JOE MOLNAR: I don't recall for sure but we encountered no problems from it, I think it was pretty pure.

DON KRIZEK: It appeared that your cuttings were rather yellow was this normal?

JOE MOLNAR: No, and I have been thinking that incorporating nutrients with the mist would overcome this but we have not done this yet.

MODERATOR FORSTER: I would like to introduce to you now, Dr. Phil Kozel who will speak on "Chemical Control of Plant Growth."

CHEMICAL CONTROL OF PLANT GROWTH

DR. P. C. KOZEL
Department of Horticulture and Forestry
The Ohio State University
Columbus, Ohio

We in horticulture are the potential beneficiary of a great deal of research being conducted in areas of biochemistry, chemistry, physics and plant physiology. Outstanding scientists, who are very often not plantsmen, have demonstrated that chemicals can profoundly effect plant growth. Today, for example, chemicals exist which can

— prevent, delay, or stimulate seed germiniation
— retard or accelerate vegetative growth
— increase or decrease lateral branching
— chemically prune plants (roots and shoots)
— prevent, delay, or accelerate flowering
— inhibit or promote fruit formation
— defoliate plants
— substitute for cold temperatures or long days etc., the list is very long

It is our responsibility in horticulture to be aware of the information gained from research in other areas of science and apply it to current needs of our industry. This concept is the essence of our plant growth regulator program at The Ohio State University.

One important concept must be understood concerning the use of chemicals to control plant growth. They are only a cultural tool for us to use, just like fertilizer and water. Chemicals can increase the quantity and quality of plant growth, but they will not substitute for poor cultural practices. In fact, best results will be attained only when the best possible cultural practices are already being followed.

I will present today some of the highlights of our work with growth regulators this past season. Our major goals in this program are to decrease the time it takes to produce salable size plants, increase plant quality, decrease labor costs and hopefully increase profits for the grower.

One phase of our study involved the testing of two growth retarding chemicals, B-Nine and Phosfon. B-Nine (N-dimethyl-

aminosuccinamic acid) was used to help solve a troublesome problem with *Pyracantha coccinea* 'Lalandi'. This plant attains a salable size the second season after propagation but does not flower and fruit well until the third season. A single foliar application of B-Nine (10,000 ppm) applied in mid-August induced excellent flowering and fruiting of Pyracantha the second season following propagation. Since the fruits are the major sales feature of the plant the potential exists, through the use of B-Nine, for marketing this plant earlier and at greater profit than had heretofore been possible.

A second growth retardant, phosfon (2,4-dichlorobenzyl tributyl phoshonium chloride), was used in an attempt to increase flower bud formation on three year old plants of *Rhododendron* 'Roseum Elegans'. Phosfon is commercially available as a 10% solution and hence was used in his experiment. A mixture of 250 ml of this solution and water (1:25) was applied in the spring to the soil medium around plants at the time of their being transplanted into one-gallon containers.

Untreated plants this fall produced an average of less than one flower bud per plant. Phosfon treated plants, in contrast, averaged four flower buds per plant. The ease of phosfon application, and the fact that it can be applied in the spring at the time of transplanting reducing potential labor costs, suggests the possibility that phosfon can be adapted to commercial operations.

Gibberellic acid (GA_3) is a growth accelerating substance that has been used extensively in a variety of plants. In one study *Viburnum plicatum* 'Grandiflorum' plants were treated in mid-July with GA_3 at concentrations ranging from 100 to 1000 ppm. The objective being to determine if high quality plants of large size could be developed sooner than possible under normal cultural practices. The 1000 ppm treatment resulted in excessive shoot elongation and, in addition, had the interesting effect of inducing treated plants to flower in late August. A concentration of 500 ppm GA_3 provided best results, as a larger than normal, but still good quality plant was produced.

One other interesting effect of GA_3 should be mentioned as it does have commercial possibilities. Last January *Cotoneaster apiculata* and *Pachysandra terminales* plants, which had been maintained in a greenhouse since early fall and were in a dormant condition because of short days were treated with GA_3. Two foliar applications of 50 ppm GA_3 one week apart induced treated plants to resume vegetative growth while check plants remained in a dormant condition. The possibility exists, therefore, that we can through the use of chemicals expand the growing season of plants and get them to a salable size sooner.

The cost of manually pruning certain plants in order to obtain good lateral branching is often quite large. Substances are available today, which will chemically prune plants reduc-

ing manual labor requirements. These chemicals are esters of C_8, C_9, or C_{10} alcohols and work by selectively killing just the shoot tip of plants, and thus inducing lateral branch formation.

One year old plants of *Rhododendron* 'Roseum Elegans' were treated with an 8%, 10%, or 12% foliar spray of these alcohols last spring when new growth was approximately ½" long. The 10% concentration proved to be the best as branching was increased and no injury occurred on treated plants. Control plants normally developed one break from a terminal bud while treated plants had from three to four breaks per bud.

The same esters of alcohols were also effective in increasing lateral branching of 1 year liners of *Ilex opaca* 'Big Red'. The most effective concentration was 20% applied as a foliar spray in the spring when the holly was just beginning vegetative growth. A second application, at the same concentration, applied in mid-June increased branching even further. The end result this fall was a large, well branched, very salable plant.

A second group of chemicals called Morphactins were also used in an attempt to increase lateral branching of several plants. Morphactins are a group of three compounds of similar structure but varied biological activity. They, in contrast to the chemical pruning agents, do not kill the shoot tip, but rather retard its development and thereby induce lateral branch formation. This is an important difference as it is often undesirable, as in the case of many shade trees, not to prune or remove the shoot tips from main branches.

Morphactins as a group were effective in increasing lateral branching on *Ilex opaca* 'Big Red' when applied as foliar sprays in the spring at a concentration of 100 ppm. They were effective also at 100 ppm in increasing branching on such plants as Boxwood and Juniper.

The Morphactins when applied as a foliar spray at a concentration of 1000 ppm proved to severely retard vegetative growth of Pyracantha and Honeysuckle. Applications were applied in late May and little growth occurred in treated plants during the growing season.

Morphactins, like most plant growth regulators, do not work on all plants and have undesirable effects on some plant genera. Forsythia, for example, following treatment with 1000 ppm of the Morphactins, appeared as if it had just been treated with 2,4-D. The leaves were severely curled and distorted. In addition, foliar applications of the Morphactins (100-1000 ppm) to *Rhododendron* 'Roseum Elegans' resulted in no increased branching but rather moderate leaf distortion.

In addition to testing the previous substances which directly effect plant growth, considerable research was conducted with herbicides and their effectiveness in controlling weeds in container grown nursery stock. One new concept deserves some comment. A very thin porous pad has recently been de-

veloped which has 4 lb./A active Casoron incorporated in it. The pads come in sizes to fit either a one or two gallon container. Exact rates of herbicide per plant, therefore, are obtained by simply placing one of these pads around a plant, thus eliminating the dangers of applying too much or too little herbicide per plant.

In our trials, which included such plant genera as *Cotoneaster, Juniperus, Pieris, Rhododendron, Taxus,* and *Weigela,* three herbicides provided excellent weed control. The herbicides were Casoron (6 lb/A), Casoron Pad, (6 lb/A) and Simazine (3.75 lb/A); application was made to the soil surface of container grown plants in late May. The plants treated with these herbicides averaged less than three weeds per container during the period of late May to late August. In contrast check plants averaged more than fifteen weeds per container during this same period. Fresh and dry weights of the shoots and roots of *Cotoneaster divaricata* and *Taxus media* 'Hicks' were taken in late August of this year. In both instances plants treated with Casoron or Simazine were larger and had a much higher fresh and dry weight of roots and shoots than the control plants. The Casoron pad, even though providing excellent weed control did not result in a significantly higher fresh or dry weight of shoots or roots in either plant species tested.

The last substance I would like to mention today is a material called Ethrel (2-chloro-ethyl phosphonic acid). This material induces many biological responses in plants but one of its outstanding attributes is that it is an excellent chemical defoliant. When used as a foliar spray, it has the interesting property of being converted to ethylene gas within a plant leaf thus causing natural leaf abscission. It does not burn or dessicate leaves in order to induce defoliation thus greatly decreasing potential injury to treated plants. *Malus* 'Snowdrift', *Acer platanoides* 'Cleveland' and many rose varieties were completely defoliated this October five days after treatment with 5000 ppm Ethrel. Lower lates of Ethrel (1000-2500 ppm) also caused complete defoliation of the same plants but took ten rather than five days for complete effectiveness. This chemical will soon be available commercially and I'm sure, find many uses in nursery or landscape operations.

MODERATOR FORSTER: Thank you Phil, for a very fine paper. We are running a bit short of time and I'll ask you to withhold your questions until later or for the Question Box. I'd like to introduce Dr. John Wott who will speak on "Propagation of Chrysanthemums under Nutrient Mist."