24 to 30 inches apart. Rows of plants grouped together should not exceed 10 to 12 feet across with a 3 to 4-foot aisle on either side. This provides enough room to drag hoses and water without needing to reach more than 5 or 6 feet to reach the furthest pot.

Irrigation

Garden mums require plentiful amounts of water and delivering adequate water during the summer is not a simple task. Irrigation frequency is affected by characteristics of the growing media, container size, stage of growth, and the environment. Because garden mums are often grown outdoors, the weather can play a large part in irrigation timing. Rain reduces the need for irrigation, while hot, dry weather can greatly increase irrigation frequency. The media should be moist, or allowed to dry only slightly between waterings.

Enough water should be applied at each irrigation to completely saturate the medium plus 10 to 15 percent leachate. This leaching prevents soluble salts buildup in the substrate.

Garden mums should not be allowed to wilt. Water stress will greatly reduce plant growth and can cause yellowing of lower leaves or even death on bright summer days. In the middle of the summer, the water demand of mums may require multiple waterings per day. This makes hand watering impractical. Few garden mum growers depend entirely on manual irrigation with a hose. Manual watering cannot provide the degree of control over soil moisture required for quality mum culture and the cost in time and labor is high. Most garden mum growers have the crop on some form of automatic watering system when placed at final spacing outdoors. Overhead sprinkler-type watering systems have not proven satisfactory because they waste a lot of water, provide poor watering uniformity especially on windy days, and keep the foliage wet for extended periods.

Microtube systems are widely used for garden mums and provide the greatest uniformity with the least waste of water. It is important that installation of a microtube system be 'designed' for the area in which it will be used, preferably by those experienced in microtube system design. Uniformity and water application rate can be checked by collecting water from several tubes in different locations on the same station for a known period of time. Measuring the amount of water collected in each container can be used to determine the time required to deliver a specific amount of water to plants.

Fertilization

Garden mums require large quantities of fertilizer during the vegetative stage of production, especially nitrogen and potassium. It is vital that plants be supplied ample nutrition beginning the day of potting. However, as flowers begin to open, fertilization should be reduced to very low levels and may be discontinued if levels have been adequate during production. This is because much of the growth of the plant is completed by the time flowers begin to open so the plant requires less fertilizer. In addition, the keep quality of garden mums in the retail setting is improved by reducing soluble salts levels in the medium before shipping.

Most garden mum growers deliver a water soluble fertilizer to the crop using a fertilizer injector. These devices inject a small amount of concentrated liquid solution into the water line so that plants receive fertilizer every time they require water. It is

important to fertilize with enough solution to completely saturate the medium plus 10 to 15 percent leachate. Damaging amounts of fertilizer can buildup if the medium is not fertilized thoroughly.

Apply 200 to 250 parts per million (ppm) nitrogen with a fertilizer injector at each watering using a complete N-P-K fertilizer such as 20-10-20 or 15-15-15. Choose a fertilizer that has between 60 and 75 percent of the total nitrogen in the nitrate form. Many growers will alternate between 20-10-20 and a fertilizer containing calcium and magnesium such as 15-5-15 Cal-Mag. The fertilizer rate can be reduced to about 125-150 ppm nitrogen when flower buds begin to show color. Although these rates are for a constant fertilization program, liquid fertilizer can be applied at weekly intervals when constant fertilization is inconvenient or labor intensive. For weekly application, use 400 to 500 ppm nitrogen.

Benefits have been observed in garden mums when liquid fertilization is combined with a controlled-release fertilizer. Osmocote 14-14-14 or 19-6-12 slowly releases fertilizer over a period of 2½ to 3 months and can be either mixed with the medium before potting or added as a top dressing after potting. Experience has shown that application is often more beneficial when applied to the media surface. Keep in mind that once a controlled-release fertilizer has been added to the medium, it cannot be removed and the grower has little control over fertilizer availability. Therefore, follow the manufacturers recommendation rate for soil mixing or as a top dress. Liquid fertilization rates should be reduced when used in combination with controlled-release fertilizers.

Growers should manage the fertility program for garden mums by performing a soil test and tissue analysis at least once a month. Floral crop soil tests provide medium pH, soluble salts, and levels of macro and micro nutrients. The soluble salts for garden mums should be 1.5 to 2.0 mmhos/cm (2:1 extraction) but should not exceed 2.5. Low readings often mean not enough fertilizer is being applied, application is too infrequent, or a combination of both. High readings may mean too much fertilizer is being applied, application is too frequent, not enough water is applied to wet the medium and obtain drainage, drainage is poor, or a combination of these conditions exists. Tissue analysis provides information about what nutrients are being absorbed by the roots and transported to the foliage. Guidelines for tissue analysis values can be found in Table 4.

Table 4. Foliar Analysis Guidelines For Garden Mums.

(Dry Weight Basis)			
Nutrient	Concentration	Nutrient	Concentration
N (%)	4.00-6.50	B (ppm)	25-100
P (%)	0.25-1.00	Cu (ppm)	5-50
K (%)	3.50-6.50	Fe (ppm)	50-300
Ca (%)	0.50-2.00	Mn (ppm)	30-350
Mg (%)	0.30-0.60	Zn (ppm)	15-50

Source: *Plant Analysis Handbook*, Georgia, 1988.

Pinching

Pinching is an artificial way of forcing plants to branch. The timing of the first pinch on garden mums should be coordinated with growth of the roots and shoot. Before pinching, the plant should have a root system that has reached the bottom and sides of the pot and there should be 1 to 1½ inches of new growth on the cuttings. This generally occurs 12 to 14 days after planting. A soft pinch is used, removing about ½ inch of the stem tip, and allowing 6 to 8 nodes to remain on the cutting. Hard pinches are not desirable because it reduces the number of breaks.

A second or third pinch may be required on some cultivars. These can be applied after 3 to 4 inches of new growth has developed from the previous pinch, again removing ½-inch of growth. Some of the more recent cultivars are heavily self-branching and may not require additional pinches. Regardless, the last pinch should be completed between July 10 and July 25. Late pinches can delay flowering. See Table 3 for a typical pinching schedule.

Garden mum cuttings can, at times, set flower buds prematurely under low temperatures, stress from under watering, low fertilizer levels, late application of the first pinch, or inadvertent exposure to the incorrect photoperiod. Fortunately, they can be developed into quality plants by pinching back further to remove visible buds and unseen developing buds. Cultural practices should also be altered to keep the plant actively growing with plenty of water, fertilizer, light, and space to grow.

Plant Growth Regulators

Plant growth rate and final height varies among garden mum cultivars. Some growth regulation is beneficial to most cultivars, but is essential for those cultivars that grow too tall for a quality product. A plant growth regulator can be applied after the final pinch when 1 to 2 inches of new growth has occurred. This will reduce final plant height, intensify dark green color of the foliage, and result in a more rounded, uniform product. The most commonly used growth regulator for garden mums is B-Nine. It is applied as a foliar spray at 2500 ppm about 2 weeks after the last pinch. Additional application at the same rate can be used if plants begin to stretch, but should not be applied after flower buds are visible. Late application can reduce flower size. See Table 3 for a typical growth regulator schedule.

Flowering

Garden mums respond to photoperiod or the length of the day (more correctly, the length of the night) to produce flower buds. They are facultative short-day plants which means that they will eventually flower under any day length but flower much faster when the day length is shorter than the night length. The critical day length for the majority of garden mum cultivars is between 13.5 and 14.5 hours. This means that some cultivars initiate flowers earlier in the season while others initiate flowers later.

Garden mum cultivars can be classified by response groups. This refers to the amount of time between the beginning of short-day conditions and flowering. Most garden mum cultivars have a response time between 6 and 9 weeks. Response group and critical day length interact to determine when a given cultivar will flower. Response time information is only useful under conditions where temperature and photoperiod are carefully controlled such as in a greenhouse. Under outdoor conditions cultivars can be better classified into early, mid and late-season bloomers based on when they initiate flowers and how long they take to flower.

Unfortunately, temperature can modify the photoperiodic response for flowering in garden mums. The critical day length decreases as the night temperature increases above about 72 to 74°F. This means that flower initiation can be delayed when night temperatures are warm at the beginning of short-day conditions and flowering will generally be later in the season. This discussion helps explain why the same garden mum cultivar may bloom later or earlier from one year to the next.

Scheduling

A generalized production schedule for fall production of garden mums is provided in Table 3. This is a basis for planning a schedule, but variations can occur due to cultivar response group, final plant size desired, cultural practices and environmental factors.

Final plant size and container size desired for the market will influence scheduling. Generally, smaller plants in smaller containers require a shorter production schedule (cuttings planted later) and larger plants grown in larger containers require a longer production schedule (cuttings planted earlier). In addition, 10 to 14 days should be added to a schedule if production starts with unrooted cuttings to allow for propagation time.

The number and timing of pinches can also influence production timing. Generally, more pinches will increase production time. The timing of the last pinch is especially critical. Delaying the last pinch will delay flowering, but this response varies by cultivar. Application of the growth retardant, B-Nine, can also delay flowering. The amount of delay depends upon the cultivar, concentration and timing of applications. Late applications, especially after flower initiation can cause significant delay.

When all the factors that may influence garden mum scheduling are considered together, it makes sense for the grower to establish a system of record keeping on the performance of cultivars and cultural practices as an aid to fine tuning future production. This might consist of a notebook with a page for each cultivar, container size, and potting date. Dates would be recorded for all of the major production steps including when the plants were ready for market. Information accumulated over several years can then be used to more precisely plan next year's crops.

Diseases

The primary diseases of garden mums are bacterial leaf spot, septoria leaf spot, *Pythium*, and *Botrytis*.

Bacterial Leaf Spot

Bacterial leaf spot (*Pseudomonas cichorii*) is favored by moisture on the leaves, high humidity, high temperature, and growing susceptible cultivars. Symptoms include dark-brown to black lesions covering half of the leaf. The disease typically begins on lower leaves and spreads upward, often on one side of the plant.

Septoria Leaf Spot

Septoria leaf spot (*Septoria chrysanthemella*) causes small yellow spots on the foliage that later turn dark brown or black. In advanced stages, the leaves may turn completely yellow and fall off or remain attached to the stem. The disease is spread by splashing water, so overhead watering should be avoided.

Pythium

Pythium is a root rot disease that is present in most media. The disease causes browning and death of the roots accompanied by wilting of the foliage, especially during the day. Avoid conditions which stress the plant and damage the root system such as over watering, high soluble salts, or cool medium temperature.

Botrytis

Botrytis can infect leaves and flowers under high humidity conditions. Avoid overhead watering and space plants far enough apart for good air circulation.

Pests

The primary pests of garden mums are aphids, leaf miners, spider mites, thrips, and caterpillars.

Aphids

Green peach aphids, melon aphids, and chrysanthemum aphids are common pests of garden mums. Aphids feed on young terminal growth and flower buds prior to opening using piercing-sucking mouthparts causing plant stunting, wilting, leaf yellowing, and leaf curl. A by-product of feeding is a sticky honeydew that serves as a medium for black sooty mold.

Leaf Miners

Chrysanthemum and serpentine leaf miners are the common leaf miner species that infest garden mums. Adult females puncture the leaf surface and lay eggs inside the leaf. The eggs hatch into larvae that tunnel between the upper and lower leaf surfaces causing white, twisting mines that disfigure the leaves and reduce marketability.

Spider Mites

The two-spotted spider mite is the most common mite species that infest garden mums. Spider mites feed on the underside of leaves by sucking plant sap. Damage appears as tiny yellow speckles on the upper leaf surface. Severe mite damage can cause leaf drop. Mites are favored by dry warm conditions.

Thrips

The common flower thrip and western flower thrip are the two most common thrips infesting garden mums. Thrips feed on young leaves and flowers using rasping-sucking mouthparts. Feeding on leaves causes a silvery-appearance while damage to flowers causes deformed flower buds, bud abortion, or streaking of petals.

Caterpillars

A number of caterpillars are pests on garden mums including beet armyworm, cabbage looper, fall armyworm, corn earworm, and European corn borer. Caterpillars can feed on almost all of the aboveground portions of the plant including leaves, stems, and flowers. Adult female moths lay eggs on plant parts which emerge as larvae to begin feeding. Adults generally migrate to garden mums when they are placed outdoors.

Specific control measures for insect and disease problems on garden mums can be found in the Extension Circular ANR-500A, *Alabama Pest Management Handbook—Volume 1*, and Extension Circular ANR-500B, *Alabama Pest Management Handbook—Volume 2* or contact your county Extension agent.

Costs Of Production

A knowledge of the costs involved in garden mum production is essential for making decisions on the optimum number of plants to produce and how to establish prices. Costs of production can be classified as either variable or fixed. Variable costs are incurred directly during the production of the crop including pots, plants, medium, and chemicals. These items are usually easy to allocate to a specific crop. Fixed costs are incurred whether or not the crop is produced including salaries, depreciation, insurance, and taxes. These items may be more difficult to allocate to a specific crop. Because garden mums are often produced outdoors, fixed costs may be allocated as a percentage based on actual use of a piece of equipment or as a percent of sales.

Despite the best production practices, a certain percent of the crop will not be marketable. The cost of inputs for unmarketable plants should be taken into account. This is often done by adjusting the variable costs using a shrinkage factor. Adding the total variable costs adjusted for shrinkage and the total fixed cost provides a total cost of production. Profitability of the crop is then related to the price received.

Additional References

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This publication was prepared by **J. R. Kessler, Jr.**, *Extension Horticulturist*, Assistant Professor, Horticulture, Auburn University.

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