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# POINSETTIA HEIGHT CONTROL[1]

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The application of recent scientific findings has made "tailored" poinsettia plants the rule, rather than the exception in Minnesota. Six years ago, Lindstrom and Tolbert (4) reported that applications of CCC (Cycocel or 2-chloroethyl trimethylammonium chloride) to the soil of poinsettia plants resulted in the development of short plants with thick stems. Three years ago,

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Larson and McIntyre (3) reported that B-995 (B-Nine or N-dimethylaminosuccinamic acid) effectively regulated the growth of poinsettias under certain conditions. In 1964, Widmer (5) noted that soil drenches and foliar applications of CCC produced similar plant responses. In 1965 Widmer et al. (6) found once again that soil and foliar applications of CCC to poinsettia plants produced similar results. They also reported that B-995 applied to the foliage significantly reduced plant height, but that many florets of plants treated with high concentrations (7,500 ppm) failed to develop to normal size and frequently abscised prematurely. Widmer et al. (6) suggested the following application rates for the varieties Barbara Ecke Supreme and Paul Mikkelsen.

| Time of application | Cycocel | | B-Nine |
|---|---|---|---|
| | Soil | foliar | foliar |
| July, August | 6,000 ppm | 3,000 ppm | 7,500 ppm |
| September | 3,000 ppm | 3,000 ppm | 7,500 ppm |
| October | 1,500-3,000 ppm | 1,500 ppm | 5,000 ppm |
| Thereafter (if desired) | 500 ppm | 500 ppm | 500 ppm |

Basic objectives of the 1965 study were (1) to determine the relative effectiveness of foliar and soil applications of growth regulators and (2) to determine whether repeat applications were necessary to control height of plants propagated early in the season.

## Materials and Methods

All 1965 studies were conducted in the University greenhouses on the St. Paul Campus. Plants were propagated by placing cuttings in 2½-inch clay pots under intermittent mist. The soil mixture consisted of two parts sphagnum peat moss, one part loam, and one part sand with 8 pounds coated 18-9-9 fertilizer incorporated into each cubic yard of soil. The panning soil was a mixture of two parts loam, one part sphagnum peat moss, and one part sand with 2½ pounds superphosphate (0-20-0) per cubic yard of soil mixed in before planting. All mixtures and pots were steam-sterilized. Plants were grown in full light intensity at a night temperature of 60° F. until December 1, and at 65° thereafter. Plants were lighted from September 15 to October 5 unless otherwise noted. Panned plants were fertilized regularly with a solution of a 20-20-20 ratio supplemented with muriate of potash (0-0-60) when needed.

Technical CCC with Dreft (1 level tablespoon per 2 gallons water), added as a wetting agent for foliar applications, and the commercial preparation of B-Nine, which included a wetting agent, were used. Quantities of CCC solution applied as a soil drench were 20 and 250 ml. per 2½- and 6-inch pots, respectively. Foliar applications were applied to runoff. Water was kept off foliage for 24 hours after application to prevent washing off the growth regulator. For simplification, the name Cycocel is used hereafter to indicate the use of the commercial preparation with wetting agent included, and CCC is used to indicate the use of the technical material in combination with Dreft as a wetting agent.

All plants were watered freely to encourage rapid growth. The plants were graded into uniform groups per treatment at the start of each study.

## Early Propagation

Study 1. Cuttings of Barbara Ecke Supreme, Paul Mikkelsen, and a limited number of Elisabeth Ecke were taken on July 16. Growth regulators were applied to established plants at intervals beginning on August 12 as indicated in Table 1. There were 10 plants per treatment. They were transferred to 6-inch plastic pans on September 23 (Elisabeth Ecke on October 13), three plants each in two pans, and four plants in the third pan.

Because of a calculation error, the August 12 and September 2 applications of B-Nine were made at one-tenth the desired concentration. These low concentration applications of B-Nine served to accelerate rather than limit stem elongation. Therefore, subsequent applications were modified accordingly and B-Nine applications were not equivalent to foliar applications of CCC.

Chlorotic areas were evident starting in late August on some foliage of each of the three varieties sprayed with CCC. Plants of Barbara Ecke Supreme were least affected; Paul Mikkelsen plants were most affected. The chlorosis was not considered serious, and all of the affected areas had turned green by flowering time, with the exception of a few leaf margins on Paul Mikkelsen plants.

Paul Mikkelsen plants sprayed with B-Nine and check plants matured later than those treated with CCC.

Plant measurements shown in Table 1 were recorded on December 22. All treated plants were shorter than check plants. All treatments were more effective in limiting stem elongation in plants of Barbara Ecke Supreme than in plants of Paul Mikkelsen. In most instances, the diameter of the bract cluster was not reduced by the application of growth regulators. A comparison of equivalent concentrations of CCC applied to soil and foliage showed that foliar applications were more effective in limiting stem elongation (see Figures 1 and 2).

Study 2. Cuttings of Barbara Ecke Supreme and Paul Mikkelsen were taken on July 27. Growth regulators were applied to established plants at intervals beginning on August 23, as indicated in Table 2. Once again, there were 10 plants per treatment. They were transferred to 6-inch plastic pans on October 13.

As in Study 1, the August 23 application of B-Nine was made at one-tenth the desired strength because of a calculation error. Once again, the application of low concentrations of B-Nine served to accelerate rather than limit stem elongation. Subsequent applications were adjusted in accordance with the error but were not equivalent to foliar applications of CCC.

Chlorotic areas were evident starting in early September on some foliage of plants of both varieties sprayed with CCC. All chlorotic areas had turned green by flowering time.

Plants treated with B-Nine, especially the Paul Mikkelsen plants, were slower to mature than those treated with CCC.

Table 1. Comparison of soil and foliar applications of growth regulators to three varieties of poinsettias propagated July 16 and treated beginning August 12.*

| | Treatment | Variety: Barbara Ecke Supreme | | Paul Mikkelsen | | Elisabeth Ecke | |
|---|---|---|---|---|---|---|---|
| | CCC to soil | Mean Height (in)** | Mean Bract Diameter (in) | Mean Height (in)** | Mean Bract Diameter (in) | Mean Height (in)** | Mean Bract Diameter (in) |
| 1 | 6,000 ppm Aug. 12 | 18.9 | 13.2 | 23.0 | 11.3 | | |
| 2 | 6,000- Aug. 12, 3,000- Sept. 9 | 18.1 | 13.0 | 23.4 | 10.9 | | |
| 3 | 3,000- Aug. 12 | 24.1 | 12.5 | 27.9 | 11.2 | | |
| 4 | 3,000- Aug. 12 and Sept. 9 | 24.6 | 12.5 | 26.1 | 10.8 | | |
| 5 | 3,000- Aug. 12 and Sept. 9, 1,500- Oct. 7 | 22.4 | 13.3 | 25.6 | 10.6 | | |
| 6 | 3,000- Aug. 12, Sept. 9, Oct. 7 | 19.9 | 13.2 | ---- | ---- | | |
| | CCC to foliage | | | | | | |
| 7 | 3,000 ppm- Aug. 12 | 22.3 | 12.6 | 26.1 | 10.9 | | |
| 8 | 3,000- Aug. 12, 1,500- Sept. 2 | 19.7 | 12.3 | 24.6 | 10.4 | 8.7 | 10.8 |
| 9 | 3,000- Aug. 12, Sept. 2 | 16.2 | 14.1 | 21.5 | 10.2 | | |
| 10 | 3,000- Aug. 12, Sept. 2, 1,500 Sept. 30 | 13.3 | 13.9 | 20.0 | 9.5 | | |
| 11 | 3,000- Aug. 12, Sept. 2, 1,500 Sept. 30, Oct. 21 | 13.7 | 12.3 | ---- | ---- | | |
| | B-Nine to foliage*** | | | | | | |
| 12 | 500 ppm Aug. 12, 5,000- Sept. 9 | 26.8 | 13.7 | 29.1 | 9.4 | | |
| 13 | 500- Aug. 12, Sept. 2, 5,000 Sept. 9 and 3,000 Sept. 30 | 23.0 | 14.1 | 29.7 | 9.5 | | |
| 14 | 750- Aug. 12, 7,500 Sept. 2 | 25.7 | 13.8 | 28.4 | 9.3 | | |
| 15 | 750- Aug. 12, 500 Sept. 2, 7,500 Sept. 9, 3,000 Sept. 30 | 24.8 | 13.4 | 29.0 | 8.9 | 13.5 | 11.9 |
| 16 | 750- Aug. 12, 750 Sept. 2, 7,500 Sept. 9, 5,000 Sept. 30 | 24.0 | 12.6 | ---- | ---- | | |
| 17 | 750- Aug. 12, 750 Sept. 2, 7,500 Sept. 9, 5,000 Sept. 30, 3,000 Oct. 21 | 22.4 | 12.5 | ---- | ---- | | |
| 18 | 300 Aug. 12, Sept. 2, 3,000 Sept. 9, Sept. 30 | 27.9 | 10.9 | 29.2 | 9.8 | | |
| 19 | Untreated check | 33.0 | 11.4 | 32.2 | 9.1 | 15.4 | 14.5 |

*There were 10 plants per treatment. Plants were measured on December 22.
**Height above pot rim.
***B-Nine applications August 12 and September 2, one-tenth desired strength.

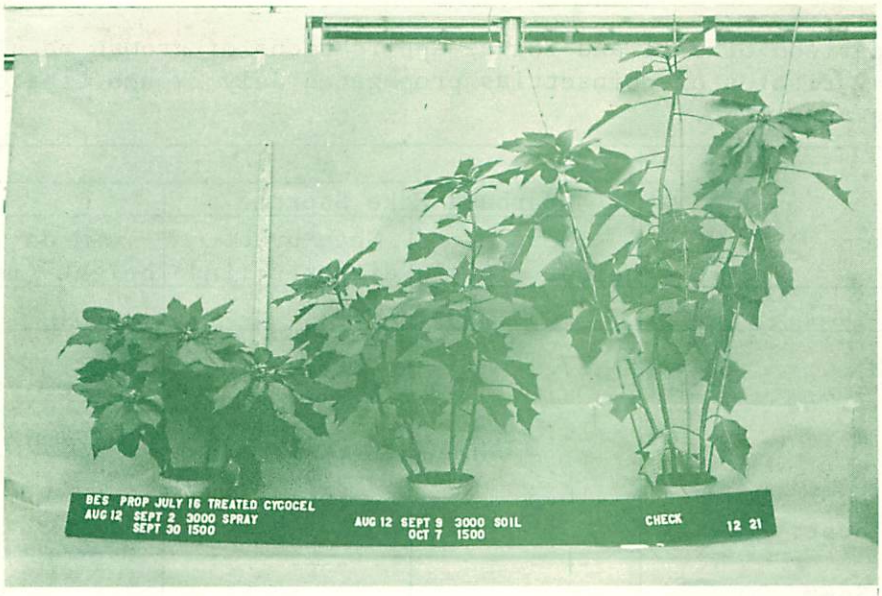


Figure 1. **Plants of Barbara Ecke Supreme** propagated on July 16 and treated with CCC as indicated. They were shifted from $2\frac{1}{2}$-inch pots to 6-inch pans on September 23 and lighted from September 15 to October 5. The two applications of 3,000 ppm to the foliage were made 3 weeks apart, whereas the two applications of 3,000 ppm to the soil were made 4 weeks apart. Photographed December 21, 1965.


Figure 2. Plants of Paul Mikkelsen propagated on July 16 and treated with CCC as indicated. They were shifted from $2\frac{1}{2}$-inch pots to 6-inch pans on September 23 and lighted from September 15 to October 5. The two applications of 3,000 ppm to the foliage were made 3 weeks apart, whereas the two applications of 3,000 ppm to the soil were made 4 weeks apart. Photographed December 21, 1965.

Table 2. Comparison of soil and foliar applications of growth regulators to two varieties of poinsettias propagated July 27 and treated beginning August 23.*

| | Treatment | Variety | | | |
|---|---|---|---|---|---|
| | | Barbara Ecke Supreme | | Paul Mikkelsen | |
| | | Mean height (in)** | Mean bract diameter (in) | Mean height (in)** | Mean bract diameter (in) |
| | Cycocel to soil | | | | |
| 1 | 6,000 ppm Aug. 23 | 17.4 | 13.4 | 21.3 | 10.4 |
| 2 | 6,000- Aug. 23, 3,000 Sept. 20 | 16.8 | 13.1 | 21.3 | 10.4 |
| 3 | 3,000- Aug. 23 | 19.5 | 14.4 | 22.6 | 10.9 |
| 4 | 3,000- Aug. 23, Sept. 20 | 16.3 | 15.1 | 23.1 | 10.5 |
| 5 | 3,000- Aug. 23, Sept. 20, 1,500- Oct. 18 | ---- | ---- | 22.5 | 10.1 |
| 6 | 3,000- Aug. 23, Sept. 20, Oct. 18 | ---- | ---- | 21.7 | 10.1 |
| | Cycocel to foliage | | | | |
| 7 | 3,000- ppm Aug. 23 | 17.0 | 14.5 | 20.2 | 10.1 |
| 8 | 3,000- Aug. 23, 1,500 Sept. 13 | 14.1 | 13.4 | 19.9 | 9.9 |
| 9 | 3,000- Aug. 23, Sept. 13 | 12.8 | 13.4 | 19.5 | 9.7 |
| 10 | 3,000- Aug. 23, Sept. 13, 1,500 Oct. 11 | 11.4 | 12.1 | 17.5 | 9.5 |
| 11 | 3,000- Aug. 23, Sept. 13, 1,500 Oct. 11, Nov. 8 | ---- | ---- | 18.8 | 9.7 |
| | B-Nine to foliage*** | | | | |
| 12 | 500 ppm Aug. 23, 5,000 Sept. 9 | 19.9 | 14.6 | 22.5 | 10.9 |
| 13 | 500- Aug. 23, 5,000 Sept. 9, 3,000 Sept. 30 | 18.2 | 14.7 | 23.8 | 10.2 |
| 14 | 750- Aug. 23, 7,500 Sept. 9 | 18.3 | 14.4 | 21.8 | 10.3 |
| 15 | 750- Aug. 23, 7,500 Sept. 9, 3,000 Sept. 30 | 17.4 | 13.4 | 22.8 | 10.1 |
| 16 | 750- Aug. 23, 7,500 Sept. 9, 5,000 Sept. 30 | ---- | ---- | 22.8 | 10.4 |
| 17 | Same as 16 + 3,000 Oct. 21 | ---- | ---- | 23.3 | 10.3 |
| 18 | 300- Aug. 23, 3,000 Sept. 9, 3,000 Sept. 30 | 20.8 | 14.6 | 22.5 | 9.4 |
| 19 | Untreated check | 23.7 | 15.6 | 23.6 | 11.3 |

*There were 10 plants per treatment. Plants were measured at maturity: Barbara Ecke Supreme, December 14; Paul Mikkelsen, December 20.

**Height above pot rim.

***B-Nine application August 23, one-tenth desired strength.

Plant measurements shown in Table 2 were recorded on December 14 and 20. Slower maturing plants of Paul Mikkelsen were measured on the later date. CCC effectively limited plant height and diameter of the bract cluster. A comparison of equivalent concentrations of CCC applied to soil and foliage showed once again that foliar applications of CCC to both varieties were more effective in limiting plant height and also resulted in smaller bract clusters. Height restriction was greater in plants of Barbara Ecke Supreme than in plants of Paul Mikkelsen. Diameter reduction of bract clusters of plants treated with CCC ranged from 0.5 to 3.5 inches. The application of B-Nine limited plant stretch in most instances, but only to a limited extent in Paul Mikkelsen plants. Diameter of the bract cluster of plants treated with B-Nine was reduced by 0.4 to 2.2 inches.

## Normal Season Propagation

Study 3. Cuttings of Barbara Ecke Supreme, Paul Mikkelsen, and Elisabeth Ecke were taken on August 25. Growth regulators were applied to established plants on September 23 and October 14 as indicated in Table 3. Half of the plants were grown at a night temperature of 60° F. and the other half at 68° from September 23 to December 1. All plants were grown at 65° thereafter. The plants were transplanted into 6-inch pans (three and four plants per pan) on November 8. Plants of Paul Mikkelsen were grown in the natural photoperiod. There were 10 plants per treatment.

Plant measurements are presented in Table 3. Applications of CCC reduced plant height at both temperatures for all varieties. Diameter of the bract cluster also was reduced in most instances. The extent of height control was similar at the two temperatures for plants of the variety Barbara Ecke Supreme. Height control for plants of Paul Mikkelsen and bract cluster restriction for plants of Paul Mikkelsen and Barbara Ecke Supreme were less at 68° F. than at 60°. The application of B-Nine generally had less effect than CCC in limiting plant height or restricting size of bract cluster for plants of the three varieties. Response to temperature by plants treated with B-Nine did not indicate any trend.

## Discussions And Conclusions

July propagation of poinsettias is not a recommended procedure for the commercial producer. Cuttings were taken on July 16 and 27 in the studies reported to determine the need for and the effect of repeated applications of growth regulators. These studies showed that (1) foliar applications of CCC were practical, (2) early propagated plants could be kept at a practical height, and (3) repeat applications at 3 week intervals effectively controlled plant stretch. The number of repeat applications required should be determined by the degree of plant stretch and weather conditions.

Study 3 results showed that CCC was less effective at 68° F. than at 60° in controlling height of Paul Mikkelsen plants and that diameter of the bract cluster was greater at 68° for both Barbara Ecke Supreme and Paul Mikkelsen. A similar response was reported by Widmer (5) and Widmer et al. (6) in 1965. The temperature in September 1965 averaged 7.6° lower than normal, and percentage of possible sunshine was 27 compared to a norm of 59. Thus, plants in the 1965 studies would have grown taller in a normal year. Increases in temperature did not appear to influence the effectiveness of B-Nine.

Table 3. Comparison of foliar applications of growth regulators to three varieties of poinsettias propagated August 25 and treated beginning September 23 *

| | Treatment | Variety | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Barbara Ecke Supreme | | | | Paul Mikkelsen | | | | Elisabeth Ecke | |
| | | 60° F. | | 68° F. | | 60° F. | | 68° F. | | 60° F. | |
| | | Mean height (in)** | Mean bract diameter (in) | Mean height (in)** | Mean bract diameter (in) | Mean height (in)** | Mean bract diameter (in) | Mean height (in)** | Mean bract diameter (in) | Mean height (in)** | Mean bract diameter (in) |
| | CCC to foliage | | | | | | | | | | |
| 1 | 1,500 ppm Sept. 23 | 8.2 | 10.8 | 8.8 | 11.3 | 8.3 | 8.5 | 11.5 | 9.6 | 6.6 | 10.2 |
| 2 | 1,500 Sept. 23, Oct. 14 | 9.3 | 10.1 | 9.1 | 12.0 | 8.9 | 8.1 | 9.7 | 8.8 | 5.8 | 9.8 |
| 3 | 3,000 Sept. 23 | 8.4 | 10.5 | 7.6 | 11.4 | 9.0 | 8.6 | 9.9 | 10.2 | 5.3 | 9.3 |
| 4 | 3,000 Sept. 23, Oct. 14 | 8.2 | 10.6 | 8.1 | 11.6 | 8.3 | 8.3 | 9.4 | 8.6 | --- | ---- |
| | B-Nine to foliage | | | | | | | | | | |
| 5 | 2,500 ppm Sept. 23, Oct. 14 | 10.7 | 11.5 | 9.9 | 10.9 | 10.3 | 8.7 | 11.8 | 9.6 | --- | ---- |
| 6 | 5,000 Sept. 23 | 9.9 | 11.1 | 10.2 | 10.8 | 10.1 | 8.8 | 12.6 | 10.9 | 7.0 | 10.1 |
| 7 | 5,000 Sept. 23, 2,500 Oct. 14 | 9.9 | 10.8 | 8.0 | 9.3 | 10.0 | 8.4 | 12.6 | 10.2 | 6.9 | 9.6 |
| 8 | 5,000 Sept. 23, Oct. 14 | 10.0 | 11.2 | 8.4 | 11.1 | 10.2 | 9.9 | 10.6 | 9.5 | --- | ---- |
| 9 | 7,500 Sept. 23 | 10.1 | 11.4 | 8.6 | 11.1 | 10.2 | 9.8 | 12.9 | 10.4 | 7.0 | 9.8 |
| 10 | Untreated check | 9.6 | 12.1 | 10.6 | 11.6 | 10.9 | 9.6 | 12.6 | 9.7 | 8.1 | 9.9 |

*Half of the plants were grown at 60° F. and half at 68° from September 23 to December 1, and all were grown at 65° thereafter. There were 10 plants per treatment. Plants were measured on December 22.

**Height above pot rim.

Kiplinger and Miller (1) reported that in Ohio, applications of Cycocel to the soil of poinsettias were more effective in reducing height than were foliar sprays, even when the sprays were repeated twice at monthly intervals. Larson and Love (2) stated that in North Carolina, there was little difference in final height between plants sprayed twice with Cycocel at a 3-week interval and plants treated with a Cycocel drench. Results with the July 16 and July 27 propagated plants in this report showed quite clearly that foliar applications of CCC with Dreft were equal to and sometimes more effective than soil drenches in controlling stem elongation. The foliar applications were made at 3-week intervals and the soil applications at 4-week intervals when repeated. The Minnesota findings confirmed results obtained in 1963 (5) and 1964 (6).

Three possible reasons for the supposedly different results obtained by workers in Ohio and North Carolina might be differences in (1) the quantity of drench applied to the soil, (2) the wetting agents used, and (3) the climate of the area. Kiplinger and Miller (1) applied 60 ml. of Cycocel solution per plant, and Larson and Love (2) applied 60 ml. per 2 1/4-inch pot. In Minnesota, 20 ml. of solution were applied per 2 1/4-inch pot, so a smaller quantity of actual CCC was applied to the soil. Therefore, Minnesota and North Carolina findings were not too varied when quantities of growth retardant applied were considered. The difference between wetting agents resulted because the Ohio and North Carolina workers used the commercial formulation of Cycocel which had a wetting agent incorporated. In Minnesota, technical CCC was used and Dreft was added as a wetting agent. As for climate, Minnesota is generally cooler than either Ohio or North Carolina. Previous discussion indicated that CCC frequently is less effective with increases in temperature. It is conceivable that foliar applications of Cycocel may be less effective than soil applications at high air temperatures, because a smaller total quantity of the growth retardant is applied in foliar sprays than in soil drenches of equal concentrations. In addition, the foliar application of CCC at 3-week intervals, as used in North Carolina and Minnesota, appeared preferable to foliar applications at monthly intervals as used in Ohio.

Larson and McIntyre (3) found that B-Nine provided good poinsettia height control with plants propagated between August 1 and 15, but only limited control with plants propagated between August 31 and September 14, 1963. Widmer (5) noted similar results. Kiplinger and Miller (1) stated that a foliar spray of B-Nine was less effective than a Cycocel drench. In the current study, where a comparison could be made, CCC was more effective than B-Nine as a foliar spray. In addition, the use of B-Nine frequently delayed maturity by 1 to 2 weeks.

All of the Paul Mikkelsen plants that were lighted developed some degree of bract cluster splitting. Unlighted plants in Study 3 did not develop split bract clusters.

Foliar applications of CCC are suggested (at 3 week intervals) as the most practical approach to controlling the height of poinsettias because:

(1) Foliar applications are equal to or more effective than soil applications.
(2) Less chemical is needed for foliar than for soil applications, thus lowering the cost of materials.
(3) Foliar applications are easier and quicker to apply because soil applications must be measured to provide a uniform effect.
(4) B-Nine at effective rates is considerably more costly than CCC for application to poinsettias. It also is more variable in effect on poinsettias.

The grower should be careful in measuring the desired concentration of Cycocel and should remember that other poinsettia varieties may require different Cycocel concentrations. Effective recommended rates of Cycocel may cause some temporary foliar chlorosis. If the aforementioned precautions are observed, any chlorosis that develops should be temporary and insignificant.

## Summary


1. Plants of Barbara Ecke Supreme, Paul Mikkelsen, and Elisabeth Ecke were treated with foliar applications of B-Nine and soil and foliar applications of CCC.

2. Soil and foliar applications of CCC provided similar and effective height control. Repeat applications were recommended, especially for early propagated plants.

3. Foliar applications of B-Nine were less effective and less consistent in controlling plant height than were soil applications.

4. Foliar applications of B-Nine at low concentration (500 ppm) served to accelerate rather than limit stem elongation.

5. High temperatures decreased effectiveness of CCC, but not of B-Nine.

6. Applications of B-Nine delayed anthesis by 1 to 2 weeks.

7. The application of growth regulators controlled plant stretch to a greater extent with Barbara Ecke Supreme than with Paul Mikkelsen plants. In addition, Paul Mikkelsen plants were more subject to chlorosis from foliar applications than from soil applications of CCC.

8. Foliar applications of CCC are suggested as the most practical chemical method of controlling plant stretch in the poinsettia varieties Barbara Ecke Supreme, Paul Mikkelsen, and Elisabeth Ecke. Suggested rates are 3,000 ppm (1-40) applied in July, August, and September; 1,500 ppm (1-80) applied in October; and 500 ppm (if desired) in November. Repeat applications at 3-week intervals for early season plants.


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