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Poinsettia Production

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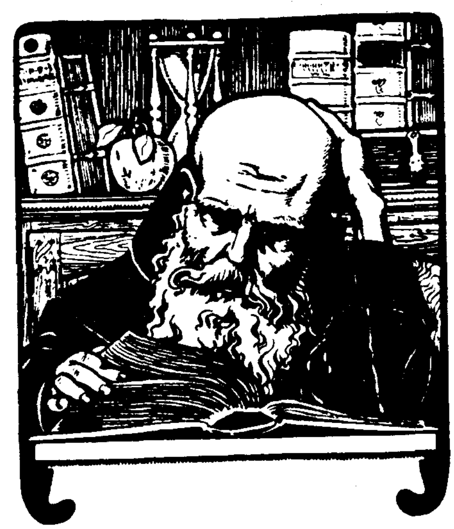
Introduction: Poinsettia (*Euphorbia pulcherrima* Willd.) are native to southern Mexico and northern Guatemala. In 1895, Joel Robert Poinsett, the first ambassador to Mexico, introduced poinsettias into the United States.

The poinsettia is a member of the *Euphorbiaceae* family. Most member so the *Euphorbiacae* family are succulents. The family is characterized by a single female flower without petals and usually sepals surrounded by individual male flowers all enclosed in cup-like structure called a cyathium.

The poinsettia is grown for its colored bracts (modified leaves). Bracts are not flowers. Poinsettia flowers are actually the small round structures in the middle of the bract called cyathia.

More pots of poinsettias are grown in the United States than any other flowering pot plant. The growth in popularity of poinsettias occurred because of the development of:



1) development of shorter, free branching cultivars with large bracts

"The popularity of the poinsettia can be attributed to the efforts of 3 primary individuals/organizations."

2) development of cultivars that retain both green leaves and bracts in the postharvest environment

3) development of growth retardants for height control.

4) aggressive marketing of the poinsettia as a 'Christmas' plant

Historically, large dormant woody stock plants were shipped to propagators in the spring for forcing. Now young actively growing plants are shipped instead. Cuttings are taken during the summer, rooted during the end of July and early August, and are flowered for November and December sales.

The marketing date has changed dramatically in poinsettia production. Retailers are requesting flowering plants as early as November 1!

Breeding Efforts:

The development of the poinsettia industry can be traced back to the following significant events:

1) in 1923 the Oak Leaf seedling cultivar (a primary ancestor of the current day poinsettia) was identified by Mrs. Enteman.

2) in 1929 the first distinct sport of Oak Leaf was selected and named 'Mrs. Paul Ecke'.

3) in 1963 the 'Paul Mikkelson' cv was introduced. 'Paul Mikkelson' had stiff lateral branches, larger and longer lasting bracts, and offered a variety of different colors.

4) in 1964-1965 Annette Hegg Red was first grown and introduced in Norway. The introduction of 'Annette Hegg' was perhaps one of the most significant events in the poinsettia industry because it dramatically helped increase the popularity of the 6"pinched poinsettia market. Annette Hegg Red is still grown by many producers today. Annette Hegg Red was a very good brancher, retained its cyathia, and had large bracts.

5) in 1968 Eckespoint C-1 was introduced. C-1 had large bract size, good color, and was better branching than the previous plants. C-1 was an excellent plant for 'straight-up' or single stemmed no-pinch production.

6) in 1979 V-14 Glory was introduced. V-14 had wide bracts, a bright red color bract, could be produced in time using cooler night temperatures. V-14 Glory is used today primarily for tree production in Minnesota.

7) in 1988 Gutbier Angelika was introduced into the United States from Europe. Angelika is a <u>very</u> free branching plant.

Table 1. Primary *Euphorbia pulcherrima* Willd. (poinsettia) cultivars, color, use, and response group.

Cultivar	Color	Use	Response Group
Annette Hegg:			
Dark Red	Red	6" pinched, 4"	9 weeks
Hot Pink	Pink	6" pinched, 4"	9 weeks
Topwhite	White	6" pinched, 4"	9 weeks
Eckespoint:			
Celebrate II	Red	6" pinched, 4"	8 1/2 weeks
Freedom	Red, white, pink, marble,	6" pinched, 4"	8 weeks
Gross Supjibi	Red	6" pinched, straight up, 4"	8 1/2 weeks
Jingle Bells III	Pink and red	6" pinched, straight up, 4"	10 weeks
Lemon Drop	Yellow/white	4"	8 1/2 weeks
Lilo	Red	6" pinched, straight up, 4"	8 1/2 weeks
Monet	Pink and white	6" pinched, straight up	9 1/2 weeks
Pink Peppermint	Pink	6" pinched, straight up, 4"	9 weeks
Red Sails	Red	6" pinched, straight up	9 weeks
Success	Bright Red	6" pinched, straight up, 4"	9 1/2 weeks
Gutbier			
V-14 Glory	Red, pink, white	6" pinched, straight up, 4", tree	9 1/2 weeks
V-17 Angelika	Red, pink, white	6" pinched, 4"	9 weeks
Mikkelsens':			
Blitzen	White	6" pinched, 4"	8 1/2 weeks
Dasher	Red	6" pinched, 4"	8 1/2 weeks
Donner	Red (B. green leaf)	6" pinched, 4"	8 weeks
Red Delight	Red	all pots	8 weeks
Yuletide	Red, White and Pink	6" and larger	9 1/2 weeks
Peace:			
Jolly Red	Deep Red	6" pinched, 4"	8 weeks
Red Delight	Red	6" pinched, 4"	8 weeks
Red Elegans	Dark Red	6" pinched, 4"	8 weeks
Red Splendor	Bright Red	6" pinched, 4"	9-9 1/2 weeks
Regal Velvet	Dark Red	6" pinched, straight up, 4"	9 weeks
Pelfi			
Bonita	Dark Red	6" pinched, 4"	8 weeks
Cortez	Dark Red	6" pinched, 4"	8 1/2 weeks
Dark Puebla	Pink/Yellow Bicolor	6" pinched, 4"	9 1/2 weeks
Flint	Bright Pink	6" pinched, 4"	8 1/2 weeks
Maren	Salmon-Pink	6" pinched, 4"	8 weeks
Nobelstar	Coral (orange)	6" pinched, 4"	8 weeks
Picacho	Dark Red	4", 4" pinched	7 1/2-8 weeks
Puebla	Pink Bicolor	6" pinched, 4"	8 weeks
Sonora	Dark Red	6" pinched, 4"	9 weeks
Oglevee			
Nutcracker	Red, Pink, Red	6" pinched, 4"	8 weeks

8) in 1988 Gross Supjibi was introduced from France into the U.S. Supjibi was shorter, had very thick stems and had large red bracts. Supjibi is grown primarily as a'straight up' plant in Minnesota.

"'Freedom' dramatically changed U.S. poinsettia production. We now schedule poinsettias with night interruption lighting instead of with black cloth."

9) in 1986 'Lilo' was introduced. Lilo had very dark green leaves and dark red bracts. In addition, Lilo had a very long postharvest life. The only difficulty with Lilo was poor breaking. Research by Faust and Heins at Michigan State University identified the basis for the poor branching on Lilo (see following section).

10) in 1993 Eckespoint Freedom was introduced in the U.S. market. Freedom dramatically changed the U.S. market and poinsettia production in that it is the earliest blooming of poinsettias, had dark green foliage and dark red bracts. In addition, Freedom has an extremely long postharvest life. The only disadvantage of Freedom is that it has few cyathia that are often not retained as long as the bracts. With the advent of Freedom, we often scheduling using black cloth to deliver short-days early, rather than using night interruption to delay flowering.

The advancement of the poinsettia industry in the United States can be attributed to primarily 2 companies: Paul Ecke Poinsettias, Inc., and Ed Mikellsen's, Inc.

Table 2. Variation in schedules for 'Freedom' in different parts of the U.S.

Scheduling Freedom in several U.S. regions

Location	Plant rooted cutting	Pinch	Short days	Flower date
Pacific NW, Great Lakes, Northeast	Aug. 5 to 7	Aug. 20	Natural	Nov. 15 to 25
Florida, Texas, Gulf Coast states	Aug. 15	Sept. 1 to 7	Natural	Nov. 15 to 20
Pacific NW, Great Lakes, Northeast	Aug. 15	Sept. 5	Sept. 29	Dec. 1
Florida, Texas, Gulf Coast states	Aug. 21	Sept. 10	Oct. 6	Dec. 1

Schedule guidelines for 6-inch Freedom grown with and without lights.

New cultivars produced by Fischer, Inc. are entering the U.S. market in recent years and appear to be competitive with Freedom cultivars (Table 1). In specific, they are shorter, free branching, often have dark green leaves, have a long postharvest life, and are offered in a variety of colors.

Scheduling:

Develop your poinsettia schedule around what you want the plant to look like in the end, i.e. when marketed. Every grower and every region of the U.S. has a different 'ideal' plant. For instance, consumers in Michigan seem to prefer a smaller and shorter plant than consumers in Minnesota.

The best way to determine your schedule is to have picked your 'perfect' plant the previous year and collected critical data on different aspects of plant form that identify how to grow it. If you do not have the following information you should collect it this Thanksgiving!

Critical data include:
1) lateral shoot number
2) leaf number on lateral shoots
3) leaf number on mother shoot
4) total plant height
5) mother shoot height

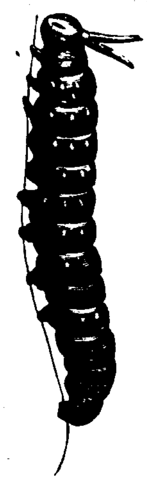
How this information is used to determine a schedule will be discussed in a future article.

Standard schedules for Freedom in different location in the U.S. are shown in Table 2.

Photoperiodism:

A photoperiodic response is some plant growth activity that varies with the length of the day. Photoperiodism in plants was first identified by Garner and Allard at the USDA laboratories in Beltsville, Maryland in 1920. They observed 2 responses that led to the discovery of photoperiodism:

1) Maryland Mammoth tobacco grew to a height of 3-5 meters (6-15 feet) in Maryland but did not flower during the summer. However, that same plant flowered profusely at 1 meter (3 feet) tall when grown in a greenhouse during the winter.



2) All of the individuals of a variety of soybean flowered at the same time in the field regardless of when they were planted in the spring.

From the research with tobacco and soybean they discovered that flowering could be regulated by daylength. The tobacco and soybean plants flowered when days were shorter than some maximum length. Garner and Allard named the response of plant flowering to daylength 'photoperiodism'. In actuality, it is night length that is important, i.e. flowering only occurred on these plants when night length was longer than some critical length.

"The poinsettia is a short-day plant."

Further research showed that plant responses to photoperiod could be broken down into 3 primary groups:

1) short-day plants,
2) long-day plants, and
3) day neutral plants.

Short-day plants flowered when the daylength was shorter than some critical length. Long-day plants flowered when the day was longer than some critical length. Day-neutral plants flowered regardless of photoperiod length.

The poinsettia is a short-day-plant. Therefore, flowering typically occurs when the day is shorter than the night. Newer cultivars are almost facultative short-day-plants since they flower eventually, but short days hasten the flowering process.

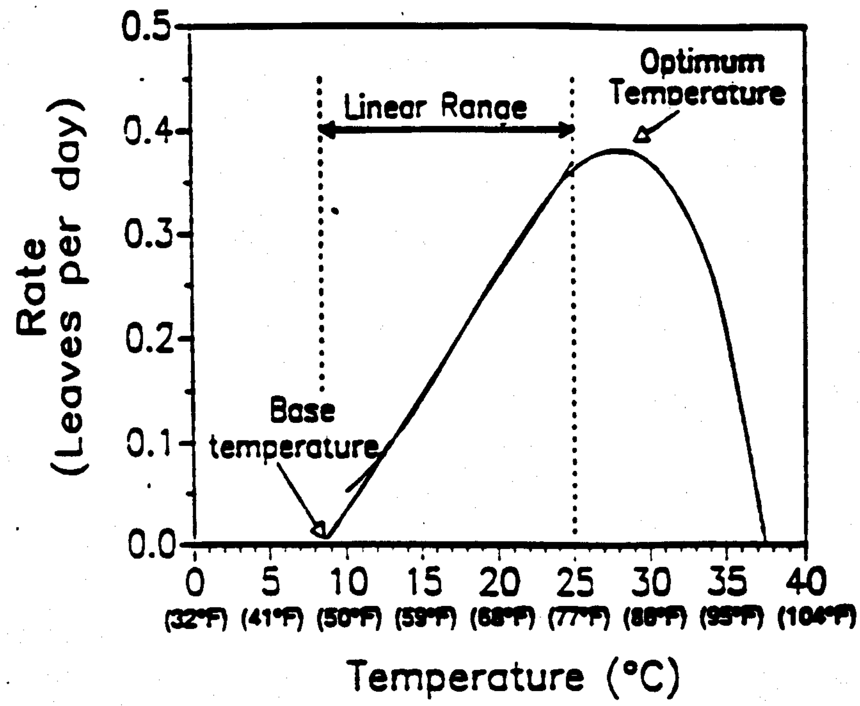


Figure 1. Generalized graph showing the effect of average daily temperature on poinsettia leaf unfolding rate per day.

Vegetative Development:

As mentioned previously, vegetative development is that growth not associated with reproduction or flowering.

In poinsettia production, we are concerned with factors that affect 'vegetative' growth during cutting growth from planting until flower initiation (from early August until September 7-23 with most cultivars).

Four environmental concerns during vegetative development of poinsettias that can impact final plant quality are:

1) high temperatures during early cutting growth can result in 'absent' axillary buds that are incapable of producing lateral shoots, and

2) leaf unfolding rates a function of average daily temperature when temperatures range from 45 to 85°F (Figure 1).

3) low/high light intensity (irradiance) reducing total overall growth and/or stem strength.

4) altered light quality (color) resulting from crowding plants.

Absent Axillary Buds:
Day temperatures in excess of 75°F can result in absent axillary, or side, buds. You can see whether axillary buds are missing simply by observing the cutting upon arrival and determining whether an axillary bud is present where the leaf petiole meets the stem. Always examine cuttings when they arrive; you may receive cuttings that are incapable of producing a number of lateral shoots. Absent axillary buds were common on the cv 'Lilo' for years when cuttings were produced in hot climates. Growers thought 'Lilo' was simply a poor brancher when few branches developed when, in fact, Lilo cuttings they received had been grown in a hot greenhouse and were incapable of branching. When grown under appropriate conditions, Lilo branched as much as any other variety accept Freedom.

High day temperatures can produce absent axillary buds on the following cultivars:

1) Lilo
2) Freedom
3) Supjibi

If you grow these cultivars, while you are growing the cutting prior to pinching, it is important that you keep day temperatures below 75°F so that axillary buds develop normally in your care and ultimately result in the development of a lateral shoot.

Leaf Unfolding:
The term 'leaf unfolding' refers to the developmental movement of a young leaf from an upright position on the shoot tip (meristem) to a nearly horizontal position perpendicular to the stem. Leaf size usually increases from about <1/2" to >1 1/2" as a poinsettia leaf unfolds.

Measuring the rate of leaf unfolding is a way that we can measure the rate of plant development on many crops we grow. In particular, leaf unfolding rate is critical when timing the rate of development of an Easter lily crop.

Monitoring leaf unfolding is important on poinsettias to insure that a pinched cutting is at a desired stage of development (leaf number) when flower initiation occurs. Failure to understand how temperature affects leaf unfolding can result in undesirably short plants with small bracts, or undesirably tall plants at flower.

Leaf unfolding of poinsettias is affected by average daily temperature, as with many other plants, when temperatures range from 45 to 85°F (Figure 1). There is a base temperature and an optimal temperature for leaf unfolding. Between the base and optimal temperature, leaf unfolding rate increases in proportion to a temperature increase. Leaf unfolding rate decreases rapidly as temperatures increase above the optimal temperature.

"Poinsettia leaf unfolding is a function of average daily temperature when temperatures range from 55-80°F."

The optimal temperature for leaf unfolding of many poinsettias is approximately 80°F. When leaf temperature exceeds 80°F, leaf unfolding rate can decrease. Remember that sunlight heats a leaf; leaf temperature can be 4-8°F warmer than air temperature when a leaf is in direct sunlight. Therefore, we probably reduce leaf unfolding rate of poinsettias in many parts of the country where air temperatures alone can exceed 80°F. If maximum leaf unfolding rate is desired continuously, then it is important to understand that good cooling systems are critical in a greenhouse in many parts of the U.S.

"Leaf unfolding increases as the average daily temperature plants are grown under increases up to 76°F, then decreases as temperature increases further."

The effects of average daily temperature on poinsettia leaf unfolding rate varies with cultivar. The maximum and minimum leaf unfolding rate per day were 0.30/day (3.3 days/leaf) for Supjibi, and 0.38/day (2.6 days/leaf) for Angelika White (Royal Heins, Michigan State University, personal communication). A good 'rule-of-thumb' to keep in mind is you get about 1 poinsettia leaf every week when plants are grown with a 68-70°F average daily temperature.

It is very important to know how many leaves you desire on a mother shoot before you pinch the plant. Remember, you can not produce any more lateral shoots than there are leaves/axillary buds on the mother shoot. Set a target number of leaves on a mother stem and adjust average daily temperature to achieve more than that number since you pinch off 2-3 leaves! Table 3 shows the approximate time required between planting and pinchingto produce plants with various lateral shoot numbers at different average daily temperatures.

Similarly, there should be a target leaf number of leaves on lateral shoots that develop after pinching when you want to initiate flowers.

Table 3. The approximate time required between planting and pinching to produce plants with various lateral shoot numbers at various average daily temperatures. 80% breaking is assumed.

Number of days required between planting and pinching to produce plants with various break numbers at various average daily temperatures

Final estimated inflorescence number	Average daily temperature (F) 60	63	65	68	71
	No. of days				
4	21	18	16	15	14
5	28	24	22	20	19
6	35	30	27	25	23
7	42	35	33	30	28
8	49	41	38	35	33

Table assumes cuttings had four leaves when planted, pinching removed two leaves, 80 percent of axillary buds developed into breaks, and flower initiation occurs on September 20.
Times based on leaf unfolding rate functions published in: Berghage, R., R.D. Heins and J.E. Erwin, Quantifying leaf unfolding in the poinsettia, Acta. Hort., *272: 243-247*.

In general, a 'good' target number for a typical Minnesota 6" pinched poinsettia is 3-4 leaves/lateral shoot. In contrast, you may want a target leaf number of '0' on 4" pinched poinsettias to limit the lateral shoot size on this crop.

Table 4. Typical time required to unfold 3 leaves after pinching at a variety of average daily temperatures.

Number of days to produce a shoot with three leaves after pinching when plants are grown under different daily temperatures

	Average daily temperature (F)				
	60	63	65	68	71
No. of days	20	18	17	15	14

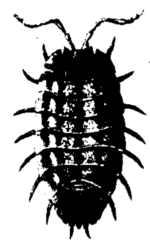
Times based on: Berghage, R., R.D. Heins and J.E. Erwin, Quantifying leaf unfolding in the poinsettia, Acta. Hort., *272: 243-247.*

Table 4 the typical amount of time from pinching until 3 leaves have unfolded at various average daily temperatures.

Pinching:

Pinching technique influences lateral shoot number and the shape of the plant.

We pinch poinsettias to remove apical dominance. Apical dominance is that factor that inhibits lateral shoot development. In all plants apical dominance is maintained by the apical meristem (shoot tip) producing a chemical called auxin. Auxin moves down the stem and inhibits side branch development. When we pinch off a shoot tip, we remove the primary source of auxin. Thus, we get side shoot development. A secondary source of auxin in the poinsettia are the young developing leaves. Failure to remove these leaves will also affect lateral breaking. When we 'hard pinch' we remove the shoot tip and the young leaves so lateral shoot development occurs immediately. In contrast, when we soft pinch, the young leaves left may inhibit lateral shoot development. The effect of different pinching techniques on plant development are outlined in Table 5.



Flower Induction and Initiation:

The poinsettia is a short-day plant. Flower initiation will eventually occur under long or short-days but rapid flower initiation occurs only under short-day-conditions.

"The poinsettia is a short-day plant. The night length must exceed some critical amount of time for flowering to occur."

As mentioned previously, although we refer to plants as short or long-day plants, the night length is actually what is important for flowering in

Table 5. The advantages and disadvantages of different pinching techniques on poinsettias.

Advantages and disadvantages of pinching techniques

Hard pinch

- **Advantages:** Easy, fast; generally results in uniform axillary bud breaking.
- **Disadvantages:** Can be used only on plants with desired leaf number. Occasionally one of the upper two shoots will be excessively tall, resulting in an uneven flowering canopy.

Medium pinch

- **Advantages:** More nodes left on the plant than with a hard pinch, which can ultimately cause more breaks.
- **Disadvantages:** Immature leaves left on the mother shoot inhibit lateral shoot growth below, resulting in longer uppermost lateral shoots; gives plants an uneven appearance.

Soft pinch

- **Advantages:** More nodes left on mother shoot. Plants often grow tall and narrow; may be an advantage with limited bench space.
- **Disadvantages:** Tall and narrow plants with more lateral shoots appearing below flower canopy. A smaller percentage of lateral shoots develop into flowering shoots.

Soft pinch and leaf removal

- **Advantages:** Lateral shoot release occurs quickly and uniformly; maximizes number of potential lateral breaks. More lateral shoots contribute to flower canopy, compared to medium- or soft-pinched plants. Yields a more uniform flower canopy balanced with height.
- **Disadvantages:** Labor intensive. Delayed flowering no longer than two to three days on plants where leaves have been removed compared to plants that are soft-, medium- or hard-pinched.

most cases. In other words, short-day plants require a long night to induce flowering.

Commercially we reduce photoperiod length to induce flowering by pulling blackcloth over poinsettias. We extend photoperiod, or deliver long-day conditions, by interrupting the night by lighting plants in the middle of the night. Because of electrical and lamp costs, most growers use night interruption lighting to inhibit flowering in the poinsettia.

Flowering is inhibited using night interruption lighting by applying light of adequate intensity to plants when they are most sensitive to being lit. Poinsettia cuttings should be lit from 2200-0200 hr each night with at least 10 footcandles of light to insure inhibition of flowering.

Poinsettia cultivars vary in the critical daylength at which flower initiation will occur. For instance, the critical daylength for "Annette Hegg" is 11.5 hours. In contrast, the critical daylength for "Freedom" is 10.5 hours.

The critical daylength for flower initiation is affected by irradiance (light intensity) and night temperature. Flower initiation of poinsettias occurs naturally between September 7 and 23. Cloudy conditions can result in earlier flower initiation. Clear skies can result in earlier flower initiation.

High night temperature can inhibit flowering of poinsettias. In particular, night temperatures in excess of 72°F will delay flowering of many cultivars. The warmer the night temperature up to 72°F, the shorter the daylength required to initiate flowers.

Flower Development:

Poinsettia cultivars are categorized into different response-groups. A 'response group' is the length of time normally required from the start of short-day conditions until flowering. Poinsettia response-group types vary from 8 to 11 weeks when plants are grown with a 65-68°F average daily temperature (Table 1).

The rate of development after flower initiation increases as day/night temperature (average daily temperature) increase to 76°F. Therefore, an 8-week-response group poinsettia can require 9 weeks to flower when plants are grown cool (below 65°F day/night temperature). In contrast, an 8 week-response group poinsettia could only require 7 weeks when plants are grown warmer than 68°F.

Poinsettias must be grown under short-day conditions for 5 weeks for normal flower development to occur.

Stem Elongation:

Control of poinsettia stem elongation is important from 'sticking' the cutting until shipping the plant. It is critical that you use a graphical track to monitor the rate of elongation throughout the crop to insure producing a crop of desirable plant height. Graphical tracking is discussed later in this section.

Poinsettia stem elongation is affected by light and temperature. Traditionally, we have controlled stem elongation using growth retardants only (mainly Cycocel). New shorter growing cultivars, in combination with alternative temperature management strategies have dramatically reduced the need for growth retardants in northern climates. In some cases with northern growers, the need for growth retardants has been eliminated entirely after flower initiation. However, growth retardants are still almost always necessary prior to pinch.

Both, the difference between day and night temperature (DIF = day temperature - night temperature) and absolute temperature affect poinsettia stem elongation. Internode elongation increases as the difference between day and night temperature increase when temperatures range from 50 to 86°F (Figure 2). Stem elongation also

Too often, stem elongation of the mother shoot is ignored and pinching is used as a height control method. Remember, it is critical that mother stem height is controlled and leaf number on the mother stem is maximized to insure that a minimum lateral shoot number is achieved.

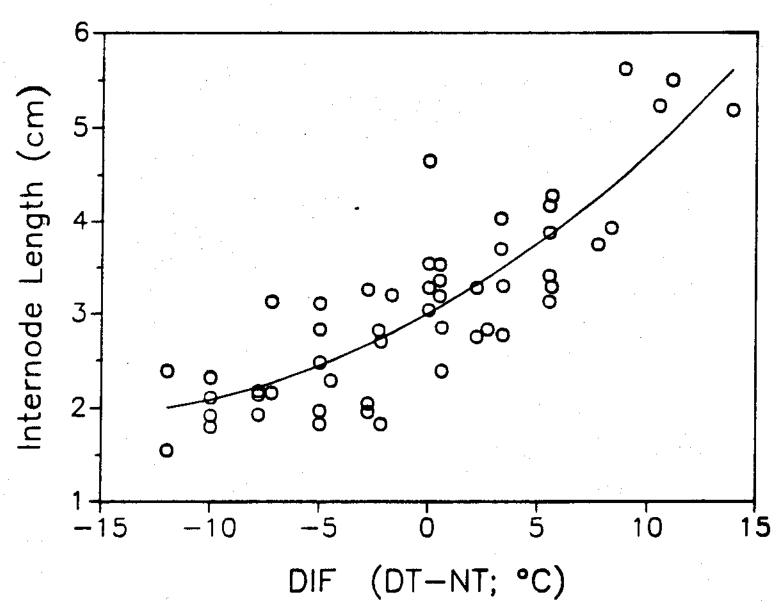


Figure 2. The effect of the difference (DIF) between day and night temperature (DIF=Day temp.-night temp.) on poinsettia internode length.

increases as day or night temperature approach 76°F.

Poinsettia stem elongation, as with many other plant species, is most sensitive to temperature during the morning and mid-day when stem elongation is occurring most rapidly. Early work on Easter lily stem elongation suggested that plants were most sensitive to temperature during the first 4 hours of the photoperiod (day). Subsequent research on impatiens, salvia, and petunia has suggested that plants are actually most sensitive in the late morning and early afternoon. Regardless, poinsettia stem elongation can be dramatically reduced by dropping temperatures during the first part of the photoperiod. In contrast, increasing temperature rapidly during the beginning of the day can stimulate stem elongation.

> "Stem elongation is most sensitive to temperature during the morning."

The degree that stem elongation is reduced or increased depends on how much the temperature is dropped or increased and the rapidity of the temperature change.

In general, growers can drop the day temperature from 68 to 55-57°F for the first part of the day without any deleterious effects on plant growth. Dropping temperatures to below 50-54°F could result in chilling injury on poinsettias growth continuously at warm temperatures (68°F).

The greatest benefit of dropping temperatures in the morning only is that the rate of development (dependent on average daily temperature) is often not greatly affected. Also, leaf color is not reduced significantly. Leaves can get significantly lighter in color when grown with a cooler day than night temperature all day.

The effect of DIF or morning temperature drops on poinsettia stem elongation increases as daylength decreases and as light intensity increases. Therefore, DIF is less effective in controlling stem elongation under cloudy conditions in the middle of the summer and most effective under bright days in the middle of the winter.

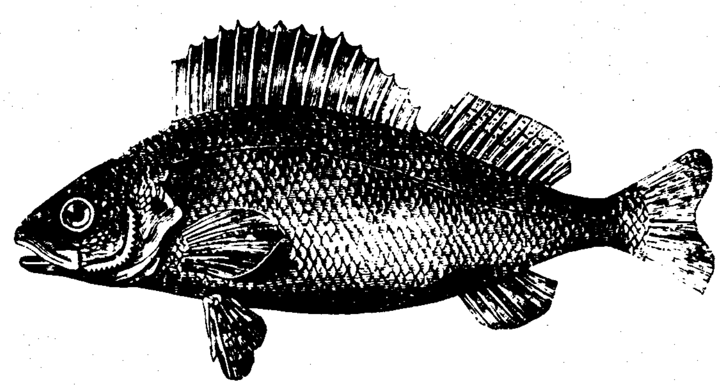


Table 6. Recommended growth retardant applications for poinsettias and when they can be applied when producing poinsettias in northern climates.

Retardant	Rate	Comments
Cycocel	1,000 ppm	Do not apply after October 10
B-Nine + Cycocel	750 ppm each	Do not apply after October 10
Bonzi	2-4 ppm	Achieving uniformity in retardantion when spraying can be difficult. Do not spray after October 10. Useful when trying to stop elongation within Freedom bract at the end of production when applied as a drench.
Sumagic	2-4 ppm	As for Bonzi.

Often, it is necessary to apply a growth retardant to control excessive stem elongation on poinsettias. Registered growth retardants, and recommended rates are shown in Table 6.

Foliar chlorosis can occur along the leaf margin on poinsettias following a Cycocel application. Chlorosis seems to be reduced when lower concentration of Cycocel are applied and/or when Cycocel is applied under cooler and lower light intensity conditions.

Crowding plants reduces the response of those plants to either DIF or growth retardants.

Both light quantity (intensity) and quality (color) affect poinsettia stem elongation. In general, as with most plant species, poinsettia stem elongation decreases as light intensity increases from 0 to 2,500 footcandles.

Light quality, or color, also affects poinsettia stem elongation. In particular, the amount of red versus far red light can dramatically affect the amount of internode elongation that occurs.

Graphical Tracking:

Graphical tracking is a technique used to monitor the rate of stem elongation at any given point in poinsettia development to insure that plants achieve a desired height at flower.

How to develop your own graphical track for a poinsettia crop is discussed on the following 2 pages in Figures 3 and 4. A typical graphical track for a Freedom crop in Minnesota is shown in Figures 11, 12, and 13 at the end of this article.

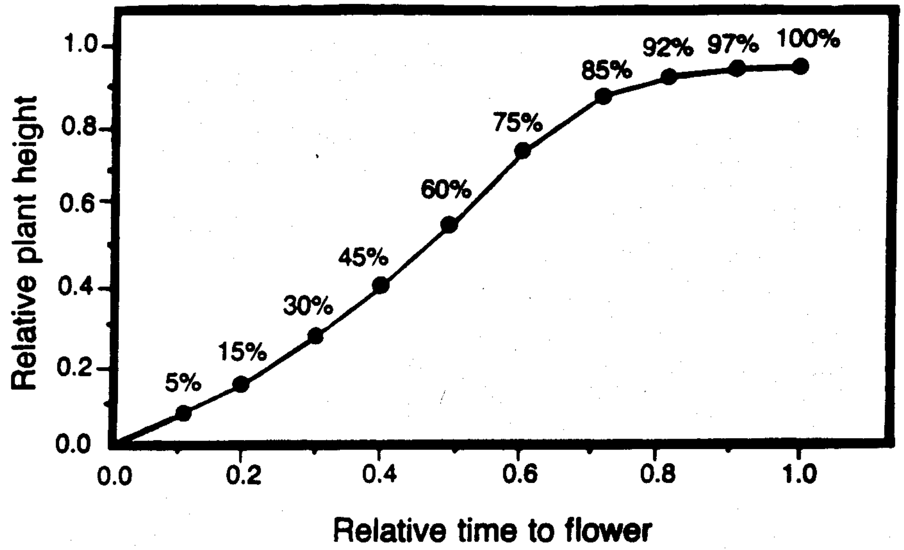
Bract Expansion:

Poinsettia bract expansion is affected by the day/night temperature plants are grown under. Bracts are modified leaves. The bracts, themselves, are typically expanding during the last 2

"Everyone should graphically track their poinsettia crop. It is the best way to insure that your crop finishes at your desired height."

Making a graphical track

Figure 1. Growth curve for poinsettia and chrysanthemum.



To make a graphical track, all you need to know is your crop time (from pinch to flower), growth percentages at specific points during crop development (taken from growth curve above) and final desired crop height.

To make a graphical track for a poinsettia crop, start with the above growth curve, which is typical for a poinsettia crop. From the curve and the percentages shown, you can make your own growth curve for any poinsettia crop.

For example we'll use a poinsettia crop we grew at the university, which has an 11-week (77 days) production time from pinch to finish. Pot height is 5.5 inches; cutting height is 4 inches. Final desired height is between 18 and 20 inches, determined by customer specifications.

The growth we're really concerned with is lateral shoot growth after pinching, so we subtract the fixed or constant factors making up total plant height. Leave a window on the final lateral shoot length of 1 or 2 inches.

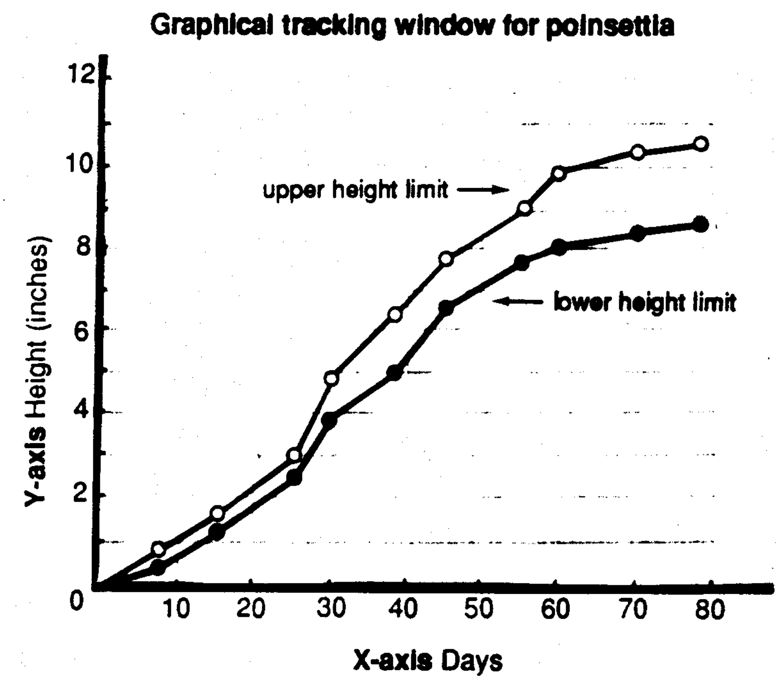
Lateral shoot length = 18 inches – 4-inch cutting height – 5.5-inch pot height = 8.5 inches to 10.5 inches.

In this case, over the 77-day crop time, we want lateral shoots to elongate at least 8.5 inches but no more than 10.5 inches. Lateral shoot lengths are numbers you'll use to calculate upper and lower limits of the tracking window.

Now, to make the graphical tracking window, make two tables—x-axis and y-axis—like the ones on page 29. In both tables, the relative time and relative height columns (black numbers) stay the same for every poinsettia graph. The red numbers are ones you need to fill in: the number of days from pinch to flower on the x-axis table (in our example 77 days) and the lower and upper height limits on the y-axis table (8.5 inches and 10.5 inches).

The blue numbers are ones we calculate; these are the numbers we'll use to create your tracking window. In the x-axis table, multiply time in crop development (expressed as a decimal, not a percentage) by number of days from pinch to flower to get your x-values. In the y-axis table, multiply crop height (taken from the growth curve and expressed as a decimal, not a percentage) by the lower final height limit to get y-values for the lower line of your tracking window. Follow the same procedure with the upper final height limit to get y-values for the upper line of your tracking window.

Use the blue numbers to create a graphical tracking window. On the days represented on the x-axis, measure sample plants (use the same plant over time) and plot their average height (y-value) against the day in crop development (x-value). Points should fall within the tracking window.



X-axis

Time (%)	Calculation (time % as a decimal × days from pinch to flower)	Days (X-value)
0	0 × 77	0
10	0.1 × 77	7.7
20	0.2 × 77	15.4
30	0.3 × 77	23.4
40	0.4 × 77	30.8
50	0.5 × 77	38.5
60	0.6 × 77	46.2
70	0.7 × 77	53.9
80	0.8 × 77	61.6
90	0.9 × 77	69.3
100	1.0 × 77	77.0

Y-axis

Height (% taken from growth curve)	Calculation (height % as a decimal × final height lower limit)	Lower height limit (inches) (y-value)	Calculation (____ × final height upper limit)	Upper height limit (inches) (y-value)
0	0 × 8.5	0	0 × 10.5	0
5	0.05 × 8.5	0.4	0.05 × 10.5	0.5
15	0.15 × 8.5	1.3	0.15 × 10.5	1.6
30	0.3 × 8.5	2.6	0.3 × 10.5	3.2
45	0.45 × 8.5	3.8	0.45 × 10.5	4.7
60	0.6 × 8.5	5.1	0.6 × 10.5	6.3
75	0.75 × 8.5	6.4	0.75 × 10.5	7.9
85	0.85 × 8.5	7.2	0.85 × 10.5	8.9
92	0.92 × 8.5	7.8	0.92 × 10.5	9.7
97	0.97 × 8.5	8.2	0.97 × 10.5	10.2
100	1.0 × 8.5	8.5	1.0 × 10.5	10.5

weeks of October before coloring. Bract leaf size increases as temperature increases up to approximately 76°F. Too often, night temperatures are reduced late in development when bract leaves are still expanding and final bract size is inadvertently reduced.

Growth regulators should not be applied when bract leaves are expanding since bract size can be reduced because of reduced leaf expansion.

Bract Coloring:

Bract coloring occurs due to a buildup of the pigment anthocyanin in the bract leaves. Anthocyanin production is affected by light intensity and temperature. Anthocyanin production increases as light intensity (irradiance) increases. In contrast, anthocyanin production increases as temperature decreases. Therefore, the greatest coloring occurs under cool and bright conditions.

Drop temperatures at the end of the production cycle to intensify poinsettia bract color if you have sunny days. Dropping temperatures during cloudy conditions/high humidity could result in a *Botrytis* outbreak.

Temperatures should not be dropped until after bract leaves are done expanding and if fungicides have not been applied for *Pythium* and *Rhizoctonia* control. Temperatures can be dropped to 55-57°F without harming plants.

Nutrition:

Poinsettias are unique in their nutritional requirements (Table 7). Specifically, poinsettias

1) are a high nitrogen requiring crop compared to other crops we grow.

2) have a high molybdenum requirement,

3) and can be poor at taking up calcium.

Recommended nutrient levels for 'standard' irrigation water are shown in Table 8.

Nitrogen Requirement:

Poinsettias benefit from elevated nitrogen levels, particularly early in development. The amount of ammoniacal nitrogen should never exceed 30% of the total nitrogen in the fertilizer mix.

> "Bract leaf expansion increases as day and/or night temperature approaches 72-74°F."

A continuous liquid feed program through the irrigation water is recommended. To apply 240-360 ppm N, mix 1 to 1.5 lbs. of a 20% nitrogen fertilizer per 100 gallons of final solution. The fertilizer have an equal amount of potassium (K). Therefore, a 20-20-20 or a 20-10-20 premixed fertilizer can be used. If you are applying phosphoric acid to your irrigation water to reduce pH and/or alkalinity, then do not apply fertilizer that contains phosphorus (P).

Typical premixed fertilizers contain a high proportion of the nitrogen in the urea/ammonium form (often 50-75%). Use low ammonium fertilizers early in development. Use NO ammonium fertilizer late in development. The 'dark mix' types of fertilizer has little or/no ammonium in the fertilizer.

Table *. Recommended media nutrient levels as identified by Spurway and Saturated Paste Extraction procedures.

Extraction Technique	Recommended Nutrient Levels											
	SS	pH	NO3	NH4	P	K	Ca	Mg	Fe	Mn	Zn	B
Spurway	<160	6.2	250	5	8	80	175	45	0.25	0.25	0.25	0.25
Saturated P.	2.0	6.0	180	5	20	130	150	75	not reported		-	-

Item	Desirable Range	Units	Comments
pH	6.0 to 8.0	—	Normally slightly alkaline for ground waters due to contact with limestone. Acidic waters may evolve from areas of decomposing organic matter or unusual mineral deposits. Very high values may indicate high sodium.
Salinity	Less than 800	EC X 10^6	The conductivity indicates dissolved mineral content. Where specific element balance is favorable, higher values may be satisfactory. The higher the salinity, the greater the leaching requirement.
SAR	0 to 4		Sodium absorption ratio is a calculated value indicating the sodium hazard. Values above 8 indicate potential for impairing growing medium structure.
Boron	0.2 to 0.8	ppm	An important element for plant nutrition, but toxic in high concentration.
Sodium	Less than 2	meq/l	Small amounts are not harmful and can beneficially substitute for potassium when deficient. Excess causes leaf necrosis and burn.
Calcium	1 to 5	meq/l	Levels equal to or higher than sodium are desirable. A plant nutrient, relatively harmless at fairly high concentrations.
Magnesium	0.5 to 2	meq/l	A plant nutrient normally present in lower concentration than calcium. Higher values not apt to be harmful.
Chloride	Less than 2.0	meq/l	Although required in minute amount for plant nutrition, high levels are toxic to some plants.
Sulfate	0.5 to 5.0	meq/l	An important plant nutrient. Less apt to be harmful in high concentration than chloride.
Carbonates	Less than 2	meq/l	Plant tolerance varies. High values may enhance sodium effects. Can be neutralized by adding mineral acid.

Table 8. Water analysis interpretation. Higher levels of specific nutrients than caited may be beneficial if they are nutrients utilized in plant growth.

Fertilizer effects on postharvest life are discussed later in this article.

Table 23. MINERAL ANALYSIS INTERPRETATION KEY FOR POINSETTIA LEAF TISSUE

	Element	Critical Level	Normal Range	Toxic Level
Percentage	Nitrogen	3.5	4.0-6.0	7.3
Percentage	Phosphorus	0.15	0.3-0.6	0.9
Percentage	Potassium	1.0	1.5-3.5	4.0
Percentage	Calcium	0.5	1.0-1.75	
Percentage	Magnesium	0.2	0.3-1.0	
Percentage	Sulfur	.05	0.1-0.3	
Percentage	Sodium		0-0.4	0.5
Percentage	Chloride		0-1.5	3.0
PPM	Fluoride		0-4	5
PPM	Lithium		0-15	20
PPM	Copper	1	2-10	
PPM	Zinc	20	25-60	
PPM	Manganese	40	60-300	650
PPM	Iron	50	100-300	
PPM	Boron	15	25-75	100
PPM	*Molybdenum	0.5	1-5	

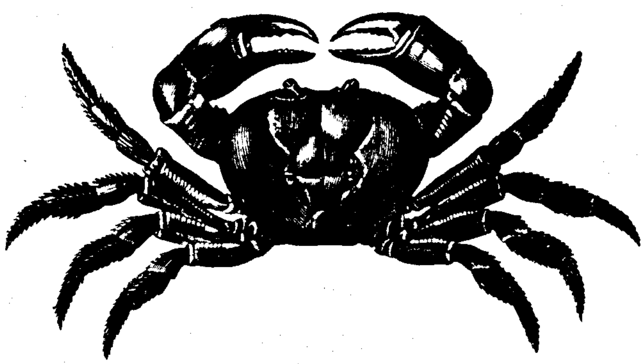
(Concentrations based on oven-dry tissue)

Sampling: Youngest mature leaves including petiole. Approximately 20 leaves required per sample.

*Molybdenum deficiency can be indirectly assessed by determining nitrate-nitrogen. Levels of nitrate-nitrogen higher than 3000 ppm indicate molybdenum deficiency.

Table 9. Mineral analysis interpretation key for poinsettia leaf tissue.

Optimal media nutrient levels (identified using Spurway and saturated paste extraction procedures) are shown above.



Molybdenum:

Poinsettias grown without supplemental molybdenum will often develop molybdenum deficiency. Molybdenum deficiency symptoms include

1) chlorosis along the edges of leaves on the middle of the plant that eventually results in necrosis,

2) often leaves are distorted and some yellow blotching of leaves is evident,

3) Symptoms spread up and down the plant.

Molybdenum should be added throughout poinsettia production in the fertilizer. Premixed 'poinsettia' fertilizer mixes usually contain molybdenum.

You can mix your own molybdenum stock solution to add to your fertilizer.

Mix 1 lb of sodium or ammonium molybdate in 5 gallons of water to make a molybdenum stock solution. Mix 1.5 fluid ounces of stock solution in 1,000 gallons of final fertilizer solution.

Molybdenum deficiency is aggravated by a ??? medium pH.

A quick solution to molybdenum deficiency is to spray plants with ammonium or sodium molybdate at a rate of 2 ounces/100 gallons (0.15 grams/liter). Add a surfactant to facilitate coverage of foliage.

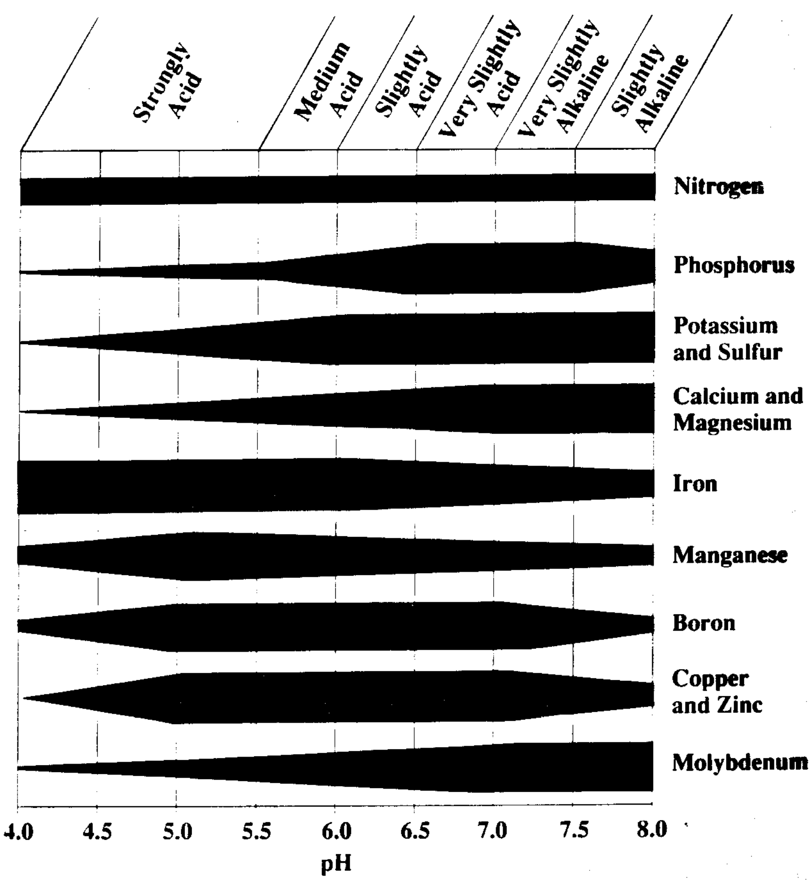
<u>Calcium Deficiency:</u>
Poinsettias can have difficulties taking up calcium even when sufficient calcium is available in the media. Calcium deficiency is usually expressed on young leaves early in poinsettia development. Late in development calcium deficiency is expressed as a bract edge burn or necrosis. *Botrytis* often attacks tissue along the edge of the bract after calcium deficiency has resulted in necrosis.

Poinsettia need adequate calcium levels in the medium AND an environment that encourages transpiration (evaporation of water from the leaves) to achieve adequate endogenous calcium levels. Environmental conditions that limit calcium uptake include:

1) high humidity
2) low light conditions
3) cool day temperatures

Calcium levels in the upper leaves should be a minimum 4-6% (4,000-6,000 ppm) as determined by ICP Spectroscopy to inhibit bract edge burn (Table 9). Determine foliar calcium levels regularly starting the beginning of

Figure 5. The influence of <u>soil</u> pH level on the availability of essential nutrients for plant growth.



SOLUBLE FERTILIZER	ANALYSIS	AMT./ 10 CU.M.	PPM IN SOLUTION
Ammonium nitrate	34-0-0	1 kg	34 N
Ammonium nitrate/lime	26-0-0	1 kg	26 N
Ammonium sulfate	21-0-0	1 kg	21 N, 72 SO_4
Calcium nitrate	15.5-0-0	1 kg	15.5 N, 21 Ca
Urea	46-0-0	1 kg	46 N
Di-ammonium phosphate	21-54-0	1 kg	21 N, 23 P (54 P_2O_5)
Mono-ammonium phosphate	12-62-0	1 kg	12 N, 27 P (62 P_2O_5)
Potassium chloride	0-0-60	1 kg	50 K (60 K2O)
Potassium sulfate	0-0-50	1 kg	42 K (50 K_2O), 56 SO_4
Potassium nitrate	13-0-45	1 kg	13 N, 37.5 K (45 K_2O)
Magnesium sulfate	10% Mg	1 kg	10 Mg, 41 SO_4
Salitre Chileano	14-0-15	1 kg	14 N, 12.5 K, 22 Na
75% Phosphoric acid	0-54-0	1 liter (1.64 kg)	38.5 P (88.6 P_2O_5)
85% Phosphoric acid	0-61-0	1 liter (1.62 kg)	49 P (113 P_2O_5)
Copper sulfate	25% Cu	10 grams	.25 Cu
Zinc sulfate	35% Zn	10 grams	.35 Zn
Iron sulfate	20% Fe	100 grams	2 Fe
Manganese sulfate	27% Mn	10 grams	.27 Mn
Borax	11% B	10 grams	.11 B
Borax	20.5%	10 grams	.21 B
Sodium molybdate	40% Mo	1 gram	.04 Mo
Ammonium molybdate	54% Mo	1 gram	.05 Mo
Molybdic acid	59% Mo	1 gram	.06 Mo

Note: 1 cu. meter = 1000 liters = 264 U.S. gallons
1 kg = 1000 grams = 2.2 lbs.
1 liter = 1000 cc = 34 fl. oz.

Table 10. Useful information when mixing your own fertilizer as is recommended in northern climates after October 1 to avoid ammonium toxicity and bract edge burn.

Table 20. FERTILIZER ELEMENTS AS PPM IN WATER

		LBS. PER 1,000 GALLONS									
		1	2	3	4	5	6	7	8	9	10
Ammonium	NO_3-N	20	40	60	80	100	120	140	160	180	200
Nitrate	NH_4-N	20	40	60	80	100	120	140	160	180	200
(33.5-0-0)	Total N	40	80	120	160	200	240	280	320	360	400
Ammonium	NO_4-N	25	50	75	100	125	150	175	200	225	250
Sulfate	SO_4	86	172	248	344	430	518	602	688	776	860
(21-0-0)											
Calcium	NO_3-N	19	37	55	73	92	110	130	149	167	186
Nitrate	Ca	25	50	75	100	125	150	175	200	225	250
(15.5-0-0)											
Di-ammonium	NH_4-N	25	50	75	100	125	150	175	200	225	250
Phosphate	P	28	55	83	110	138	165	193	220	248	275
(21-53-0)											
Magnesium	Mg	11	23	34	45	57	68	80	91	102	113
Sulfate	SO_4	47	93	140	187	233	280	328	373	420	467
(10%Mg)											
Muriate	K	60	120	180	240	300	360	420	480	540	600
of Potash	Cl	48	96	144	192	240	288	336	384	432	480
(0-0-60)											
Potassium	NO_3-N	17	34	50	67	84	101	118	134	151	168
Nitrate	K	45	90	135	180	225	270	315	360	405	450
(14-0-45)											
75%H_3PO_4	P	31	61	92	122	153	183	214	244	274	305
(0-54-0)	Fl. oz.	10.5	21.1	31.6	42.2	53	63.5	74	84	95	105

Note: Approximately 7 fl. oz. per 1,000 gallons required to neutralize 1 meq/l of bicarbonate

"Simples" refers to a single compound which may contain one or two fertilizer elements as opposed to "mixed," "blended," or "balanced" fertilizers which are combinations of "simples."

Table 22. AMOUNT OF FERTILIZER TO MAKE A 250 PPM NITROGEN SOLUTION.

	Final volume of solution (gallons)			
Fertilizer formula	**1000**	**100**	**50**	**5**
15-16-17	14 lbs.	22 ozs.	11 ozs.	2T*
20-10-20	10 lbs. 8 ozs.	17 ozs.	8½ ozs.	5t*
25-10-10	8 lbs. 5 ozs.	13 ozs.	6½ ozs.	4t
13-0-44 (potassium nitrate)	16 lbs.	25 ozs.	13 ozs.	8t
15.5-0-0 (calcium nitrate)	13 lbs. 6 ozs.	22 ozs.	11 ozs.	2T
34-0-0 (ammonium nitrate)	6 lbs. 4 ozs.	10 ozs.	5 ozs.	3t

*t = teaspoon
*T = Tablespoon

Tables 11 and 12. Fertilizer elements as ppm in water with different sources and amount of fertilizer to make a 250 ppm nitrogen solution using different fertilizer mixes.

September. It is especially critical that calcium levels are checked in the beginning of October immediately prior to bract leaf expansion.

"Do a tissue test of the edges of upper leaves at the end of September to insure that your crop has adequate calcium."

Spray plants with calcium nitrate or calcium chloride if calcium levels are low when plants are young and make sure calcium levels in the media are in the recommended range. Spray calcium nitrate at a rate of 0.8-1.9 lbs calcium nitrate/100 gallons or 0.7-1.5 lbs calcium chloride/100 gallons. Either of these formulations applies 250-500 ppm calcium to the foliage.

Late in development when bracts are coloring calcium sprays may discolor bracts. Calcium levels in the medium should be in the recommended range and the humidity of the environment should be reduced to promote calcium uptake. Reduce humidity by heating during the day and venting.

AmmoniumToxicity:
Ammonium toxicity can occur when high levels of ammonium/urea nitrogen forms are in the medium. Symptoms of ammonium toxicity include yellowing of the leaf margin on older leaves and burning of root tips. Ammonium toxicity occurs most frequently when:

1) poinsettias are often fertilized with fertilizers that contain more than 40% ammoniacal nitrogen,

2) media contain some soil,

3) temperatures are cool and light conditions are low.

Ammonium toxicity may actually be a symptom of calcium deficiency since ammonium can compete with calcium for uptake.

Magnesium Deficiency:
Magnesium deficiency is quite common in the upper Midwest since magnesium is easily leached from the medium and media pH tends to increase regularly up to 6.8 and higher since the alkalinity of the water in the upper Midwest is often high. Magnesium is less available for uptake at high media pH Figure 5). Note: magnesium is limited in soilless media when pH is high but not soil based media. Symptoms of magnesium deficiency are interveinal chlorosis of the lower leaves.

Magnesium deficiency is aggravated by excessively high levels of calcium/ potassium.

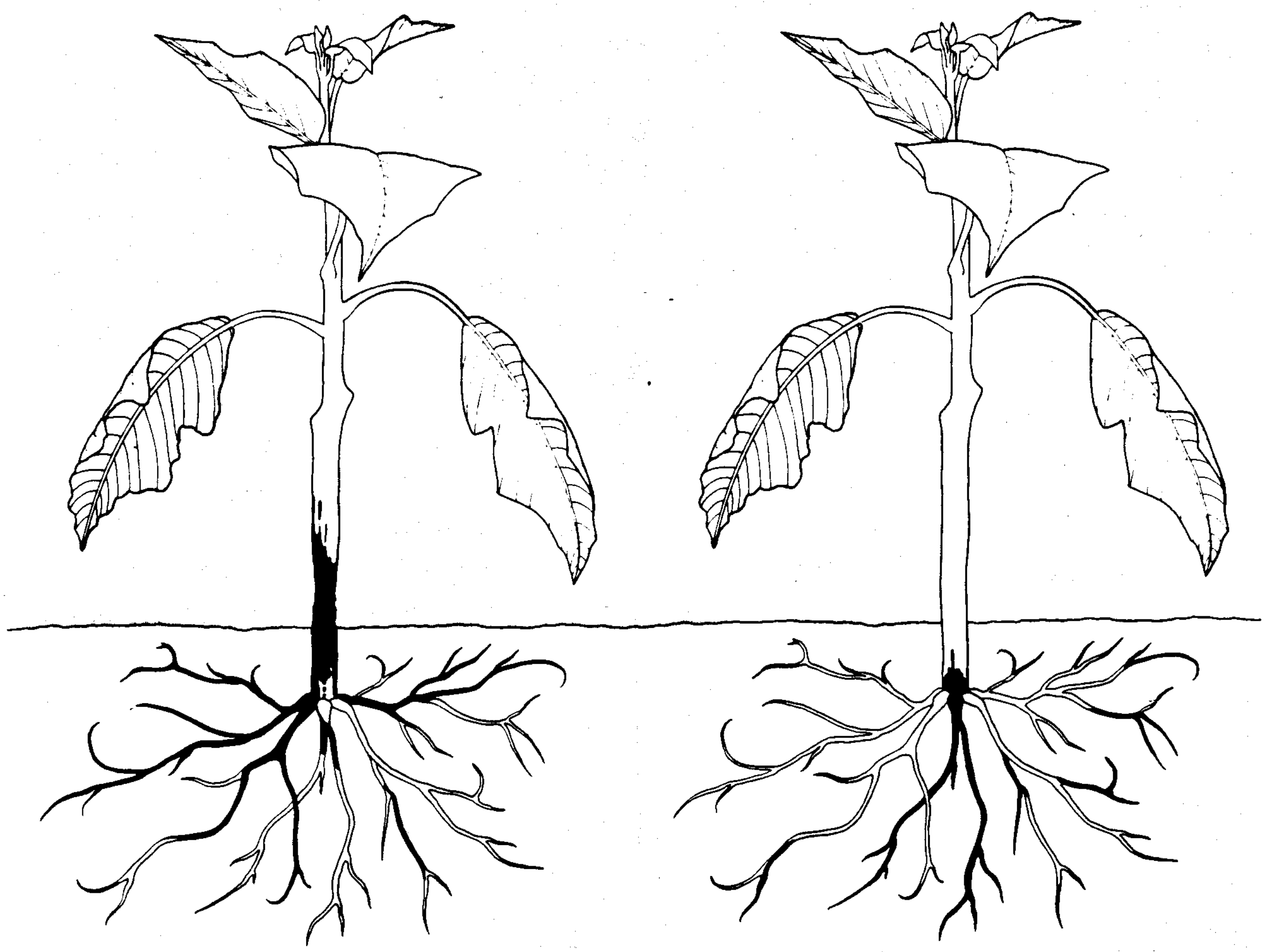


Figure 6. The difference between *Rhizoctonia* (left) versus *Pythium* (right) infestation in poinsettia.

Avoid magnesium deficiency by applying 8 ounces magnesium sulfate (Epsom salts)/100 gallons as a media drench at least once per month. Helpful tables that can be used to help you mix your own fertilizers are shown in Tables 10, 11, and 12. Remember to add molybdenum if you do this!

Root Rots and *Botrytis*:

Poinsettia are susceptible to both *Pythium* and *Rhizoctonia* root rots (Figure 6). Both of these organisms are water molds that require moisture to proliferate.

You must assume that *Pythium* and *Rhizoctonia* are always present and

"Always apply preventative fungicide drenches for both *Rhizoctonia* and *Pythium* control."

PREVENTIVELY apply fungicides to control them. Biological control is not as effective as chemical control. The profit margin on poinsettias is too narrow to absorb the loss of plants when the cost of fungicides are still relatively low.

Apply fungicide drenches at least once a month for control of BOTH *Pythium* and *Rhizoctonia*. Make sure you apply enough drench material to reach the bottom of the pot. For those of you hand watering, this may mean redrenching the crop 2-3 times.

It is especially important that fungicide applications are up to date at the end of the crop because retailers tend to overwater plants when they are marketed in the plastic sleeves that do not allow for drainage. This overwatering provides a perfect environment for root rot proliferation.

Pythium infestation early in production is often associated with a fungus gnats (Figure 8). Fungus gnat larvae attack the callose at the base of a rooted cutting. The wound provides a 'point-of-entry' for *Pythium* and/or *Rhizoctonia* to enter into the plant. Therefore, fungicide applications must be coupled with fungus gnat larval control early in production.

Materials available for *Pythium* and *Rhizoctonia* control commonly used and found to be effective are:

Pythium:
- Subdue
- Banrot

Rhizoctonia:
- Banrot
- Cleary's 3336
- Terrachlor

Rhizoctonia and *Pythium* differ initially in how they attack the plant (figure 6). Note that *Rhizoctonia* tends to attack from the soil interface both up and down. In contrast, *Pythium* tends to attack from the roots up.

Botrytis mold can also be a major problem on poinsettias. *Botrytis* is a grey mold that attacks initially on the leaf surface and gives a leaf a 'fuzzy' appearance. *Botrytis* most often attacks dead tissue first. However, severe infestations can attack living tissue.

Botrytis proliferates in environments that are cool and humid. The *Botrytis* spore must have a moist surface on which to germinate. Therefore, one of the most effective methods of *Botrytis* control is to reduce humidity by venting or adding horizontal airflow fans. Horizontal airflow can reduce the humidity within a canopy depending on how the fans are oriented.

It is very important to water in the morning and not late in the day when foliage may stay wet the entire night.

Chemical control of *Botrytis* is achieved by spraying a fungicide on the foliage or fumigating. Late in poinsettia production, fumigation is the only option since sprays could discolor bracts. Call your state extension specialist for specifics on what materials are best for *Botrytis* control at what time in plant development.

Insects:

Whitefly and fungus gnats are the most common insect problems on poinsettias in the upper Midwest. The adult whitefly flies and is covered with a white, way powder. The immature stages (pupa) are flat, oval and can appear translucent or whitish in color (Figure 7).

Whiteflies infest poinsettias on the underside of the leaf making spray applications difficult. The whitefly 1) reduces plant vigor by feeding on plant fluids, and 2) leaves unsightly waste products on the upper surface of the leaf immediately below the infested leaf.

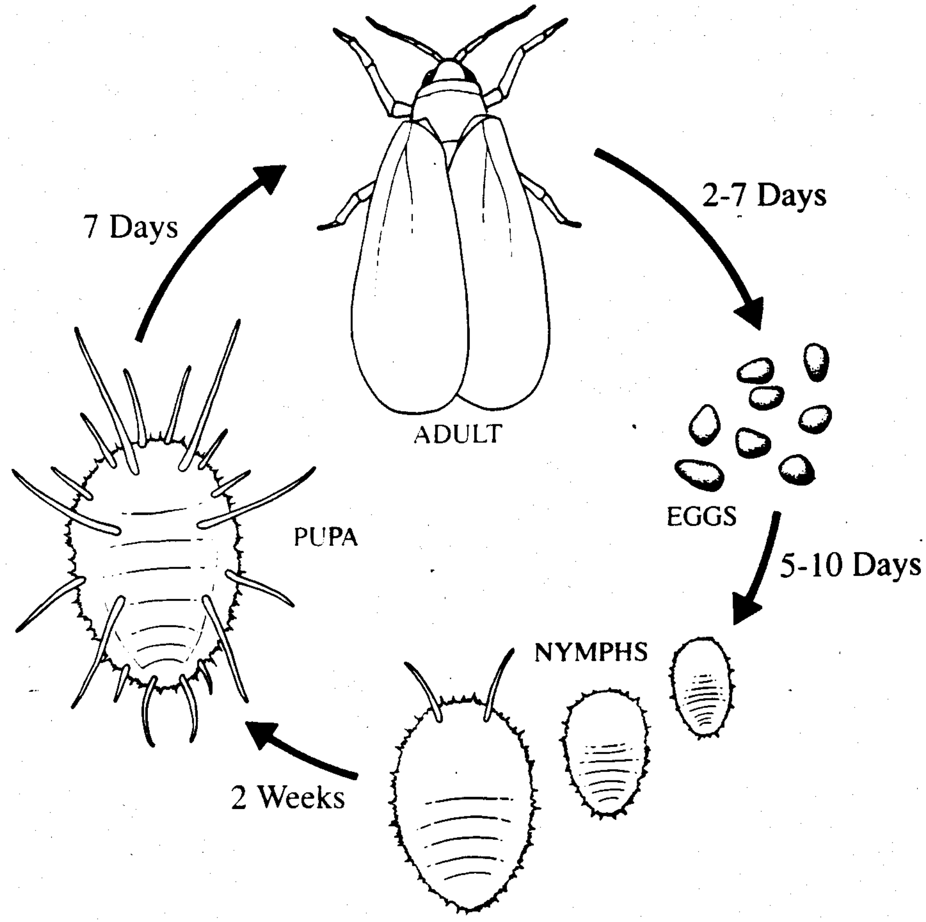


Figure 7. The lifecycle of the greenhouse whitefly (*Trialeurodes vaporariorum*).

Whiteflies exist in egg, larval, and adult stages (Figure *) which can make control difficult.

Yellow sticky cards/traps should be used to monitor for the presence of whiteflies. When using a spray control, it is imperative that the underside of the leaf is sprayed. Effective spray pesticides for whitefly control can be obtained from you state extension entomologist.

The introduction of insecticide Marathon has greatly reduced the threat of whitefly infestations on poinsettias. Marathon is a systemic insecticide that is effective for approximately 6-8 weeks.

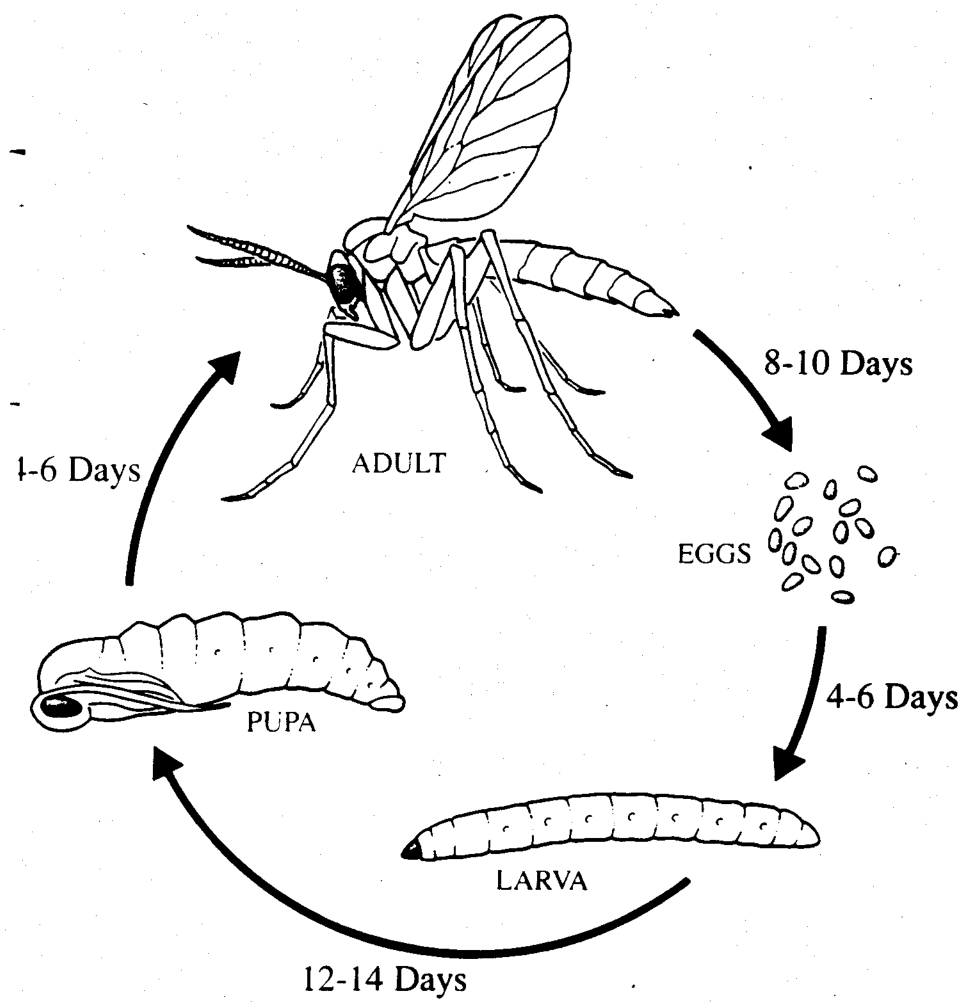


Figure 8. Life cycle of the fungus gnat (*Bradysia* spp.).

The effectiveness of Marathon is greatly affected by whether the roots are given sufficient time to take the active ingredient up. The active ingredient in Marathon is very soluble, and is therefore, easily leached from the pot with irrigation water.

Therefore, after you apply Marathon to the media surface wet the material lightly but DO NOT WATER HEAVILY. Also, remember that conditions that are not favorable for transpiration of water from the leaf, i.e. cloudy and humid conditions, will probably not encourage Marathon uptake. Therefore, uptake may take longer.

<u>Fungus Gnats:</u> Fungus gnats are small winged insects that move on the foliage and media surface with short jerky motions. Fungus gnat larvae in the media are slender, legless maggots that are white with a black head (Figure 8)..

Eggs are laid in the media and hatch in about 1 week. The maggots feed for approximately 2 weeks on organic matter in the media including roots. Fungus gnat larvae seem to especially like to feed on callose at the base of newly planted cuttings immediately after cuttings come out of propagation.

Fungus gnats are a problem in poinsettias because the larval feeding provides a point of entry for fungal diseases into the stem/root.

Hydrated lime drenches can be used to control fungus gnat infestations on soil surfaces under benches (1 1/2 pounds/gallon water) with copper sulfate (1 pound/gallon water). Insecticide sprays/drenches that are effective in controlling fungus gnats can be obtained from your regional extension entomologist.

Postharvest:

The postharvest life of poinsettias is dependent on the final conditioning plants receive by the grower, cultivar, how the retailer handles plants and how the consumer handles the plant. It is desirable for the grower to condition plants prior to shipping to limit the shock that a plant experiences when removed from the greenhouse environment. Terril Nell at the University of Florida has done a considerable amount of research in this area. Poinsettia postharvest life is usually judged by retention of cyathia and/or leaves

Reducing fertilizer, watering, and temperature at the end of the production cycle can help to acclimate the plant. High fertilization throughout production increases poinsettia leaf drop indoors. Therefore, terminate fertilizer during the final 2-3 weeks of production to limit postharvest leaf loss.

Also, limit the amount of ammonium based fertilizers late in production. In northern climates you should not be using fertilizer containing ammonium or urea anyway! Higher levels of ammonium based fertilizers tend to decrease the postharvest life of poinsettias.

Lateral shoot breakage:
Lateral shoots can break off the main stem when moved late in production. Lateral shoot breakage occurs because of weak joints/excessively large bracts. Weak joints are formed when temperatures are hot after pinching and plants are crowded. In addition, the production of larger and larger bracts places a greater pressure on the joint. Lastly, the longer the stem the greater the pressure on the joint (remember your physics of leverage!).

It is critical that the joints initially develop slowly to build strength into

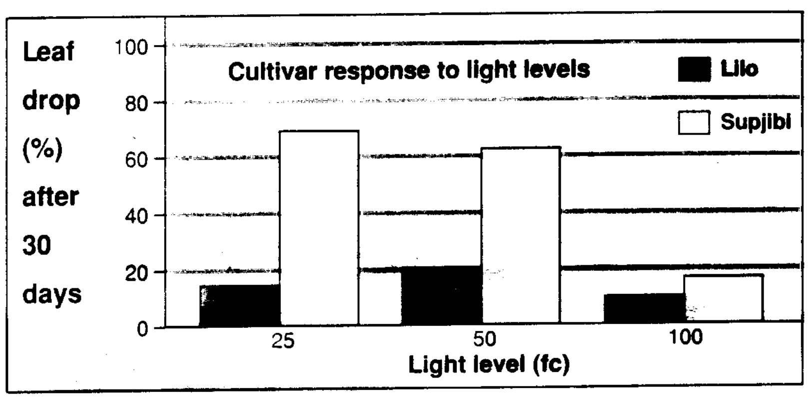


Figure 9. Effect of cultivar and light level on postharvest leaf drop (%) after 30 days.

the joint. Also, plants should be given some space - but not too much. Placing plants at final spacing after pinch can result in horizontal lateral shoots that will break off when plants are sleeved.

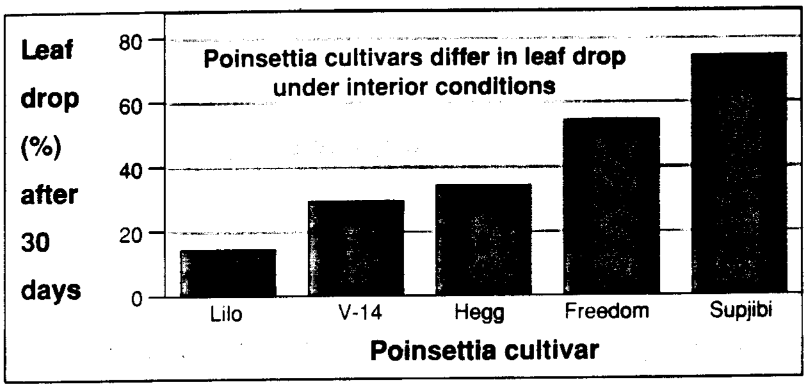


Figure 10. Effect of cultivar on postharvest leaf loss after 30 days.

Make sure you acclimate plants by reducing temperatures late in production. As mentioned previously, lowering temperatures late in production increases bract coloring and/or intensity as well. Remember that fungicides should have been applied up until this time to prevent root rots when plants are grown cool late in production.

Do not expose poinsettias to temperatures below 50oF! Chilling injury can occur. Lastly, do not water plants immediately before sleeving as this can encourage a *Botrytis* infestation.

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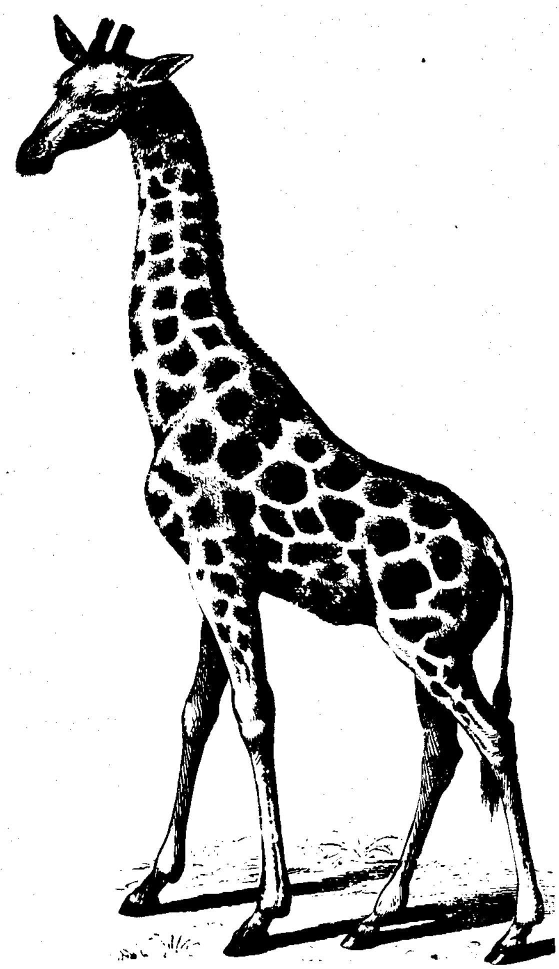
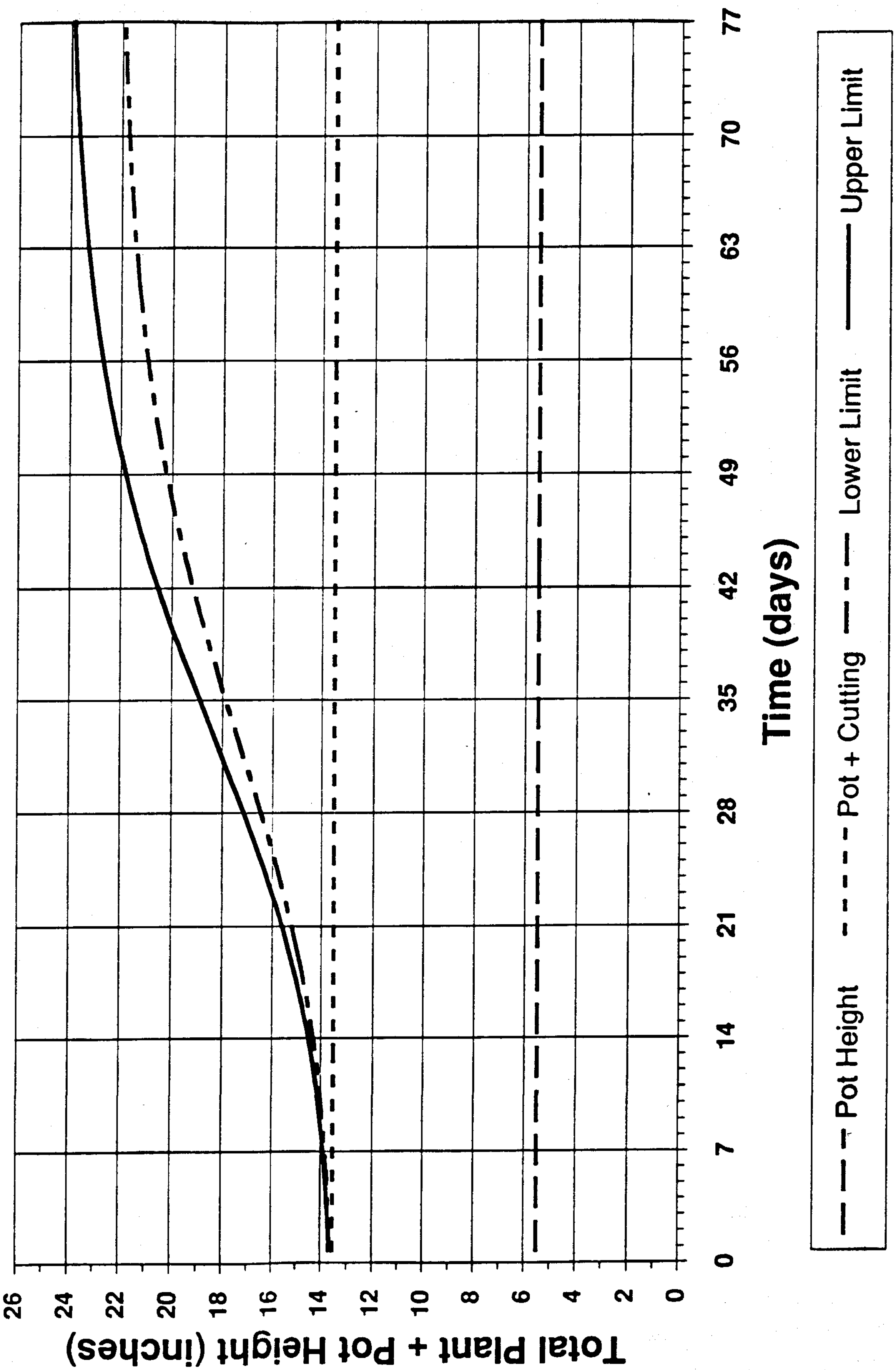


tracking graph template

22-24" (8 week) 3 Weeks From Pinch to SD 8" Mother Stem



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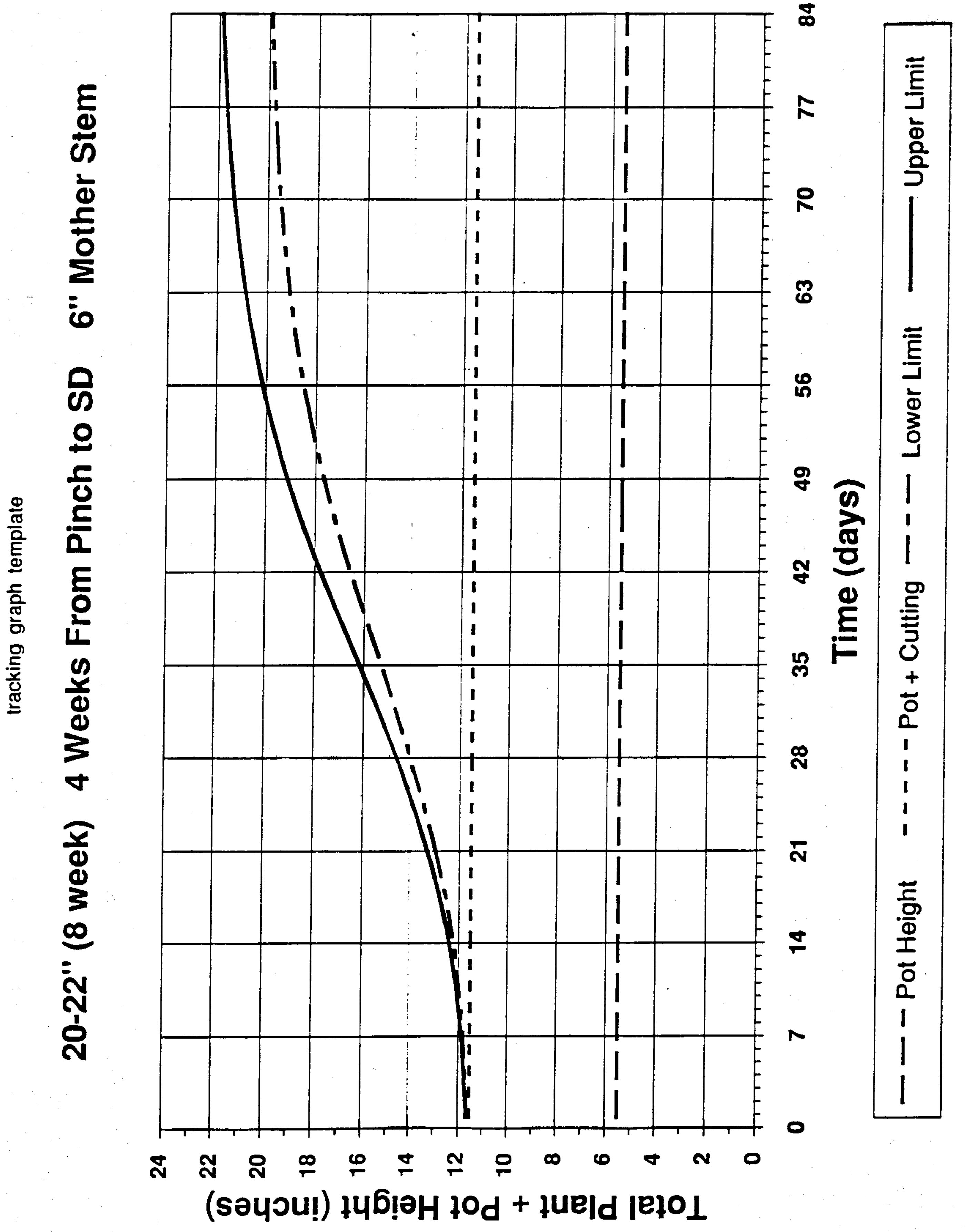
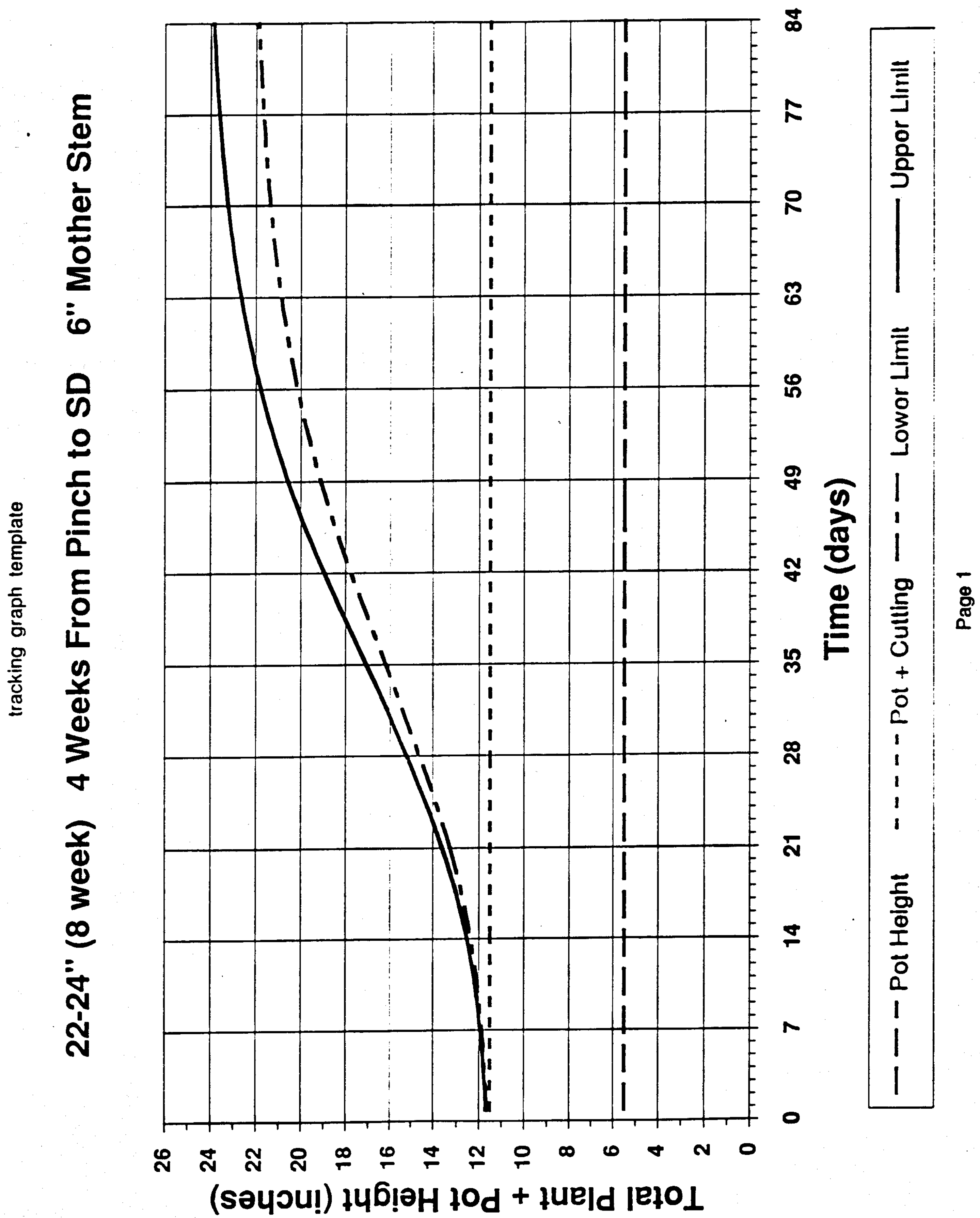

tracking graph template
20-22" (8 week) 4 Weeks From Pinch to SD 6" Mother Stem
Total Plant + Pot Height (inches)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (days)
0
7
14
21
28
35
42
49
56
63
70
77
84
Pot Height
Pot + Cutting
Lower Limit
Upper Limit
Page 1



tracking graph template
22-24" (8 week) 4 Weeks From Pinch to SD 6" Mother Stem
Total Plant + Pot Height (inches)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
7
14
21
28
35
42
49
56
63
70
77
84
Time (days)
Pot Height
Pot + Cutting
Lower Limit
Upper Limit
Page 1