SOME LONG-TERM RESIDUAL EFFECTS OF RETARDANTS ON CHAMAECYPARIS LAWSONIANA "ELLWOODII' AND RHODODENDRON 'A. R. WHITNEY"[1]

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Within the last decade chemical growth retardants have opened a vast field for exploration in plant growth and flowering. The effects of these chemicals on ornamental plants have been widely reported, especially on rhododendrons, by Cathey (1, 2), Criley (3, 4), Leach (6), and Ticknor (7, 8), but there is very little information on the long-term residual effect of retardants on shoot growth, flowering or propagation of retardant-treated ornamentals. This prompted the author to make this study.

EFFECT ON SHOOT GROWTH

Chamaecyparis lawsoniana, 'Ellwoodii'. Established rooted cuttings of *Chamaecyparis lawsoniana* 'Ellwoodii' were sprayed with Alar and Phosfon-S to the run-off stage 1, 2, 3 or 9 times at weekly intervals commencing May 24, 1964. The rates for Phosfon-S were 100, 1000 and 10,000 ppm; rates for Alar were 200, 1000 and 5000 ppm. Altogether there were 23 treatments and 115 plants.

At the end of the first growing season nearly all the Phosfon-S treatments showed varying degrees of foliage injury and for this reason all were discarded from the test. None of the Alar treatments showed injury and only the low concentration, applied once, failed to retard shoot growth significantly. Plants sprayed either three or nine times at 5000 ppm showed greatest and equal retardation.

Because of the large number of plants in the test, only the check plants and those sprayed nine times at 5000 ppm were carried on for further studies. These were subsequently transplanted twice to larger containers and at all times given the same cultural conditions. The comparative growth data for 1964, 1966 and 1969 are shown in Table 1; growth and condi-

Table 1. Average height of foliar sprayed and unsprayed *Chamaecyparis lawsoniana* 'Ellwoodii" following Alar treatment (1964) to established rooted *cuttings.*

Year	Average* height (inches)		Percent difference
	Alar in 1964 only	Check	
1964	7.7	12.1	44
1966	21.7	46.1	52
1969	52.4	72.1	27

*Average of five plants per treatment

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tion of the plants on August 23, 1969 are illustrated by the two specimens in Figure 1.

Rhododendron 'A. R. Whitney'. Established rooted cuttings of 'A. R. Whitney' rhododendron were grown in the greenhouse under two light regimes during the summer of 1965 to compare growth and flower bud production. One half of the plants in each lot were given a single soil drench of one U. S. pint of Phosfon solution, concentration 337 ppm, to each 7-inch azalea pot as outlined by Cathey (1). The remainder received no retardant. In the fall of 1966 all plants were transplanted to larger containers of Phosfon-free soil after one-third of the root ball was removed, only enough so that subsequent plant growth was not impaired. The unremoved portion of soil obviously retained sufficient Phosfon to account for the residual effects recorded. Following transplanting all plants received the same cultural conditions. The comparative growth data for 1965-1969, inclusive, are shown in Table 2; plant growth and condition on August 23, 1969 are illustrated by the two specimens in Figure 2.

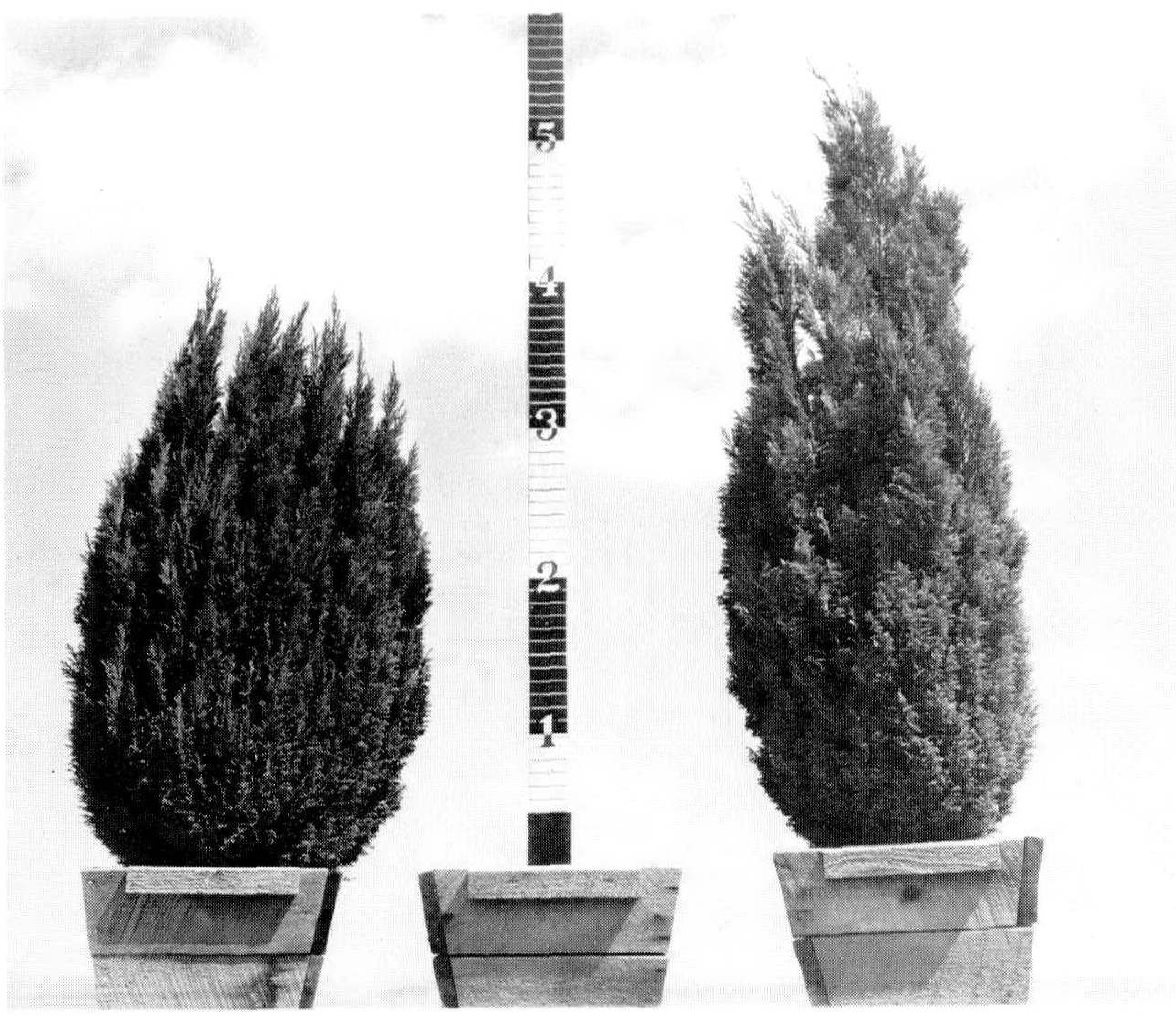

Fig. 1. **Comparative height and condition of the plants on August 23, 1969, of** sprayed and unsprayed *Chamaecyparis lawsoniana* 'Ellwoodii'. *Left.* Alar (5000 ppm), nine foliar applications at weekly intervals in 1964 to established rooted cuttings. *Right.* Control. No Alar.

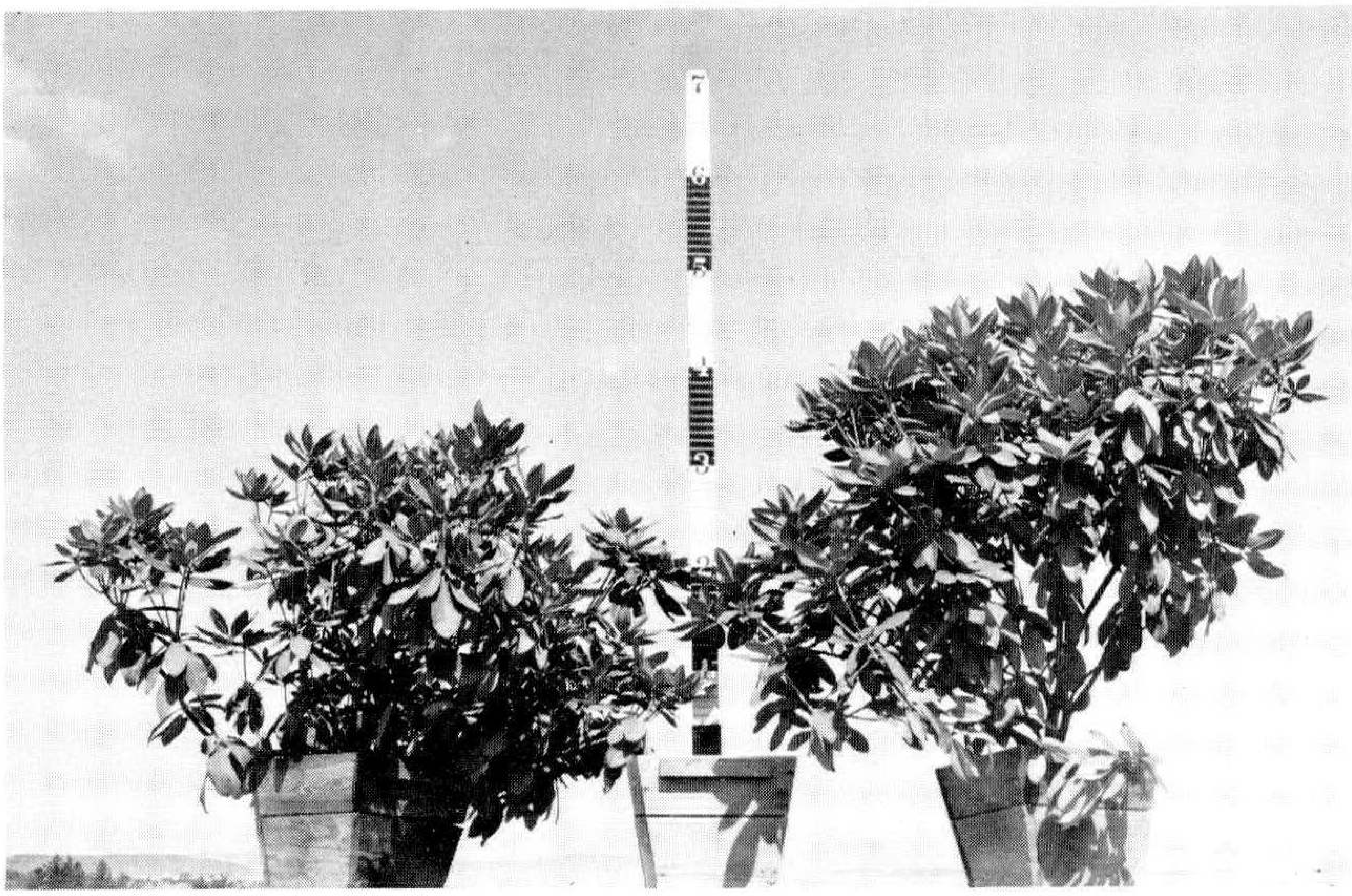

Fig. 2. Comparative height and condition of the plants on August 24, 1969, of Phosfon-treated and untreated 'A. R. Whitney' rhododendron. *Left.* Single application of Phosfon soil drench, one U. S. pint of Phosfon solution, (337 ppm) per 7-inch azalea pot in 1965 to established rooted cuttings. *Right.* Control. No Phosfon.

Table 2. Average height of treated and untreated 'A. R. Whitney' rhododendron following a Phosfon soil drench plus night illumination (1965) to established rooted cuttings.

Year	Average plant height (inches)			
	Natural days		Natural days plus supplementary night light	
	Phosfon	Check	Phosfon	Check
1965	13.1 c	16.1 b	12.4 c	19.8 a
1966	19.7 b	31.8 a	21.1 b	34.5 a
1967	25.8 b	39.7 a	29.8 b	42.0 a
1968	35.4 b	53.8 a	41.6 b	55.0 a
1969	43.2	62.1	48.2	61.3

Within years, figures with no letter in common are significantly different ($P = 0.05$). Figures are averages of a minimum of five plants in any one year.

EFFECT ON FLOWER BUD PRODUCTION

Rhododendron 'A. R. Whitney'. The same plants used for the shoot growth experiment were used in this test. Flower bud counts (Table 3.) show that the Phosfon and natural-day treatment resulted in significantly more flower buds than any other treatment during the first year (1965), and in significantly less numbers of flower buds than any other treatment during the second year (1966). The number of flower buds in the various treatments in the third year (1967) was not sig-

Table 3. Comparative number of flower buds of treated and untreated 'A. R. Whitney' rhododendron following a Phosfon soil drench and night illumination (1965) to established rooted cuttings.

Year	Average number of flower buds per plant				
	Natural days		Natural days plus supplementary night light		
	Phosfon	Check	Phosfon	Check	
1965	4.4 a	0.1 b	0.7 b	0.1 b	
1966	13.4 c	20.8 b	28.4 a	20.6 b	
1967	36.4	34.6	37.8	44.4	N.S.D.

Within years, figures with no letter in common are significantly different ($P = 0.05$). Figures are averages of a minimum of five plants in any one year.

nificantly different, indicating the effect of the treatments in 1966 had dissipated.

EFFECT ON PROPAGATION

Rhododendron 'A. R. Whitney'. Ticknor (8) applying Phosfon spray, CCC and other growth regulators to 3-year-old field-grown rhododendron to induce flowering, found that propagation as determined by cuttings taken the year of treatment was not affected by these growth regulators. But the author applying two concentrations of Phosfon drench once to established rooted cuttings, found the quantity of top grade rooted leaf-bud cuttings significantly curtailed. Leaf-bud cuttings, following Leach's (5) description, were taken at random from non-flowering shoots of the current season's wood on October 29, 1968, dusted with Seradix No. 3 and then stuck in a rooting medium of granite-sand, perlite, vermiculite and styrofoam (2-2-1-1 by volume). The rooting medium was held between 68° and 72° F. and intermittent mist was used during the daylight hours. There were eight replications per treatment with ten cuttings per replicate. The cuttings were examined on April 30, 1969 and those with roots were graded, according to the size of the root ball, as "excellent", "good", "fair" and "poor".

Results (Table 4) indicate that while the total number of rooted leaf-bud cuttings in 1968-69 derived from plants treated with two levels of Phosfon soil drench in 1966 was not significantly different from that obtained from the check plants, the quantity in the two top grades of Phosfon-treated plants was significantly less. There was no significant difference in grade between the two concentrations of Phosfon used.

Shoot growth of the rooted leaf-bud cuttings derived from the Phosfon and check plants following planting was not significantly different.

Table 4. Average[1] quantity, grade and shoot length of rooted rhododendron leaf-bud cuttings from Phosfon-treated and control plants.

Treatment: Concentration Phosfon-soil drench applied 1966	Grades: 'Excellent' grade (April 30, 1969)	Grades: 'Excellent' and 'good' grades (April 30, 1969)	Grades: All grades (April 30, 1969)	Grades: All grades Value[2] (Weighted)	Average shoot length (June 25, 1969)
(ppm)	Number	Number	Number		(inches)
0	7.0 a	7.5 a	8.3	31.2	12.3
337	4.6 b	5.6 b	7.5	24.8	12.3
1011	5.3 b	5.2 b	7.6	24.7	12.5
			NS	NS	NS

Within columns, values with a letter in common are not significantly different (P = 0.05)

[1]Average of 80 cuttings, 10 per replicate

[2]Determined by substituting the values 4, 3, 2 and 1 for "excellent", "good", "fair" and "poor" grades of rooted cuttings, respectively

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MODERATOR CLARKE: That brings us to the question and answer period. Do we have any questions now?

VOICE: I would like to ask Mr. Doty at what temperature he stratified his *Araucaria* seeds?

MR. DOTY: Our cooler stays at 36° to 41° F. All we did was to place the seeds between two layers of burlap with a little peat around them, because they are rather large seeds. Then we checked them every week for germination. Some would germinate ahead of others, but at that time we had enough coming on and we would pull them out and seed them in our Jiffy 7's or Jiffy Pots. Incidentally, there was quite a problem trying to figure out which end was which on the seed. We did find out after we germinated them that the pointed end, where the first signs of life appears, is the correct end to put downward.

VOICE: Did you use moist peat moss or put the seeds in dry to stratify?

MR. DOTY: Just wet enough to supply moisture to the seeds.

VOICE: In my experience with monkey puzzle trees I believe that a germination inhibitor is in the seed coat; if you remove this you will not need to stratify the seed — at least local seed. On any seeds that I have imported from Chile, they have all died; I have yet to produce my first seedling. I don't know if they get killed during importation, or if they are such an oily seed that they become rancid. On local seed, I almost always get 100% germination. Another thing, you don't need to worry about which end is up when you plant seeds of monkey-puzzle tree, or I don't. Plant them sideways. The radical grows out like it does in an oak seed, then it turns downward and there is a division just above it where the new shoot develops and so on. Usually you lay it on top the pot, let the root go down and the shoot will come from a division of the radical.

BOB TICKNOR: I would like to comment on *Ceanothus* seed germination. I worked once in a seed laboratory where we tried to germinate *Ceanothus prostratus,* which has a heat plus cold requirement. We found that besides the hot water treatment we could put the seeds under heat lamps, to get about 70° C. Five to ten minutes of this adequately substituted for the hot water treatment. There had been a previous graduate thesis at Oregon State University on germination of *Ceanothus velutinus* seeds, which was a real problem before we worked out the techniques. It might be one to try.

BARRIE COOKE: I have a question for Dara Emery. I believe there is a nursery in southern California growing the new introduction, a bispecific hybrid, *Fremontia californicum* x *F. mexicanum,* called 'California Glory'. I believe this grower was grafting them. Have you any comments on cutting propagation vs. the advantages or disadvantages of grafting this plant.

MR. EMERY: I have had no experience grafting this. However, I am familiar with the nursery that has been doing it, and they have discontinued this procedure because it was unsatisfactory. It is very difficult, or at least no one, so far, has found a close relative to *Fremontia* that forms a satisfactory rootstock.

DR. KESTER: This is a general question to the panel, or to anyone else. One of the problems of hard-to-germinate seeds may be a question of viability. Sometimes it is difficult to know whether seeds are non-viable or just difficult to germinate. I have wondered how many people have used the tetrazolium test to determine seed viability. It seems to me that it has some very practical uses in nursery work and I have heard no mention of it in any of our meetings. The test has been available for quite a while, and I wonder if anyone has had any experience with it as a practical test at the nursery level.

DR. LEISER: In our direct seeding program of woody ornamentals we are working with the California Highway Department. Our concern has been — "are we using viable seeds?" Frank Chan is an associate with us who is using this test quite a bit on seeds of a number of different species. It appears to be very satisfactory. This summer I had a graduate student working on *Ceanothus* seed germination, and before we started we ran the tetrazolium test to determine approximate viability of the seed lots that we had. One seed lot indicated little or no viability but we went ahead through the whole series of seed treatments. We did not get any germination from this lot. Another seed lot had about 50% viability, and in our best treatment we had about 50% germination and that was the peak we could get out of it. We have only been using the tetrazolium test in a concentrated fashion for a few months, but it looks like a good, quite easy, method for determining seed viability. Then one would know, when reporting on seed treatments and germination, whether the seeds were viable or not to begin with. We gave the *Ceanothus* seed a hot water treatment initially because many of them have hard seed coats, and this cracked the seed coats very well.

Tri-phenyltetrazolium chloride is a colorless chemical which is changed, during the respiration processes in any living cell, to a red-colored compound, tri-phenyl formazan. About 24 hours after treatment the seeds are examined. If the seeds are red or pink they are viable; if they are colorless they are dead.

VOICE: I would like to make a quick comment on that. One very simple way you can check a seed is to cut it open, and if there is no "meat" in there, you know it is not going to germinate.

DR. LEISER: Yes, but some seeds can have "meat" but still not be viable.

VOICE: This is probably true, but with local seed we have found in almost 100% of the cases, the seeds that have "meat" in them will grow, if they are stratified properly. This is not the case when you are buying seeds, because there may be quite a few harmful factors, like fumigation, poor storage, too much heat, or poor transportation, and what have you. You don't know these factors.