

Deleterious Effects of Cool Air Temperature Reversed by Root-Zone Warming in Poinsettia

Harry W. Janes and Richard McAvoy

Department of Horticulture and Forestry, Cook College, Rutgers University, New Brunswick, NJ 08903

Additional index words. *Euphorbia pulcherrima*, anthocyanin content, temperature

Abstract. Poinsettias (*Euphorbia pulcherrima* Willd. cv. Annette Hegg Brilliant Diamond) were grown in separate greenhouses, one in which the night air temperature was maintained at 16.7°C and another where the air temperature was allowed to fall to 11.5°. The cool-air-treated plants were subjected to root-zone temperatures of 17°, 23°, 26°, and 29°. In general, the deleterious effects of cool air temperatures could be reversed by root-zone warming at 23°.

Greenhouse operators are searching for ways to conserve fuel and to lower costs. It is obvious that lowering the night air temperature will result in a saving of fuel dollars. However, this practice for a poinsettia crop is not recommended since cool night temperatures, particularly early in the crop, will alter floral development and initiation (2, 4). Late in the crop, after bracts are apparent, cooler air temperatures may be beneficial to the development of anthocyanin (6). In general, the recommendations call for night air temperatures for a poinsettia crop of between 16° and 18°C (1) for bract induction.

It has been suggested (9) that lowering the night temperature for part of the night may not alter plant growth and development while still saving fuel. However, this technique has received a mixed reaction for poinsettia (8). Certain early-maturing cultivars respond positively to cool (9°-12°C) night air temperatures for part of the night, but late-maturing cultivars reached marketable quality too late in the year. Combining cool night air temperatures with warm root-zone temperatures may allow fuel savings and still produce a salable crop (7), suggesting that a warm root zone reverses the deleterious effects of cool nights.

We described (3) the growth response of several poinsettia cultivars to a warm root zone. The objective of this study was to determine whether a warm root environment would offset the effects of cool night temperatures.

Rooted cuttings of 'Annette Hegg Brilliant

Diamond' poinsettias—one of the cultivars mentioned by Shanks (8) as responding negatively to cool night temperatures—were planted in 15.2-cm pots and were grown single-stem. The greenhouse air temperature for cool night conditions was 24°C day and 11.5° night. A description of the warmed benches onto which the plants were placed was given previously (3). Unheated control plants under warm night conditions were maintained at 16.7° night. Plants were placed on the warmed benches or unheated control bench on September 15, 1980. The plants were given a 4-hr night interruption to prevent floral induction until October 10, when natural daylight conditions were imposed. The temperature of the medium in the middle of the pot in each treatment (in the 11.5° night greenhouse) averaged 17° (heated control), 23°, 26°, and 29° over the course of the experi-

Table 1. Dry weight of 'Annette Hegg Brilliant Diamond' poinsettias grown under various air and root-zone temperatures.

Treatment ^z	Dry wt (g)			
	Stems	Leaves	Axillary shoots	Bract
Warm night	7.8	9.6	10.0	3.8
Cool night				
17° root	5.7 a ^y	9.7 a	9.1 a	3.1 b
23° root	5.7 a	10.0 a	13.8 c	3.9 c
26° root	5.5 a	9.3 a	11.5 b	2.8 ab
29° root	4.8 b	8.3 b	11.2 b	2.5 a

^zThe ambient temperatures were 16.7°C under warm night and 11.5° under cool night.

^yMean separation in columns by Duncan's multiple range test, 5% level.

ment. These temperatures were monitored continuously using thermocouples and a recorder. Canopy temperatures were similar to the air temperatures early in the crop and averaged only 1.5° warmer in the canopy of plants grown with a 29° mean temperature after the canopies developed enough to cover the bench surface. The values reported for night air temperatures are average values obtained by monitoring continuously the air temperature between midnight and 6 AM from October 10 through the end of the experiment. The root-zone temperatures are average values of both day- and night-temperature readings during this same period.

There were 60 pots on each treatment bench of which 15 plants from each temperature regime, chosen randomly at the beginning of the experiment, were used for weekly height measurements and were harvested on December 15 to obtain fresh and dry weights. On November 25 and December 10, 5 plants were chosen randomly from each treatment for total anthocyanin determination of the bract tissue according to the method of Mancinelli

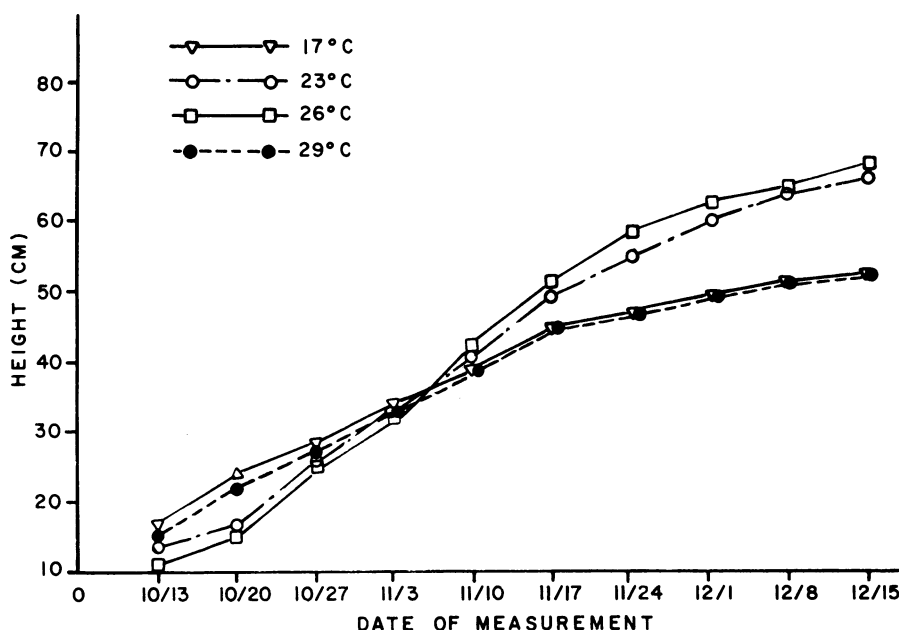


Fig. 1. Alterations in the height of 'Annette Hegg Brilliant Diamond' poinsettias by root-zone heating under cool night air temperatures (11.5°C night and 24° day). Root-zone temperatures are noted on the figure.

Received for publication August 2, 1982. Paper of the Journal Series, New Jersey Agricultural Experiment Station, Cook College, Rutgers University, New Brunswick, NJ. This work was performed as part of NJAES Project No. 12144 supported by the New Jersey Agricultural Experiment Station and Hatch Act Funds. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked advertisement solely to indicate this fact.

Table 2. Anthocyanin content of 'Annette Hegg Brilliant Diamond' poinsettias grown under various air and root-zone temperatures.

Treatment ^a	Total anthocyanin (mg/ml extract ± SE)		
	Nov. 25		Dec. 10
	Main stem	Main stem	Axillary shoot
Warm night	13 ± 1	818 ± 38	660 ± 107
Cool night			
17° root	7 ± 1	378 ± 110	214 ± 82
23° root	40 ± 14	1115 ± 164	---
26° root	43 ± 9	879 ± 82	---
29° root	31 ± 7	861 ± 71	1005 ± 128

^aThe air temperatures were 16.7°C in the warm night greenhouse and 11.5° in the cool night greenhouse.

(5). All plants were watered and fertilized with 200 ppm N (15 N–6.6 P–12.5 K) daily.

Warming the root zone to 26°C increased poinsettia height (Fig. 1). Plants grown at 23° had a height not significantly different from that of the 26° plants, whereas plants grown at 29° exhibited a height (growth) curve similar to that of the cool night control. It appears that under cool night conditions, some root heating promoted growth in height while higher temperatures in the root zone were somewhat inhibitory. Under warm night conditions (3), root-zone heating at any temperature above ambient retarded stem elongation. Plants grown under warm night had a final height of 72 cm. Plants were compact under cool night air temperatures at 17° or 29° root temperature, which is very desirable. Under cool night temperature, the dry weights of plant parts were maximal at a root-warming temperature of 23°, which equalled or surpassed dry weight under warm nights (Table 1).

Cool night conditions delayed anthocyanin development, but root-zone warming overcame this delay. On December 10, the cool night control plants had less anthocyanin than the warm night control plants, but plants grown under cool night conditions with root warming had similar or greater anthocyanin content (Table 2).

Warming the root zones of 'Annette Hegg Brilliant Diamond' poinsettias to 23°C under cool night conditions stimulated growth of bracts and axillary shoots and enhanced anthocyanin development. These plants compared favorably to those grown without root warming under more acceptable night air temperatures. Thus root-zone warming could make it possible to achieve salable plants with reduced night temperatures. Interactions among root warming, different genotypes, and growth regulators remain to be tested.

Literature Cited

1. Ecke, P., Jr. and O.A. Matkin (eds.). 1976. The poinsettia manual. Paul Ecke Poinsettias, Encinitas, Calif.
2. Goddard, G.B. 1961. Flower initiation and development of the poinsettia (*Euphorbia pulcherrima* Willd.). Proc. Amer. Soc. Hort. Sci. 77:564–571.
3. Janes, H.W. and R.McAvoy. 1982. Effect of

4. Larson, R.A. and R.W. Langhans. 1963. The influences of photoperiod on flower bud initiation in poinsettia (*Euphorbia pulcherrima* Willd.). Proc. Amer. Soc. Hort. Sci. 82:547–551.
5. Mancinelli, A.L., C.P.H. Yang, P. Lindquist, O.R. Anderson, and I. Rabino. 1975. Photocontrol of anthocyanin synthesis: III. The action of streptomycin on the synthesis of chlorophyll and anthocyanin. Plant Physiol. 55:251–257.

6. Marousky, F.J. 1968. Effects of temperature on anthocyanin content and color of poinsettia bracts. Proc. Amer. Soc. Hort. Sci. 92:678–684.
7. Sandwell, I. 1977. Warm-rooted tomatoes crop satisfactorily at 5°C night. The Grower 88(13):605–611.
8. Shanks, J.B. 1981. Poinsettia—the Christmas flower. Md. Flor. 231:13–14.
9. Thorne, J.H. and R.A. Jaynes. 1977. Split greenhouse night temperatures to save fuel. HortScience 12:194.

HortScience 18(3):364–365. 1983.

The Effect of BAS 106, Ancymidol, and Chlormequat on Chrysanthemum and Poinsettia

E. Jay Holcomb, Sally Ream, and Jeffrey Reed

The Pennsylvania State University, University Park, PA 16802

Additional index words. growth retardant, daminozide, *Chrysanthemum X morifolium*, *Euphorbia pulcherrima*

Abstract. Application of 5-(4-chlorophenyl)-3,4,5,9,10 pentaaza-tetracyclo-5,4,10^{2,6} 0^{8,11}-dodeca-3-9-diene (BAS 106) by granular (1G) application to the medium surface or 50% wettable powder (50 WP) soil drench were compared with standard methods of application for (2-chloroethyl)trimethylammonium chloride (chlormequat), butanedioic acid mono-(2,2-dimethylhydrazide) (daminozide), and alpha-cyclopropyl-alpha-(p-methoxyphenyl)-5-pyrimidinemethanol (ancymidol) for their retardation of chrysanthemum and poinsettia growth. A 32 mg/pot BAS 106 (50 WP) rate caused temporary venial chlorosis of the leaves. BAS 106 (1G) at 6 mg/pot and BAS 106 (50 WP) at 8 mg/pot retarded *Chrysanthemum X morifolium* Ramat, 'Always Pink' as effectively as daminozide spray at 2500 mg/liter; whereas the same treatments were more effective on chrysanthemum 'Ritz' than either a 2500 mg/liter spray or 0.25 mg/pot ancymidol drench. BAS 106 (1G) topdressed at 18 mg/pot or a BAS 106 (50 WP) drench at 8 mg/pot retarded *Euphorbia pulcherrima* Willd. 'Brilliant Diamond' and 'Paul Mikkelsen' as much as a 0.5 mg/pot ancymidol drench and more than a 3000 mg/liter chlormequat drench.

Chrysanthemum. On May 21, 1981, one rooted cutting of 'Always Pink' chrysanthemum was planted to each 12-cm pot containing a 1 sphagnum peatmoss:1 vermiculite mix (by volume) amended with 4.5 kg single superphosphate, 474 g gypsum, 162 g potassium nitrate, 90 g epsom salt, and 36 g fritted trace elements/m³ (Expt. 1). The night temperature was maintained at 18°C, with day temperature ventilation at 21° ± 2°. Plants were irrigated 2 to 3 times daily with a fertilizer solution containing 200 mg/liter N from a 20N–8.4P–14.9K fertilizer. On June 16 (2 weeks after pinching), all but 2 breaks were removed from each plant. On June 18, the following treatments were applied: BAS 106 (1G) (BASF Wyandotte Corp. Parsippany, N.J.) was topdressed at 2, 6, and 18 mg ai/

pot. BAS 106 (50 WP) was applied as a soil drench at 0, 2, 8, and 32 mg a.i./pot in 100 ml of solution. These treatments were compared with daminozide spray at 2500 mg/liter. The design was completely random with 6 plants per treatment. Final data, taken July 15, 1981, included average height per plant, length of longest stem, and number of nodes on the longest stem.

BAS 106 (50 WP) caused foliar injury to chrysanthemum at 32 mg/pot. The injury was characterized by a temporary yellowing of the veins one week after application. All growth retardants reduced chrysanthemum height compared to the control except for BAS 106 (1G) at 2 mg/pot (Table 1). Increased concentration of BAS 106 (1G or 50 WP) caused greater restriction in plant height. Daminozide-treated plants were 29% shorter than the control and BAS 106 at 6 mg/pot retarded growth similarly. The number of nodes per stem was greater at low levels of BAS 106 than the control, but there is no apparent explanation for this effect.

In a second experiment, rooted cuttings of 'Always Pink' and 'Ritz' chrysanthemum were

Received for publication July 8, 1982. Paper No. 6465 in the Journal Series of the Pennsylvania Agricultural Experiment Station. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.