CHEMICAL GROWTH CONTROL

by

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For centuries man has attempted to control plant growth, He is continuously looking for new, more efficient mechanical devices, new clones or cultivars that will give him dwarf plants, and for chemicals that will achieve his goal of plants that fit his landscape requirements. Actually, we want fast-growing plants, but only for a short period. Once the plant has attained its desirable height and width for a given situation, we would prefer that the plant stand still, and at the same time attain all of its qualities that make it attractive and useful. As horticulturists, we know that a plant is a complex, living organism; once it ceases to grow, it begins to die. But man continues to search for ways of controlling plant growth so that it will better fit his needs. Since plants are basically chemical factories, why not use chemicals to modify growth responses and bring about plants better adapted to man's environment.

In recent years, there has been a tremendous increase in our knowledge of plant chemistry as well as the discovery of several chemicals that have the ability to modify or temporarily inhibit plant growth. We will not go into the details of the plant chemistry, but will confine ourselves primarily to discussing several of the important chemicals in commercial use or available for research.

Much of the research in recent years has been on perennial and annual plants, using chemical growth retardants. Among the most important chemicals used are:

1. (2-chloroethyl) trimethyl ammonium chloride (CCC or Cycocel), manufactured by American. Cyanimid Co.

2. 2,4-dichloroberizyl - tributyl phosphonium chloride (Phosfon-D), manufactured by Virginia-Carolina Chemical Co.

3, 2,4-dichlorobenzyl - tributjlammonium chloride (Phosfon-S), manufactured by Virginia-Carolina Chemical Co.

4. N-dimethylamino succinamic acid (B-9), manufactured by U.S. Rubber Co,

These chemicals control stem elongation by reducing cell expansion and division in the subapical meristematic tissues that extend 1 to 4 cm below the apical meristem. Another chemical of vital concern is diethanolamine salt of 6-hydroxy-3-(2H)-pyrida zinone (MH-30T or MH-30T or Maleie hydrazide) manufactured by U.S. Rubber Co. This is not a growth retardant, Let an inhibitor that interferes with nucleic acid metabolism, and thus inhibits cell division in all tissues of the plant. However, by selecting certain low concentrations, we can prevent tissue death and merely delay plant development.

Many of these chemical growth regulators or inhibitors have been available for experiments for years. In some cases, research has been quite extensive, so that some of these chemicals are registered specifically for specific uses and widely used in the trade. Unfortunately, extensive research necessary for intelligent use has not been done, except on a limited number of crops and under limited environmental conditions. Practical application of CCC and B-9 is being used to retard the height of potted poinsettias, at the same time improving their flower characteristics. Phosfon-D also is being used commercially to shorten the stems on chrysanthemums and Easter Mies. While these advances in the floricultural field are important to all horticulturists, of primary importance to forestry nurserymen would be chemical plant control information applicable to woody plants.

In the area of woody plants, two chemicals at present seem to be of prime importance; Maleic hydrazide and B-9. B-9 soon will be on the market as Alar, a 50 percent active, water-soluable material containing a wetting agent. These two growth-regulating chemicals have been used as fo.liar sprays in the field with varying results, During this past year, the Department of Landscape Horticulture, UC-Davis, has carried on extensive research to determine: 1) penetration characteristics of the chemicals and how they vary with species, mode of application, plant development, and environment, 2) translocation activity from the point of entry to the site of action within the plant, and 3) metabolic inactivation as it may vary according to species, physiological condition of the plant, etc.

Each of these chemicals is being tested on a relatively large number of woody ornamentals using 1) variations in time of day f application, 2) variable rates of application, 3) application outdoors and under plastic, 4) variations in stage of plant growth (linears, gallon, and 5-gallon-sized plants), and 5) time of year.

Conflicting reports during the past few years have shown the need for this extensive research, Eastern experiments have shown MH-30T at rates f 5,000 ppm and 10,000 ppm did retard growth on several vigorously growing shade tree species, with no phytotoxicity, while B-9 (Alar) gave little control. When many of these same species in several San Francisco Bay area cities were treated with the same rates of MH-30T, extensive foliage damage resulted. In some cities in southern California, results with MH-30T have been promising, while control of tree growth has been poor in neighboring cities. The same species of shrubs sprayed in the Los Angeles area have shown good control, while no control. was observed at the University of California at Davis.

From the great variability we have seen in past field applications and recent research, it now seems to be apparent that the positive or negative results obtained are the result of one or more of the above five variables, and not necessarily the chemicals,

Some workers have indicated that neither MH-30 nor B-9 appeared to be effective on conifers, Recent pilot tests this year in Sacramento have shown both of these chemicals to be effective in controlling growth of some conifers. Again, it may be one or more of the major variables and not the chemical that is interacting to control the effects f these applications, In the table below are data from a few f the nursery liner plants sprayed in the glasshouse: about the time they were mature enough to move to gallons, From the results on just these few plants, it is evident that these growth-regulating compounds react differently for each species of plants. Maleic hydrazide did not control growth in Pinus radiata, but growth was well controlled by Alar (B-9), Neither Alar nor Maleic hydrazide controlled Juniperus torulosa--if anything growth was stimulated! In the Cypress species tested, MH-30 had some growth retarding effect, while Alar had none. Both of the materials were highly effective in controlling the rate of growth of

TABLE 1. The average elongation of terminal shoots from five plants of each species one month after treatment.*

	Control	0.5% MH-30T	1.0% Alar (B-9)
Pinus radiata	5.4	6.0	2.5
Cupressus sp.	6.6	4.9	6.7
Juniperus torulosa	3.0	3.5	4.8
Alnus rhombifolia	14.6	0.0	6.2
Betula verrucosa	14.5	5.8	12.5
Eucalyptus sideroxylan	15.8	2.0	9.6
Pyracantha sp.	10.1	0.0	0.0

*A partial list of plants treated as liners in a heavily shaded glasshouse. June 30, 1966. Oki Nursery, Perkins, California

In the species that responded to MH-30T and Alar treatments, lary bud break was common., In field trials at UC-Davis and at the UC-South Coast Field Station, Irvine, California, Pyracantha sp., Cotcneaster 3p, and Nerium oleander exhibited this same axillary bud break, The net: effect may not be one of total plant growth control, but a control of the vigorous terminal shoots which results in a compact and more uniform plant,

Observations which might be readily drawn from completed University experiments and those underway show the following, which may affect field practices with these chemicals:

"1, Penetration. rates vary enormously from species to species; such differences may account for apparent resistance to Alar.

2. Adjuvants have striking effects on penetration rates, although their main effect seems to be in wetting the plant surface; future studies may reveal. specific combinations between adjuvants and active ingredients which promote translocation as well as penetration.

3. Young leaves and the undersurfaces of mature leaves are the best avenues of penetration; hence, field application rates should be adjusted to the stage of development of the plant, High pressure sprayers, yielding a fine most which wets both upper and lower surfaces may be desirable. Dormant plants are relatively impermeable, and much higher rates would be required to achieve the same results as with actively growing tissues. Thus, relatively low applications in the spring will be as effective (with respect to penetration) as high

applications in the fall."

Due to the complexities involved in the practical. use of these plant growth regulators, several years of research may be necessary before the University can make specific recommendations for woody plants. Experimenters feel that recommendations will be forthcoming within 1 year for several species of *Pyracantha, Cotoneaster,* and *Nerium oleander.* One of the potentially important applications of these growth retardants stemming from present research is that of reducing evapotranspiration, thereby making the plant more tolerant to saline, arid, or other adverse environmental conditions. Several experimenters are hopeful that their research will show that treated plants have hardiness characteristics that make it possible for a young, transplanted tree or shrub to adapt to a wider range of climatic and soil conditions. From the standpoint of the forester, this appears to be the most promising area for use of chemical-growth regulators. While still very much in the experimental stages, chemical-growth regulators may become a promising tool in man's quest for "tailored" plants.

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DISCUSSION

Q: How about the effect on the root. Does it retard the root growth?

A: Hasn't been studied in any detail at this point. It should stop it, but nobody has studied.

Q: Have you tried stem injection on any of these?

A: No actual injection.

Q: Do you know of anyone that is working on a chemical that might induce dormancy on conifers?

A: Not in the area I work.