Growth retardants control development of deciduous nursery stock

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Two growth retardants were tested for nursery use to control size • five hardwood species. Alar slowed growth of lilac and contoneaster. Slo Gro stopped growth of Siberian elm, and slowed growth • honeysuckle and cotoneaster. Chemicals were less effective than undercutting on green ash.

Introduction

Many nurseries growing deciduous tree seedlings find that their stock reaches the desired size at midgrowing season. It would be valuable to have a means to prevent it from growing larger. Unsold stock that grows an additional full season may become so large that it must be destroyed.

Growth retardants are chemicals that inhibit cell division in the subapical meristem. The result is a compact. (lark green plant smaller than normal, but showing none of the symptoms of injury typically produced by growth inhibitors and herbicides (1.7) . In general. growth retardants discovered so far are effective on dicots, sometimes effective on monocots, and usually ineffective on conifers (2.6). Plants which grow indeterminately are most susceptible, while plants growing in distinct flushes are least affected. Since this latter group develops buds between flushes, in which the cells of the next flush are formed (Nienstaedt, H. 1908. personal communication; 5), it is likely that a growth retardant would have more effect on the next flush than on the flush in progress at the time of application.

Growth retardants frequently have desirable side effects on plants, such as reduced transpiration and increased resistance to drought, cold, salt. acid pH extremes (4.8). *The* retardant effect is temporary, and the plant eventually resumes normal growth.

Materials and Methods

A preliminary small-scale greenhouse test of Amo-1618, Cycocel, Alar, and Slo Gro was made on cotoneaster *(Cotoneaster lucida* Schlecht.); honeysuckle *(Lonicera tatarica L.);* Siberian elm *(Ultnus pumila L.);* lilac *(Svringa villosa);* and green ash *(Fraxinus pennsrleanica* Marsh.). Amo-1618 and Cycocel had little effect, but Alar and Slo Gro showed promise and were then field. tested.

In second-year production beds of the Lincoln-hakes Nursery, Bismarck. N.D., 14 randomly located 2.-1-meter strips were marked in each of cotoneaster, honeysuckle, Siberian elm, lilac, and green ash.

Each strip within a species was randomly assigned one of seven treatments (two strips per treatment). The treatments were no spray (control), a low dose rate, and a high dose rate. Strips were sprayed in June, July. or both. A plywood shield was placed around the marked strip, and the seedlings were sprayed until thoroughly wet but not to runoff. The volume applied varied with the amount of foliage, and averaged 120 ml per meter of row for lilac, 170 nil for ash. 190 nil for elm, and 230 ml for honeysuckle. Within each strip, 10 individual seedlings selected at random from among the dominants and co-dominants were banded with a plastic tag. At the time of the first spraying, and at 5-week intervals until the end of the growing season. height from ground line to terminal (mm ± 1) and root collar caliper (nun f 0.1) were measured.

This procedure was used to test Alar' in 1969. and Slo Gro in 1970. In 1969 no information was obtained on honeysuckle because a fungus disease caused all shrubs to stop growing in June. Because no second-year cotoneaster was available either in 1969 or 1970, first-year seedlings were used when they became large enough in mid-August.

'The Alar spray contained either 4 or 20 g/l of succinic acid 2, 2-dimethylhydrazide plus 0.5 percent Triton B-1956 spreader-sticker. The Slo Gro spray contained 2.78 or 5.66 g/l of diethanolamine salt of maleic hydrazide.

In the fall of 1969 the tagged trees were lifted, placed in heel-in beds over winter, and outplanted the following spring to determine if there were any carryover effects of the growth retardant.

In the fall of 1970 the tagged seedlings were lifted as before, but potted in #10 cans and pruned to standard nursery height: 400 mm for ash and elm, 330 mm for honeysuckle, and 300 mm for lilac and cotoneaster. After growing for 12 weeks (Dec. 1970 - Mar. 1971) in the greenhouse. height and caliper were again measured.

Statistical significance was determined in appropriate tests. Percentage growth reduction was calculated

FIGURE 1.—Middle row of Siberian elm was treated in June 1970 with 2.75 gm/l Slo Gro. Side rows were not sprayed. Background board is 1 m high. Picture was taken in September 1970.

as

$$\%\,\Delta G = 100\left[1 - \frac{(E_e - E_s)\,C_s}{(C_e - C_s)\,E_s}\right]$$

where

E = height or caliper of treated seedlings;
C = height or caliper of untreated seedlings (control):
e = end of growing season; and
s = at time of spraying or beginning of second season after spraying.

Results

Siberian elm: The most spectacular growth-retardant effect was caused by Slo Gro on Siberian elm (fig. 1). Height growth was completely stopped at each concentration and each (late of application (table 1). The retardant effect in the season following application was greater at the high dose rate than at the low, and was greater at the later (late of application. Since a single application at the low dose rate gave maximum retardant effect, there is no advantage to heavier or multiple doses. The 14-29 percentage retardation in the following season is quite acceptable for such a fast growing species as Siberian elm.

Siberian elm was significantly retarded by high and double doses of Alar. but not nearly as successfully as with Slo Gro. Both chemicals caused leaf chlorosis and some tip diehack at high dose rates; and Alar killed several trees.

Villosa lilac: Lilac responded well to high doses of Alar. A single dose produced 75-84 percent inhibition. and the effect of a dose in June was the same as a dose in July. The unsprayed control shrubs died back after outplanting, but the sprayed shrubs either died back less or made height growth gains, especially at the high dose rate.

Slo Gro had much less effect than Alar on lilac, and the retardation was as much or more during the season following application, especially at the high dose rate. A few plants sprayed with Alar at the high rate showed slight chlorosis, but otherwise there were no injury symptoms.

Honeysuckle: Slo Gro inhibited growth of honeysuckle by over 80 percent at each spray date and concentration. Inhibition in the season following application of the low dose rate was appreciable (41 percent) if sprayed in June. and negligible if sprayed in July (4 percent, not significant). Slo Gro caused extensive leaf browning and defoliation, and the general appearance of the plants was very poor. However, when potted and moved into the greenhouse, the seedlings broke dormancy promptly and grew well. At the low dose rate there was no mortality and very little dieback.

Cotoneaster: Only one treatment with each chemical was possible on cotoneaster. Application of Alar at the high dose rate in August reduced height growth 57 percent. After outplanting, some dieback occurred but the Alar-treated plants died back less than the untreated. Both groups were the same height at the end of the second season.

Application of Slo Gro at the low rate in July reduced height growth 42 percent. but at the end of the next growing season the treated seedlings were taller than the untreated. No injury symptoms appeared with either chemical.

Green ash: Growth of green ash was significantly reduced by Alar, but not enough to make its use worthwhile. Survival after outplanting was so poor that no meaningful measurements could be made on either treated or untreated seedlings.

TABLE 1.—Percent growth reduction as compared to unsprayed seedlings: 100 percent indicates complete stoppage; negative values indicate that growth of sprayed seedlings was greater than unsprayed.

Species and spray	Season[1]	Low dose			High dose		
		June	July	June + July	June	July	June + July
Siberian elm							
Alar	1	–13	0	4	9	25	32
Alar	2	48	7	10	–33	17	–23
Slo Gro	1	98	119	98	98	119	99
Slo Gro	2	14	29	38	42	60	59
Villosa lilac							
Alar	1	43	59	45	75	84	87
Alar	2	–27	–4	–128	–602	–335	–634
Slo Gro	1	10	–14	13	23	29	37
Slo Gro	2	–19	13	30	56	27	56
Green ash							
Alar	1	21	17	13	16	10	32
Slo Gro[2]	1	31	0	—	45	—	—
Slo Gro[2]	2	15	–8	—	33	—	—
Slo Gro[3]	1	27	0	42	55	0	66
Slo Gro[3]	2	–12	48	48	71	–7	58
Honeysuckle							
Slo Gro	1	84	81	83	81	100	81
Slo Gro	2	41	4	25	37	41	66
Cotoneaster							
Alar	1	—	—	—	—	57	—
Alar	2	—	—	—	—	38	—
Slo Gro	1	—	42	—	—	—	—
Slo Gro	2	—	–110	—	—	—	—

[1] *1 = Season of application of growth retardant. 2 = Season of growth following treatment.*
[2] *Not undercut.*
[3] *Undercut.*

The green ash plots for the Slo Gro experiment were inadvertently superimposed on an experiment on undercutting being performed by the nursery. One unsprayed and three sprayed plots were not undercut, while all others were undercut.

Slo Gro was effective only if applied early in the growing season, when the ash was actively flushing. The retardant effect was about the same magnitude in the next growing season: it was greater if the trees were not undercut. A few individual trees showed slight chlorosis and leaf cupping after high doses of Alar, but there were no injury symptoms from Slo Gro.

Undercutting alone reduced height growth 51 percent, nearly as much as heavy applications of Slo Gro (55-66 percent). Growth reduction in the season following treatment was only 19 percent for undercutting, versus 58-71 percent for Slo Gro.

Caliper growth reduction was usually smaller in proportion to height growth reduction, but parallel to it. It is likely that caliper reduction is a secondary effect, proportional to the reduction in amount of healthy foliage.

Discussion and Conclusions

A single dose of Slo Gro at the low rate stopped the growth of Siberian elm and honeysuckle, and could be applied anytime during the growing season. Either Slo Gro at the low dose, or Alar at the high dose cut the growth rate of cotoneaster in half when applied at midsummer to late summer. They can probably be applied earlier. Alar at the high dose nearly stopped the growth of lilac, and was about equally effective in June and July. Alar also appeared to have a favorable effect on growth of lilac and cotoneaster after they were transplanted outdoors.

Neither chemical was suitable for use on ash. Undercutting effectively reduced growth, however. In fact, although undercutting was not meant to be a part of this experiment, it may be that undercutting would be feasible on many species instead of growth retardants (3 p. 89).

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