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ALABAMA A&M AND AUBURN UNIVERSITIES

Greenhouse Production of Poinsettias

Introduction

Poinsettias are synonymous with celebration of the Christian holiday of Christmas. However, the product is used as early as the Thanksgiving season. In greenhouse production, Poinsettias dominate production and marketing efforts of wholesale business during the fall and early winter season in Alabama and across the nation. According to the USDA Floriculture Crops, 2000 Summary, Poinsettia wholesale value was $237,328,000 in the United States. In Alabama, the total wholesale value of floriculture crops was $74,356,000 in 2000. Of that total, Poinsettias were valued at $4,587,000 or approximately 6 percent of total production.

The Flower

Actually, the conspicuous part of the flower is not the flower, but modified leaves called bracts. The actual flowers are located in the center at the base of the bracts. The flower form is known as Cyathium and occurs in separate male and female flowers. One standard way to tell when Poinsettias are ready to ship is when the Cyathia open and the stamens or styles protrude from the flowers.

Cultivars

The number of cultivars available to growers has increased dramatically in the past 10 years. Growers may view the expanded cultivar selection as a blessing or a curse. The increased number of available cultivars allows growers to have more flexibility in crop scheduling, grow cultivars more suited to their particular environmental conditions, and offer customers a greater variety selection; however, deciding which cultivars to grow can be daunting. Growers need to consider several things when making cultivar selections. Approximately 80 percent of the cultivars sold annually are red flowered followed by pink, white, and peach. While each cultivar's visual characteristics (i.e., bract and leaf color and shape) are very important, other cultivar specific traits should also be considered.

Poinsettia cultivars are classified in a response group, that is, the number of weeks from the start of short days to a salable plant. Often these response times are further classified into three general groups: early, mid-, and late-season cultivars. Thus, by selecting cultivars from each response group, growers can have Poinsettias available in peak condition throughout the sale season (early to mid-November through Christmas). Some growers, however, prefer to limit the number of cultivars grown. Producers growing a limited number of cultivars may need to force plants into flower earlier by simulating short days or later by using night-break lighting to have plants ready throughout the market season.

Desired finished plant size can also have an effect on cultivar selection. Many mass merchandisers want small, compact plants, while florists may want more traditionally proportioned plants, and institutions such as churches may prefer tall plants. In addition, growers may want to utilize less vigorous cultivars in small containers and more vigorous cultivars in large containers. While plant size

can be controlled using plant growth retardants and cultural practices, matching cultivar vigor with desired finished size can reduce grower inputs.

Many growers also select cultivars based on the perceived sturdiness of those cultivars and freedom from stem breakage during handling. Very little information is available concerning which cultivars are more durable, especially because an interaction exists between cultural practices and qualities inherent to each cultivar. In general, cultivars with wider branching angles are more susceptible to stem breakage.

Growers may need some variety in their cultivar mix. In addition to the previously mentioned flower colors, growers may choose from marble colors, multitoned flecked colors, burgundy colors, rose and ruffled shaped flowers, and other flower variations that have been developed from the basic Poinsettia bract. Also, in warmer areas of the country, a place may be found in the bedding plant market for Poinsettia cultivars that feature different types of variegated foliage.

Propagation Alternatives

Growers may start a Poinsettia crop in four ways: 1) order cuttings to grow stock plants from which cuttings are taken for production, 2) order unrooted cuttings to root in house for production, 3) order rooted cuttings that are transplanted to the finishing containers, or 4) order prefinished plants already established in the final container. Regardless of the method chosen, it is essential to order the highest quality propagation material that is certified free of diseases. The choice among these alternatives is largely based on economics and available greenhouse facilities. Few growers in Alabama grow their own stock plants because they occupy a lot of greenhouse space for a long period of time, are difficult to keep pest free, and require a lot of production inputs. Therefore, this publication will not discuss the culture of that option.

Propagation of Unrooted Cuttings

Sanitation is probably one of the most important aspects of Poinsettia propagation. All surfaces should be disinfected before cuttings are stuck, including floors, benches, and intermittent-mist equipment. All weeds should be removed from the propagation area because they may host many insects, including whiteflies, fungus gnats, and spider mites. All employees handling cuttings should wash their hands with soap and water, then rinse with a disinfectant before and after handling cuttings. If the lower leaves on cuttings begin to yellow and abscise during propagation, clean them up promptly.

The rooting potential of Poinsettia cuttings in propagation is influenced by the age of the shoots on the stock plants from which cuttings are taken, the size of the cuttings, environmental conditions during propagation, and cultivar rooting potential. Good quality unrooted cuttings should be 2½ to 3 inches long with two fully expanded leaves if direct-stuck in the final container or one fully expanded leaf if stuck in high density cubes or strips plus a third leaf not yet fully expanded. The stem diameter should be about the thickness of a pencil. Cuttings that are older or larger are more woody and may be more difficult to root. On the other hand, smaller, thinner cuttings may also be difficult to root and may be lost to environmental stress or diseases. Thin cuttings have also been found to increase the incidence of stem breakage at the end of the crop. Cuttings should have green leaves (no yellowing), an active growing point, and be free of insects and diseases. If variation in cutting size exists, grade the cuttings by size and stick the different sizes in separate propagation containers.

Unrooted cuttings are usually received from mid-July to August, a time of year when care must be taken to control moisture stress. Cuttings should never wilt! Therefore, be prepared to stick unrooted cuttings as soon as possible after receiving them. Alternatively, cuttings can be stored in a cooler at 45°F for up to three days. Some growers apply a rooting hormone while others do not. If used, apply 1,500 to 2,000 parts per million (ppm) IBA or NAA either as a talc formulation or in an aqueous solution. Apply only to the cut base of the stem. Do not dip the base of the cutting in the solution or talc because this may spread diseases. An aqueous solution can be applied to the base of the cuttings with a mist bottle, and talc can be applied with a puff duster. Cuttings should be stuck in the rooting medium so that leaves do not cover the shoot tip of adjacent cuttings. Stick the cutting no deeper than ¾ to 1 inch. Some growers apply a surfactant as a foliar spray after sticking the cuttings to encourage mist water to spread uniformly over the leaf surface. Follow the manufacturer's recommendations for rate and application frequency.

Media used for rooting Poinsettia cuttings may be trays filled with peat lite medium, Jiffy 7's, Jiffy 9's, peat blocks, Oasis, or Root-Cubes. Cuttings also may be stuck directly in the final container. Thoroughly water the rooting media well in advance of sticking the cuttings. The propagation temperature should be 72 to 75°F at night and 80 to 85°F during the day. Light levels should start at 1,200 to 1,500 foot-candles and be increased to 2,500 to 3,000 foot-candles during propagation. Too much light will promote wilting and cause bleaching of the leaves.

Excessive mist also will be required. Too little light will slow rooting and cause the cuttings to stretch. Shading of the propagation area will be needed at this time of year, preferably adjustable shading.

The mist system should deliver a very fine mist capable of uniform coverage of all cuttings. The mist frequency is dictated by environmental conditions and should be monitored hourly in the first 8 to 10 days. A mist controller that can adjust mist frequency based on ambient light levels in the greenhouse is helpful. The mist frequency should be enough to keep stems turgid, although the leaves may sag for the first few days. Do not apply so much mist as to leach nutrients from the leaves, wet the media, and increase the chance of disease problems. It is preferable to increase the amount of shade on the greenhouse than to apply too much mist. Too little mist, on the other hand, will cause leaf wilting to the point of curling and delay rooting. A suggested frequency is 12 seconds on every 4 to 6 minutes for the first 3 to 4 days. During hot weather, many growers apply mist at night once per hour for the first 3 days. Some air movement in the propagation house is beneficial as long as it does not interfere with the mist coverage. After about 8 to 10 days, callus should form at the base of the cuttings and mist frequency can be reduced to every 8 to 10 minutes. By 14 to 18 days, roots should be present and the mist can be reduced to every 30 minutes.

Fertilization of the cuttings can begin at the time cuttings callus using 125 ppm nitrogen from a balanced fertilizer. This is applied once a day after the mist is turned off in the evening. Rinse the foliage after fertilization with clear water to prevent crystallization of fertilizer on the petioles. Fertilizer rate can be increased to 150 ppm nitrogen when roots appear and gradually increased to 200 ppm nitrogen just before potting. Keep in mind, however, that high fertility in high density cubes or strips can cause more rapid stretching than can be controlled using growth retardants.

Many growers begin applying growth retardant to cuttings while in propagation, often beginning 10 to 12 days after sticking. Cycocel at 1,000 ppm plus B-Nine at 1,250 ppm is used and may be reapplied after 5 to 7 days as needed. These applications are made after the mist is turned off in the evening. It is important to prevent the rooted cuttings from stretching in propagation by applying growth retardant and increasing light levels. Cuttings are usually ready to transplant in 3 to 4 weeks after sticking.

Potting

Whether the cuttings are rooted in-house or are ordered from a supplier, it is vital for the grower to be prepared to pot the cuttings immediately by having pots, potting media, labels, and any necessary chemicals on hand. The greenhouse should be prepared to receive the plants by performing clean-up and sanitation tasks and adding overhead shade beforehand.

If the rooted cuttings are purchased from a supplier, examine them carefully for quality and freedom from insects and foliage and root diseases as soon as they arrive (this is just as important for purchased unrooted cuttings and prefinished plants). The cuttings should be compact and adequately fertilized, but not stretched or showing symptoms of excessive application of growth retardant. The roots should be white in color and adequately fill the propagation media without being root-bound (excessive roots). Poorly rooted, stretched, or damaged cuttings or cuttings with disease or insect problems can be very difficult to grow into a quality finished product. It is best to plant the cuttings in their final containers upon receipt. If this is not possible, place them in a greenhouse under 50 percent shade, and keep them well watered. Do not wait more than a few days before planting, and do not stress the cuttings.

Largely, the choice of container sizes for Poinsettias is determined by the market. By far the most popular container size is the 6-inch pot, though Poinsettias are commonly grown in pot sizes ranging from 4 to 10 inches. Four- to 6-inch pots are usually planted with one rooted cutting per pot that is pinched. Larger pots may be planted with more than one cutting per pot: typically, two cuttings per 7½-inch pot, three cuttings per 8½-inch pot, and four cuttings per 10-inch pot or hanging basket. Special hanging baskets with side pockets are available for Poinsettias, and stock plants may be forced for large specimen plants. Special schedules and techniques are also used to grow Poinsettia trees.

When transplanting rooted Poinsettia cuttings to final containers, always make sure the potting medium is moist and plant shallow–no more than one-fourth inch deeper than in propagation. Deep planting can cause poor root development and increase the potential for disease. If the cuttings were rooted in artificial cubes or blocks, do not plant too high or the propagation material will act as a wick and dry the roots. Newly potted cuttings should be watered immediately, preferably with a broad-spectrum fungicide. If not, fungicide should be applied in the first 1 to 3 days after potting. The cutting should be misted or syringed by hand sev-

eral times a day under warm conditions until root growth begins. Many growers use 50 percent shade (3,000 footcandles) on newly potted cuttings to reduce the greenhouse temperature. However, the shade should not be used for longer than 7 days, or weak stems will develop. Some growers apply a pre-pinch growth retardant to transplanted cuttings if they are growing rapidly to keep the cuttings compact. B-Nine at 1,250 ppm plus Cycocel at 800 ppm works well. Begin scouting for insects and disease early, and be prepared to take action. These problems are easier to control early, before the plant canopies become dense.

Potting Media

Potting media for growing Poinsettias should be course and exceptionally well drained. The pH should be 5.8 to 6.5. Poinsettias have higher requirements for calcium and magnesium than many crops. Therefore, add dolomitic limestone (at least 10 percent magnesium) at a rate of 8 to 10 pounds per cubic yard of potting mix. Superphosphate is usually added at a rate of 4.5 pounds per cubic yard. Epsom salts is added at a rate of 0.25 pound per cubic yard and micronutrients, at the rate recommended by the manufacturer. A starter supply of nitrogen and potassium is also added as calcium nitrate and potassium nitrate each at 0.5 to 1.0 pound per cubic yard.

Water

A dependable source of high quality water is an important consideration in growing Poinsettias. The alkalinity of the water should not be so high as to drive the pH of the media above 6.5, or micronutrient deficiencies can occur. Total soluble salts and the presence of nutrients or toxins in the water supply should also be known.

Poinsettias should be grown on a definite wet, then dry cycle but should never be allowed to wilt. If the roots are few in number and thin, it is an indication of overwatering. If root hairs are curled or damaged, it is an indication of underwatering, high soluble salts, or damage by other chemicals.

Poinsettias can be watered overhead during early stages of production, but moisture on the bracts is highly undesirable. Therefore, crops should be placed on an automatic watering system at or soon after spacing. Subirrigation is effective for Poinsettias.

Fertilization

Poinsettias are generally heavy feeders, especially during vegetative growth in early production. Fertilization should begin as soon after potting as possible. Fertility programs vary widely and may include liquid fertilization or liquid fertilization in combination with controlled-release fertilizers. However, success depends on raising the initial fertility quickly, then reducing fertility toward the end of the crop.

Some growers make one application of liquid fertilizer at 300 to 400 ppm nitrogen using a high calcium fertilizer after the initial application of a fungicide. Whether or not to use this initial high rate depends on how much starter fertilizer was added to the potting medium. Thereafter, apply 200 to 250 ppm nitrogen on a constant liquid fertilization basis. Many growers alternate between a 20-10-20 formulation and 15-0-15 or calcium nitrate plus potassium nitrate to supply the extra calcium needed by Poinsettias. Additional magnesium is needed by Poinsettias and may be supplied by applying Epsom salts (magnesium sulfate) at 1 to 2 pounds per 100 gallons once a month. Epsom salts should not be mixed with other fertilizers. Poinsettias appear to have a higher than normal requirement for molybdenum. Add 0.1 ppm molybdenum to the constant liquid fertilizer program. Prepare the molybdenum as follows: 1) stock solution–mix 1 ounce ammonium or sodium molybdate in 40 fluid ounces of water, and 2) apply 0.15 fluid ounce of stock solution per 100 gallons of water.

It is important that pH and soluble salts of each crop be tested and charted at least every 2 weeks. Procedure for the PourThru method of in-house soluble salts and pH testing can be found on the North Carolina State Web page at **www.ces.ncsu.edu/depts/hort/floriculture/crop/crop_PTS.htm.** Soil tests should be sent to a commercial or university laboratory about once a month. Table 1 shows potting media analysis standard ranges. Table 2 shows tissue analysis standard ranges for Poinsettias.

Table 1. Poinsettia Potting Media Analysis Standard Ranges

Value	Fresh Media	During Production
pH	5.0-6.5	5.8-6.5
EC (mmhos/cm*)	1.0-3.0	1.25-2.5
Nitrate (ppm)	50-300	100-200
Ammonium (ppm)	5-30	<20
Phosphorus (ppm)	10-100	5-50
Potassium (ppm)	50-300	100-200
Calcium (ppm)	100-300	100-200
Magnesium (ppm)	50-150	30-70
K:Ca:Mg	–	2: 2-3: 1

*Saturated paste extract method.

Table 2. Tissue Analysis Levels for Poinsettias

Element	Critical	Normal	Toxic
Nitrogen	3.0-3.5 %	4.0-6.0 %	7.3 %
Phosphorus	0.15 %	0.3-0.6 %	0.9 %
Potassium	1.0 %	1.5-3.5 %	4.0 %
Calcium	0.5 %	1.0-1.75 %	–
Magnesium	0.2 %	0.3-1.0 %	–
Sulfur	0.1 %	0.1-0.3 %	–
Sodium	–	0-0.4 %	0.5 %
Chloride	–	0-1.5 %	3.0 %
Copper	1 ppm	2-10 ppm	–
Zinc	20 ppm	25-60 ppm	–
Manganese	40 ppm	60-300 ppm	650 ppm
Iron	50 ppm	100-300 ppm	–
Boron	15 ppm	25-75 ppm	100 ppm
Molybdenum	0.5 ppm	1-5 ppm	–

Generally, it is desirable to reduce fertilization toward the end of the crop because temperature and light intensity are decreasing in November and December, and the fertilizer needs of the plants decrease as flowers develop. Once the crop has initiated flowers and begins to show bract color, eliminate all ammonium sources of fertilizer (no later than October 15) and use only nitrate nitrogen fertilizer. Reduce the rate of fertilizer to 50 to 100 ppm nitrogen 2 to 3 weeks before full bract color. Do not eliminate fertilizer altogether in this period, or lower leaves may yellow before shipping. Shelf life of Poinsettias is increased if the media soluble salts are low at shipping time. Therefore, leach the pots just before shipping with clear water. Additional information about fertilizing Poinsettias can be found in Extension publication ANR-1221, "Fertilizing Greenhouse Crops in Alabama."

Pinching

Pinching is the removal of the terminal growing point to stimulate the growth of branches (lateral shoots). Pinch Poinsettias by removing the growing point plus one immature leaf. The topmost one or two immature leaves should also be removed by pinching the leaf blade from the petiole to get more uniform branch development. Manual misting and 50 percent shade (3,000 footcandles) after the pinch helps stimulate branch growth and reduces greenhouse temperature. The shade should not be used for longer than 7 days, however, or weak branches will develop.

Specifications may be set by the grower or by the market to have a certain number of flowers per pot. This can be controlled by how many nodes (or leaves) are left on the rooted cutting after the pinch. If a 6-inch pot should have 5 to 6 flowers at maturity, leave 7 to 8 nodes on the cutting after the pinch. Usually, the lower 1 to 2 nodes will not develop branches sufficiently to contribute flowers. Leaving more than 7 to 8 nodes on cuttings results in too many branches and stem breakage when plants are shipped. It is very important to pinch according to schedule and on time. However, be sure that plants have developed roots to the outside of the potting media. Insufficient root development causes branches to grow slowly or develop erratically and may reduce the overall number of branches. Plants in larger containers and less vigorous cultivars will require longer to develop sufficient roots than more vigorous cultivars and those in smaller containers.

Spacing

Poinsettias are often maintained pot-to-pot on benches for 5 to 6 weeks after potting for easy maintenance and application of pesticides and to make the pinching task easier. Do not space plants too soon. Plants that are pinched and spaced in one operation often develop horizontal branches that may break during shipping. However, the crop should be placed at the final spacing before plants begin to crowd. This increases light interception by the plants and decreases growth retardant needs. Spacing distances for a range of container sizes are in Table 3.

Table 3. Final Plant Spacing for Pinched Poinsettias

Pot size (inches)	Cuttings/ Pot	Spacing (inches)	Sq.Ft. /Pot
8	3	19 x 19	2.5
7	2	17 x 17	2.0
6	2	15 x 15	1.5
6	1	14 x 14	1.3
5	1	12 x 12	1.0
4	1	8 x 9	0.5

Environment

Temperature

The rate of vegetative growth in Poinsettias is primarily influenced by the average daily temperature (average of the day and night temperature, ADT). The base ADT for leaf unfolding is 41 to 48°F (essentially no growth). Leaf unfolding rate increases as ADT increases above the base to a maximum of one leaf every 4 to 5 days at an ADT of 76 to 77°F. The leaf unfolding rate above 77°F ADT decreases until plant death occurs at about 95°F ADT. Temperature can thus be used to control the leaf-unfolding rate. During the vegetative stage of growth, night temperatures should be 68 to 70°F and below 85°F during the day. These target tem-

peratures are often difficult to achieve in Alabama without the use of evaporative cooling systems.

Night temperature should be 68°F at the time of floral initiation—above 70°F delays flowering. Warm night temperatures during late September in Alabama often occur, and cultivars may flower later than in cooler parts of the United States. Therefore, it is important to do all that is necessary to reduce the night temperature below 70°F during floral initiation. For maximum bract size, maintain 68°F until bracts cover the foliage and color starts to appear. It is desirable at this point to reduce the night temperature by 2 to 3°F per day to 62°F night temperature to improve bract coloration and prevent premature Cyathium abscission. The day temperature can also be gradually reduced to 75°F during this period. Leach the pots with clear water and apply a fungicide before reducing the temperatures.

The difference in day and night temperatures (DIF) can be used as an effective tool to control Poinsettia height. It is most effective when internodes are rapidly elongating during the first 3 to 4 weeks after the pinch. A negative DIF can be used to make plants more compact. An early morning dip or rise (±6°F) in temperature can also be used to increase or decrease height. However, the practice of DIF is difficult to apply in Alabama.

Light Intensity

Poinsettias should be grown where they receive maximum light intensity (5,000 to 6,000 footcandles) as long as greenhouse temperatures can be controlled. A 50 percent shade is usually necessary to control temperature early in the crop as cuttings are establishing, often until October 1.

Photoperiod

The Poinsettia is a qualitative short-day plant for floral initiation with a critical photoperiod of 11¾ to 12½ hours (depending on the cultivar) when the night temperature is less than 70°F. A shorter day length is required at higher night temperatures (greater than 72°F). In the Northern Hemisphere, natural photoperiods become short enough for floral initiation between September 18 and 25 (depending on the cultivar). Most cultivars come into full flower 7 to 10 weeks later or late November to December.

The actual date of floral initiation depends on the cultivar and environmental conditions. Cloudy days and cool nights in late September will result in earlier floral initiation, and bright, warm days will result in delayed floral initiation. The grower also needs to be aware of possible sources of extraneous artificial light that may enter the Poinsettia production area at night. These sources may appear low intensity but can interfere with floral initiation and include streetlights, security lights, or frequent automobile lights from a busy street close to the greenhouse.

In the past, it was not necessary to manipulate day length until the market for Poinsettias became earlier and earlier. Thanksgiving marketing of many Poinsettia cultivars requires black cloth applications from mid-September to mid-October. Poinsettias may be forced at any time of the year using standard day-length control techniques. This is accomplished by applying a minimum of 10 footcandles of incandescent light to plants from 10:00 pm to 2:00 am to simulate long days and obtain vegetative growth. Conversely, pulling black cloth to exclude light from 5:00 pm to 6:00 am simulates short days. Poinsettias must receive at least 6 weeks of uninterrupted short days for flower development to continue normally.

Poinsettia cultivars are classified into response groups according to the time required from the beginning of short days to flower and be ready for market (when pollen is visible in the Cyathia). Response groups are indicative of how long a cultivar requires for flower development, but the actual time can vary with the environment. Response time is independent of plant size or container size. For example, a cultivar in an 8 weeks response group will require 8 weeks to flower, regardless if it's growing in a 4-inch pot or an 8-inch pot.

Growth Retardants

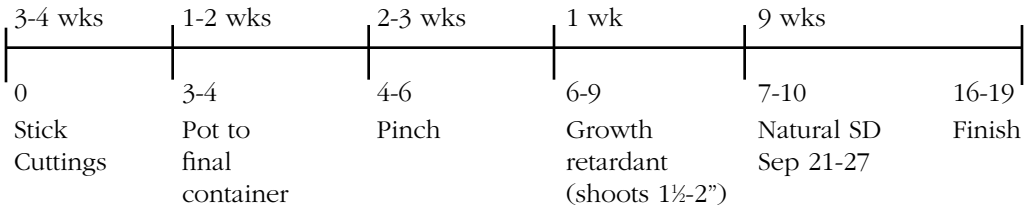
A-Rest, B-Nine, Cycocel, Sumagic, and Bonzi are registered for controlling stem elongation in Poinsettia. Timing of growth retardant application is important to avoid weak stems that may break off during shipping.

A-Rest is applied as a spray at 50 ppm (24 fluid ounces per gallon) by applying 1 gallon to 200 square feet. It should be applied when the lateral shoots are 2 to 2½ inches long. A second application can be made 2 weeks later if needed. A-Rest may also be applied as a drench at 0.25 to 0.5 mg a.i. per plant. A-Rest applied as a drench is more common because of the difference in concentration required and therefore the cost.

Bonzi is applied as a spray at 50 ppm (1.6 fluid ounces per gallon) by applying 1 gallon to 200 square feet. It should be applied when the lateral shoots are about 2 inches long. One application is usually all that is required.

Cycocel is the most widely used growth retardant on Poinsettia. It is applied as a spray at 1,500 ppm (1.6 fluid ounces per gallon) when the lateral shoots are 1½ to 2 inches long. Subsequent applica-

Figure 1. Scheduling Time Line for 6-inch Pinched Poinsettia



tions may be applied as needed up to and no later than October 15. Applications later than October 15 can reduce bract size.

B-Nine plus Cycocel tank mix has been found to be highly effective. The two together can be applied at 1,250 to 2,500 ppm (0.19 to 0.38 dry ounce per gallon) B-Nine plus 1,000 to 1,500 ppm (1.1 to 1.6 fluid ounces per gallon) Cycocel when the lateral shoots are 1½ to 2 inches long. One application is all that is usually needed. If a second application is needed, apply 1,250 ppm B-Nine plus 1,000 ppm Cycocel. This mix should not be applied after October 1.

Many growers are finding that low rates of growth retardant applied frequently can yield better results than higher rates applied less frequently as long as the total amount applied is the same. Some Poinsettia cultivars, notable 'Freedom', 'Cortez', Festival', and 'Monet', can develop late stretch just before flowers fully develop in November. Bonzi or A-Rest can be applied as a drench at 1 to 2 ppm 1 to 4 weeks before flower to prevent late stretch. Apply when plants are about 1 inch below the desired height. Keep in mind that growth retardant rates may need to be increased when the potting media contain more than 20 percent pine bark because bark can tie up some of the active ingredient.

Scheduling

With the ongoing introduction of new Poinsettia cultivars and decline in use of older ones, scheduling Poinsettia crops has become challenging. Following a schedule used by another grower, especially one from a different region of the country, may not work under your growing conditions. In addition, two cultivars with the same flower color and response group may differ substantially in plant vigor and therefore require a different crop schedule. Every cultivar and container size should have a specific crop schedule. This includes dates for sticking cuttings (if applicable), potting, pinching, and shipping. Poinsettia scheduling can be broken down into three segments: 1) time in weeks from the beginning of propagation to the pinch, 2) time in weeks from the pinch to floral initiation, and 3) the time in weeks from floral initiation to flower (response group). The time required in each of these segments must be adjusted on a per-cultivar basis to obtain the correct plant size desired by the market. A general outline of a production schedule for a 6-inch pinched Poinsettia is in Figure 1.

Propagation to Pinch

The relative size of plants in different pot sizes is largely controlled by the amount of time from propagation to floral initiation. Thus, early season cuttings go into large pots so they have the time to attain a large size before floral initiation. Conversely, late season cuttings go into small pots so they won't get too large before floral initiation. Typically, propagation of Poinsettia cuttings takes place from July 10 to August 15 in Alabama.

Time in this segment of production varies by cultivar vigor, propagation method, and by the number of branches desired after the pinch. Typically, in-house propagated (3 to 4 weeks from sticking cuttings to transplant) and purchased rooted cuttings require 2 to 3 weeks between planting in the final container and the pinch. In-house, unrooted cuttings that are direct-stuck in the final container require 4 to 5 weeks between sticking
cuttings in propagation and the pinch. Purchased unrooted cuttings may require a week longer due to the stress cuttings incur during shipping.

Pinch to Floral Initiation

Time in this segment of scheduling can be difficult because it depends on desired plant height (which is related to pot size), environmental conditions, finished quality specifications, and vigor of the cultivar. Typically, the time required for this segment of production is 0 to 2 weeks in 4-inch pots, 3 to 5 weeks in 6-inch pots, 5 to 7 weeks in 8-inch pots, and 6 to 8 weeks in 10-inch pots.

Table 4. Leaf Number Specifications at Floral Initiation

Pot Size (")	Leaf Number	Finish Height (")
4.0	0	8-10
4.5	0-1	9-12
5.5	2-3	11-13
6.0	3-4	14-16
6.5	4-6	15-17
7.0	5-7	15-18

The major controlling factor is the timing of the pinch. Cuttings should be pinched at a time relative to floral initiation so that the correct amount of growth (leaf number) occurs in proportion to the pot size. If a 4-inch pot cutting is pinched too early, it will get too large before floral initiation. Conversely, if a 6-inch pot cutting is pinched too late, it will not get large enough before floral initiation for the final product to be in proportion to the container. Typically, pinching of Poinsettia cuttings takes place from September 1 to 25 in Alabama.

One way to achieve consistent crops from year to year is to have the same average number of leaves per branch on a given cultivar and container size at the time of floral initiation. As a starting point, use the information in Table 4, but remember that cultivar vigor and finish quality specifications may modify the leaf number targets somewhat. For example, a high quality, pinched Poinsettia in a 6-inch pot should have 3 to 4 leaves per branch on average, while the same crop grown in 4-inch pots may need only 0 to 1 leaf. If a particular cultivar in a 6-inch pot requires 4 weeks to develop the correct number of leaves, we typically add 2 weeks for the same cultivar in an 8-inch pot and 3 weeks for a 10-inch pot.

Average leaf numbers can be monitored and target leaf numbers can be fine-tuned by counting and averaging the number of leaves on the branches of five randomly selected plants of a cultivar. Average daily temperature can then be manipulated to speed or slow the rate of leaf unfolding to achieve a target leaf number at floral initiation. For example, a vigorous cultivar in a 6-inch pot may require only 3 weeks between the pinch and floral initiation, while a more compact cultivar may require 5 weeks. If the target number of leaves is 3 to 4 and a crop has 4 to 5 leaves at the time of floral initiation, the schedule for the same crop in the future should be reduced by about 1 week. This is because a Poinsettia unfolds about one leaf every 4 to 5 days under ideal temperatures. Reducing the amount of time in this segment of the schedule has the added benefit of reducing the number of growth retardant applications required because fewer stem internodes are present to require growth control.

Floral Initiation to Flower

Under natural photoperiods, scheduling Poinsettias centers around the natural date of floral initiation (September 18 to 25). As long as the day length is not altered artificially, each cultivar will flower 7 to 10 weeks after that date depending on its response group. Information on the response group and when a given cultivar will flower in your area can be obtained from your supplier and the results of trials published in national greenhouse magazines. Count forward the number of response weeks from the week of floral initiation (between September 18 and 25, depending on the cultivar) to determine when a cultivar will flower. Crops for different parts of the Thanksgiving / Christmas season can be finished at different times by growing cultivars from different response groups and by modifying the night temperature. A cultivar can be finished in more time (usually not more than 2 weeks longer) than its response time by lowering the night temperature to 60 to 62°F but it cannot be finished any sooner. Remember that warm night temperatures at the time of floral initiation can delay flowering, especially in the South, where night temperatures are difficult to control during September. For example, a cultivar that flowers about November 12 in the Midwest may flower November 18 in the Southeast and November 25 in south Florida. Response-group timing is accurate for all areas of the country as long as 68 to 70°F night temperatures can be maintained. Response-group timing is not altered by container size.

It was once said that growers who do not keep crop records are doomed to repeat the same errors over and over! This is especially true when growing Poinsettias. Keep records by cultivar and planting date on crop timing in each stage, fertilizer rates, plant growth retardant applications and rates, pesticide applications and rates, and set-point temperatures. Records of this kind can be used to determine what happened when things go wrong and to improve crop scheduling in the future. Photographs are another kind of useful record that can be used to document stages of crop development with respect to the target sales date.

Shipping and Handling

Poinsettias are sensitive plants that should be protected from bruising and breakage using plant sleeves and boxes for shipping. Sleeves should extend 2 to 3 inches above the tops of the bracts. Avoid placing Poinsettias in paper, plastic, or mesh sleeves more than 24 hours in advance of shipping because the plants can develop epinasty, a condition characterized by droopy bracts and leaves. Sleeved plants should be placed in boxes or on shipping shelves so that the flowers do not rub against the top of the box or shelf. Ship Poinsettias in trucks at about 53 to 56°F. Warmer temperatures can result in severe epinasty. Shipping temperatures below 50°F can result in chilling injury. Do not ship Poinsettias along with fruit, especially bananas or apples. Development of ***Botrytis*** on

bracts during shipment can be a problem if it is not controlled during production (preexisting) or when moisture condenses on the bracts prior to or during shipment. Shipping time should not exceed 4 days.

Common Nutrient Deficiencies

Potassium: Deficiency symptoms start as marginal chlorosis on older leaves followed quickly by marginal necrosis. Similar necrotic spots may appear across the leaf blade but are more concentrated near the leaf margins. Potassium deficiency is more likely to occur in early fall when plants are growing rapidly. Change to a fertilizer higher in potassium than in nitrogen such as 15-5-25 until symptoms abate.

Magnesium: Deficiency symptoms appear as interveinal chlorosis on the older leaves. There may be two causes: 1) Low media pH leads to rapid leaching of magnesium and thus deficiency symptoms. The media pH must be raised and plants supplied with supplemental magnesium. 2) High levels of calcium in the media will block the uptake of magnesium. This can occur with the overuse of high calcium fertilizers such as 15-0-15. Deficiency symptoms can be corrected by applying 1 to 2 pounds of Epsom salts per 100 gallons of water.

Calcium: Deficiency symptoms appear as cupping, crinkling, stunting, chlorosis, and finally necrosis of young leaves. Roots are often shorter, thicker, and more branched than normal. Colored bracts are particularly susceptible, and symptoms appear as marginal necrosis, often referred to as bract edge burn. There may be three causes: 1) Low media pH leads to rapid leaching of calcium and thus deficiency symptoms. The media pH must be raised and plants supplied with supplemental calcium. 2) High levels of magnesium in the media will block the uptake of calcium. 3) Low transpiration rate during prolonged periods of cool, cloudy weather prevents uptake and movement of calcium in the plant. Calcium deficiency can be corrected or averted by including a calcium-based fertilizer in the fertility program such as 15-0-15, 14-0-14, or 13-2-13. In a difficult situation, calcium sprays can be applied to the foliage at 400 ppm calcium once or twice per week until symptoms abate. Table 5 provides rates for mixing calcium sprays.

Table 5. Rates for 400 ppm Calcium Sprays for Poinsettia

Compound	Oz./100 Gal.
Calcium nitrate	22
Anhydrous calcium chloride	15
Calcium chloride dihydrate	20
Calcium chloride, hydrated	29

Molybdenum: Deficiency symptoms start as marginal chlorosis of middle leaves about halfway up the plant and progress upward and downward. The chlorosis quickly progresses to necrosis. Affected leaves may be mildly distorted. Either sodium molybdate or ammonium molybdate at 2 ounces per 100 gallons may be applied to correct deficiency symptoms. This solution can be applied as a media drench or as a foliar spray. If a foliar spray is used, include a surfactant to improve leaf coverage. Do not apply these sprays during midday heat.

Physiological Problems

In addition to nutritional problems, several problems may be encountered in Poinsettia productions that are not caused by diseases or insects.

Leaf Crippling or Distortion: Leaf crippling and distortion may occur just after rooting or on axillary shoots immediately after plants are pinched. While this problem may be worrisome, plants should outgrow the damage. This problem has been attributed to excess foliar absorption of phosphorous in newly rooted cuttings and may be a particular problem if phosphoric acid is used to correct high water alkalinity or pH. Rinsing the foliage after an overhead fertilization may help alleviate this problem. For rooted cuttings, the distorted growth may be related to physiological stress when plants are moved from the propagation area to production areas. Applying shade to reduce light levels and syringing plants until roots are well developed may help reduce leaf distortion in newly pinched plants.

Cycocel Damage: The use of Cycocel may cause irregular yellow patches or marginal yellowing of leaves. Symptoms usually occur within 3 to 4 days following application. This damage may recover if it is not too severe. Cycocel should be applied at rates of 1,500 ppm or lower to prevent severe damage.

Heat Delay. Night temperatures in excess of 72°F in late September and early October can delay floral initiation. Growers who face this problem should try to reduce night temperatures using evaporative cooling or exhaust fans. The use of shade cloth to shorten day length during floral initiation may also negate heat delay.

Flower Splitting: Splitting is caused by the premature initiation and development of terminal

flowers. Plants affected by splitting may result in inflorescences with uncharacteristically open centers. The likelihood of splitting increases with the age of the shoot. Plants that have been pinched too early or produced from cuttings that were physiologically too mature or crops that were started too early are more prone to this problem. Also, certain cultivars are more susceptible to this problem.

Pesticide Damage: Poinsettias and other greenhouse and nursery crops are susceptible to phytotoxicity caused by pesticide applications. Pesticides should never be sprayed at the hottest part of the day or on dry plants. Always read and follow pesticide label directions before making any applications. New and unfamiliar pesticides should be tested on a few plants from each cultivar and examined 24 hours later before applying to the entire crop. Most pesticides should not be used when bracts are showing color; even chlorothalonil (e.g., Exotherm Termil) can cause damage to colored bracts.

Uneven Flowering: Uneven flowering among the same variety may be caused by deviations in the environmental conditions. Cooler areas of the greenhouse (or cooler greenhouses) will cause plants to develop more slowly. Uneven watering and light conditions can also produce an uneven developing crop.

Excessively Small Bracts: Plants that have grown under environmental stress (water, temperature, low light, or growth regulators) during bract development may develop excessively small bracts. This is very commonly seen when late growth regulator sprays have been made during bract expansion or by overapplication of Bonzi drenches, especially during flower initiation.

Rabbit Tracks: Rabbit tracks or bilateral bract spots are silvery spots located on either side of the midvein of colored bracts. The cause of rabbit tracks is unknown at this time. The problem occurs late in the crop cycle and may be related to high nutritional levels and warm night temperatures late in the crop.

Bract Edge Burn: This late-season problem is characterized by marginal necrosis of colored bracts. Besides making affected bracts unsightly, these lesions can serve as entrance points for ***Botrytis*** infection. Bract edge burn has been associated with low calcium levels and high nutritional levels. Water stress caused by high soluble salts, excessive or inadequate irrigation, root damage, pesticide injury, air pollution, and high humidity also have been associated with this problem. Some sources recommend weekly sprays of 400 ppm calcium chloride or calcium nitrate starting with bract coloring and continuing until pollen shed to prevent this disorder.

Stem Breakage: While handling finished plants, one or more lateral shoots may break off. Several measures have been suggested to help prevent this problem. Cutting quality may have an impact on this problem with more stout cuttings being less susceptible to stem breakage later in the crop. Spacing plants 5 to 6 weeks after pinching may induce stems to grow more upright and reduce breakage. Calcium deficiency has also been reported as a contributing factor. Reducing the number of lateral shoots by leaving no more than 4 or 5 nodes after pinching may create stronger stems. Some cultivars seem to be more susceptible than others to stem breakage and should either be avoided or handled with special care during shipping.

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For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

Use pesticides **only** according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label.

The pesticide rates in this publication are recommended **only** if they are registered with the Environmental Protection Agency and the Alabama Department of Agriculture and Industries. If a registration is changed or cancelled, the rate listed here is no longer recommended. Before you apply any pesticide, fungicide or herbicide, check with your county Extension agent for the latest information.

Trade names are used **only** to give specific information. The Alabama Cooperative Extension System does not endorse or guarantee any product and does not recommend one product instead of another that might be similar.

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