FLOWER INITIATION IN RHODODENDRONS AS INFLUENCED BY TEMPERATURE AND LIGHT INTENSITY

Christina W. Auman

One of the most highly prized and popular ornamental plant species known, the genus Rhododendron consists of over 900 species and is native to almost all mountainous regions in the northern hemisphere. Many in horticulture have wanted to capitalize on the assets of Rhododendrons by incorporating them into the pot plant industry. Attempts to do this over the last 15-20 years have met with only limited success. There is as yet no reliable method for the successful forcing of a potted rhododendron. Progress has been achieved in many problem areas such as controlling erratic growth habit (7,8), preventing root rot disease (4,5), and in producing a younger flowering plant (9). There are still major problems to be overcome. Obtaining consistently uniform bud set on a high percentage of the plants grown is still a major problem, however. This lack of uniformity has been a major stumbling block to grower acceptance of the rhododendron as a serious contender for the pot plant industry. Research in this area has been limited and the data presented are inconsistent from study to study.

The concept to overcome this problem using growth regulators was first introduced by Cathey (2) in the mid-sixties. He reported an increase in flower buds using Phosfon and B-nine and an interrupted photoperiod. Work done at N. C. State in the early seventies by Nell (6) showed little if any increase in flower bud number when Phosfon was applied as a drench on the cultivar 'Cheer'. Ryan (7) found increased flower initiation on field-grown 'Cynthia' plants in the second year of growth with pre-plant treatments of treble superphosphate combined with two applications of 10,000 ppm Alar (B-nine). However, nutritional work done by Bosley (1) could not show any correlation between increased bud set and fertilizer treatments. Ticknor (9) at Oregon State recommended forcing one-year old cuttings treated with either Phosfon or Cycocel. Growth regulating chemicals such as Cycocel, Phosfon, and B-nine can have a positive though somewhat unreliable effect on flower initiation in rhododendrons. Success with these chemicals seems dependent on cultivar selection and the environmental conditions employed. A consistently reliable method for producing uniformly budded plants must be devised.

A large majority of the hybrid rhododendrons now being used and tested for forcing are progenies of species which are natives of mountainous regions. Their habitats have cool nights and days and high light intensity. Little work has been done to determine the influence of temperature and light intensity on bud set. A recent study done at N. C. State was designed to determine the effects of these environmental conditions on flower bud initiation in combination with and compared to currently recommended forcing procedures for rhododendrons.

All temperature and light intensity treatments were conducted in the NCSU Phytotron with actual forcing done in the Horticultural Greenhouses.

Ten month old rhododendron plants with an average of two shoots per plant were grown in controlled environment rooms in the Phytotron. Cultivars, 'Dr. A. Blok,' 'Jean Marie de montague,' 'Marchioness of Lansdowne,' and 'Unique' were chosen on the basis of one or more of the following characteristics: parentage, hardiness, growth habit, disease resistance, floriferousness, and forcing quality. Plants were grown in 6'' (15 cm) standard plastic pots in a medium consisting of three parts bark humus to one part perlite on a volume basis amended with dolomitic limestone and treble superphosphate. Throughout the course of the study Truban and Benlate applied at standard rates were used as protective fungicides against the root rot fungus *Phytophthora cinnamomi*.

An equal number of plants of each cultivar were separated into three temperature combinations (Table 1). Half the plants in each temperature treatment

Table 1. Temperature combinations and their duration used in the study

Chamber	Day Temperature	Night Temperature	Duration
A (warm)	72 F (22 C)	65 F (18 C)	22 weeks
B (seasonal)	72 F (22 C)	50 F (10 C)	4 weeks
	72 F (22 C)	65 F (18 C)	12 weeks
	72 F (22 C)	57 F (14 C)	6 weeks
C (cool)	72 F (22 C)	50 F (10 C)	22 weeks

were place under shade cloth which reduced the light intensity from 4500 ft candles (480 hlx) to 2250 ft candles (240 hlx). The forcing procedure was timed from July 8, 1977, when the terminal bud was removed from all shoots of each plant. Plants were given 14 weeks of 9 hour days with a 3 hour light break from 11 PM - 2 AM followed by 8 weeks of short (9 hour) days regardless of temperature treatment. Five weeks after the pinch date, when new shoots had begun to expand, plants were treated with Cycocel, Phosfon or no growth regulator. Cycocel (11.8% active ingredient) was applied as a drench at a rate of 200 ml per pot at a concentration of 5900 ppm. Plants treated with technical grade Phosfon (99% active ingredient) received .4 grams active ingredient in a 200 ml solution per pot. Plants were watered twice daily with Phytotron nutrient solution (3).

After 22 weeks plants were moved from the Phytotron to a 40°F (4°C) cooler for eight weeks. Twenty ft-candles (2.2 hlx) of light were provided 12 hours per day. On February 2, 1978, plants were placed in the greenhouse with a natural photoperiod and 65°F (18°C) minimum night temperature. Data were taken when plants bloomed or resumed vegetative growth.

Results

More flower buds were produced in full light than in 50% shade, regardless of cultivar (Table 2). Growth regulator treatments did not substitute for the light intensity requirement. In general, plants treated with Cycocel or Phosfon had an increase in flower bud number over the non-treated plants. However, the increase was not consistent from plant to plant within each treatment and each cultivar responded differently to the chemical treatments. Although cultivars responded differently to the temperature treatments there was not a consistent overall pattern to the responses. Approximately the same percentage of plants flowered within each temperature combination.

Table 2. Effect of light intensity on number of flower buds per plant and percentage of flowering shoots of individual cultivars

% Shade	Cultivar	Avg. No. Flower Buds/Plant	% Flowering Shoots
0% (Full Light)[1]	'Dr. A. Blok'	0.9	28
	'Jean Marie de Montague'	3.4	51
	'Marchioness of Lansdowne'	5.2	78
	'Unique'	3.5	47
50%	'Dr. A. Blok'	0.3	6
	'Jean Marie de Montague'	0.7	15
	'Marchioness of Lansdowne'	1.9	41
	'Unique'	0.3	5
LSD_{05}		1.8	17

[1]Full light equal to 4500 ft candles (480 hlx)

'Dr. A. Blok' did not force well. A majority of the plants of this cultivar failed to initiate any flower buds. Plants grown in the cool temperature produced the most flower buds. Chemically treated plants had flowers of poor quality with buds opening improperly or not at all. Control plants under the same conditions had a high percentage of flowering shoots with excellent flower quality (Fig. 1).

'Jean Marie de Montague' responded well to all chemical treatments when grown without shade. Cycocel-treated plants had the greatest percentage of flowering shoots, though numbers of flowers in the Phosfon treatments were high. Plants in the coolest temperature were shorter and more compact, producing a better quality potted plant (Fig. 2). Plants receiving no chemical treatment had a minimal number of flower buds except in the warm chamber where numbers of flowering shoots were comparable to the chemical treatments.

Figure 1. Effect of cycocel, phosfon, and no chemical on percentage of flowering shoots and flower quality of cv. 'Dr. A. Blok' grown at 4500 ft candles and 72/50 temperature for 22 weeks. A = cycocel, B = no chemical, C = phosfon.

Figure 2. Comparison of cycocel-treated plants of cv. 'Jean Marie de Montague' grown at 4500 ft candles in different temperatures. A = 72/65 for 22 weeks, B = 72/50 for 4 weeks, 72/65 for 12 weeks, 72/57 for 6 weeks, C = 72/50 for 22 weeks.

A high percentage (75%) of flowering shoots was produced on cv. 'Marchioness of Lansdowne' except for shadegrown plants treated with either Phosfon or no chemical. Plants grown in the chamber where temperature fluctuated during the course of the study had 90% or more flowering shoots, both in chemical and non-chemical treatments. Flower quality was excellent for this cultivar.

Chemically-treated 'Unique' plants grown in full light had a greater percentage of flower buds than non-treated plants in all temperature combinations. Plants grown in the warmest chamber had a slightly smaller percentage of flowering shoots than any other temperature combination.

Conclusions

No set of optimal conditions can as yet be recommended for the successful production of a budded rhododendron. As has been the case in almost all previous research, the degree of success seems to depend almost entirely on cultivar selection. Often plants treated in a similar manner responded differently. The most conclusive statement which can be made is that flower bud initiation is severely restricted by reduced light intensity.

The theory that the requirements for flower initiation might be based on the climatic habitat of the individual cultivar did not seem to hold true for all the cultivars tested. Only 'Dr. A. Blok' responded as might have been expected when exposed to cool temperatures similar to those from which one of its parents, *R. catawbiense*, originated. Correlations between temperature and native habitats were only minimal with the other cultivars. However, without more detailed studies similar to this one, temperature cannot be ruled out as a critical factor in rhododendron flower bud initiation. Perhaps a better understanding of the requirements of floral initiation of the rhododendron species from which the cultivars are derived would be the key to quality production of consistently budded rhododendrons. Until there is better understanding of flower bud initiation the rhododendron will remain an untapped resource for the pot plant industry.

Literature Cited

1. Bosley, R. W. 1972. Rhododendron nutrition vs. budding. *Quart. Bull. Amer. Rhod. Soc.* 26(3):176.
2. Cathey, H. M. 1965. Initiation and flowering of rhododendron following regulation by light and growth retardants. *Proc. Amer. Soc. Hort. Sci.* 86:753-760.
3. Downs, R. J. and V. P. Bonaminio. 1976. Phytotron procedural manual for controlled-environment research at the Southeastern Plant Environment Laboratories. *N. C. Agri. Exp. Stat. Tech. Bull.* No. 244.
4. Hoitink, H. A. J. and A. F. Scmitthenner. 1972. Control of *Phytophthora* root rot (wilt) of rhododendron. *Amer. Horticulturist.* 51(2):42-45.
5. Hoitink, H. A. J. and A. F. Scmitthenner. 1974 Recent developments in control of rhododendron root rot. *Proc. Intl. Plant Prop. Soc.* 24:361-364.
6. Nell, T. A. 1973. The influence of several photoperiod and temperature regimes on the growth and flowering of two *Rhododendron catawbiense* Michx. cultivars. Master's Thesis, N. C. State University, Raleigh.
7. Ryan, R. F. 1970. Effects of succinic acid, 2,2-dimethylhydrazide and phosphorus treatments on rhododendron flowering and growth. *J. Amer. Soc. Hort. Sci.* 95(5):624-626.
8. Ticknor, R. L. and C. A. Nance. 1968. Chemical control of rhododendron growth

and flowering. Quar. Bull. Amer. Rhod. Soc. 22(2):90-95.

9. Ticknor, R. L. 1974. New forcing rhododendrons. Horticulture. 52(5):44-46.

This research was conducted as partial fulfillment of the Master of Science degree in the Department of Horticultural Science at N. C. State University. The assistantship funds were provided by the Fred C. Gloeckner Foundation.

The author acknowledges the Robert B. Peters Company, Allentown, Pa. for fertilizer used in the study, and to the Phytotron and greenhouse staffs for their able assistance.