

form you on the way to try carbon dioxide fertilization properly.

As a final encouraging statement for you as propagators, interested particularly in the growth of young plants, I would say that it is here where plants are relatively uncrowded and in an exponential phase of growth that I feel the largest gains from carbon dioxide fertilization are likely to be realized.

MODERATOR FURUTA: We have with us this morning Arthur Myhre from Western Washington Research and Extension Center, Puyallup, Washington. He will discuss with us at this time, "Chemical Pre-Emergence Weed Control". Arthur:

### **CHEMICAL PRE-EMERGENCE WEED CONTROL IN WESTERN WASHINGTON**

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The need for weed control in ornamental nursery plantings is without doubt one of the major problems which confront nurserymen in western Washington. Our moderately cool summer temperatures and abundant moisture cause weeds such as pigweed, lambsquarter, chickweed, smartweed, groundsel annual blue grass, horsetail, quackgrass, etc. to grow and spread with much rapidity. These weeds are commonly found here and are widespread in their distribution.

Extensive weed control research investigations involving the testing of chemical herbicides on different kinds of species and varieties of ornamental shrubs have been underway for nine years at the Western Washington Research and Extension Center, Puyallup, Washington. Cooperating on this project is Dwight V. Peabody, Jr., Northwestern Washington Research and Extension Unit, Mount Vernon, Washington. Our weed control studies have been designed especially for nurserymen. The procedure for testing pre-emergence herbicides is as follows: Rooted shrub cuttings are taken directly from the propagation frames and are lined out in the spring in nursery row plots. Approximately one month later herbicides are applied by machine properly equipped to provide good agitation of spray materials, accurate calibration, and adequate and uniform coverage. Previous to spray application, soil is cultivated and crop plants hoed so that soil is weedfree (no existing weeds). Weed seeds common to this area are sown to insure adequate and uniform infestation throughout the plots. In order to activate the chemical and to bring about fast weed seed germination in the surface soil, irrigation follows spray application when rainfall does not appear imminent. Generally, the herbicides are sprayed directly upon the plant foliage and between the rows and the soil thereafter is left undisturbed. However, certain herbicides were incorporated into the soil directly after application and were found to be more effective when treated in this manner.

Each year, for a period of at least four years, herbicides are applied at the same rates upon the same group of shrubs. At the end of this period, the shrubs are taken out bare-rooted, the soil in the rows of the most promising treatments is rotovated and sown to a test plant, (oats), which are extremely sensitive to herbicides. This test is made because nurserymen are much concerned regarding persistence of chemicals in soils that have had repeated yearly applications.

Results obtained from these investigations indicate that when properly applied certain chemicals will do an excellent job of controlling many kinds of weeds with little or no damage to a wide range of ornamental shrubs. It was observed that the correct application rates for a particular herbicide varies to some extent with the type of soil, the amount of soil moisture and the kinds of weeds to be controlled. Repeated herbicidal treatments applied on the same group of shrubs over a period of years show that different species vary considerably in their tolerance. It cannot be assumed that when one variety of shrub shows tolerance, then all varieties within the same group or family likewise will react similarly. An example of this can be cited from results obtained on holly. No plant injury was noted on English holly upon receiving yearly herbicidal applications. Japanese holly, however, has shown foliage discoloration and decreased plant growth with similar chemical treatments. Other shrubs that also show varying degrees of tolerance are rhododendrons, azaleas, boxwood and viburnum.

More than sixty herbicides have been tested to date. Of those that have been tested for five years or more, Simazine, Casoron, and Herban have performed best. Treflan, tested only in 1965 also shows promise. Combinations of Paraquat, a contact herbicide, with Simazine and Casoron applied as a directed spray, has merit and should be useful for certain situations.

*Simazine 80 W* has been on test for nine years. It has long residual life and has given good to excellent all summer control of annual weeds at 2 and 4 pounds, respectively.

Coniferous evergreen shrubs have shown much tolerance to this herbicide, whereas some broadleaved evergreen shrubs are somewhat sensitive. These are *Azaleas* 'Hinodegiri', 'Caroline', 'Mollis', *Buxus sempervirens*.

No plant damage has been noted on the following shrubs at four pounds: *Arctostaphylos Uva-ursi*, *Chamaecyparis pisifera* 'Cyano-viridis', *C. Lawsoniana* 'Ellwoodii', *C. pisifera* 'Plumosa', *Cotoneaster horizontalis*, *Erica carnea*, *Erica darleyensis*, *Eunonymus radicans*, *Ilex aquifolium*. *Juniperus chinensis* 'Pfitzeriana', *Prunus Laurocercasus* var. *Zabliana*, *Pernettya mucronata*, *Potentilla fruticosa*. Rhododendron varieties 'Blue Diamond', 'Cynthia', 'Jock', 'Sapphire', *Taxus baccata* and 'Repandens', *Thuja occidentalis* 'Globosa' and 'Umbraculifera', *Veronica cypressoides*; two pounds: *Ilex crenata* (established plants),



*Osmanthus Delavayi*, *Pieris japonica*, *Rhododendron mucronatum*, *Viburnum Davidii*, *V. Tinus*.

Results to date indicate good assurance that new plantings of ornamental shrubs can be set out within a reasonably short time in soil that has previously been treated with Simazine 80 W. Oats were planted for several years in soil that had applications of this chemical at 2, 4, 8, and 16 pounds for three consecutive years. Amount of damage to oats varied the first year from no injury at 2 pounds to complete kill at 16 pounds, the second year from no injury at 4 pounds to moderate injury at 16 pounds, the third year no injury at 16 pounds. Good tilth was found to be essential to rapid breakdown of the chemical.

*Casoron 50 W* has been on test for five years. It has fairly long residual life and has given good to excellent control of summer annual weeds at rates ranging from 8 to 12 pounds, respectively.

No plant injury has been observed on the following shrubs with application rates of 12 pounds: *Azaleas* 'Hinodegiri', 'Mollis', *Rhododendron mucronatum*, 'Blue Diamond', 'Sapphire', *Buxus sempervirens*; 8 pounds: *Azalea* 'Caroline', 'Rosebud', *Rhododendron* 'Bowbells', 'Jock', *pemakoense*, *Pieris japonica*, *Viburnum Davidii*, *Osmanthus Dalavayi*, *Ilex crenata* (established plants).

*Casoron 50 W* has given excellent control of field horsetail, a common perennial weed in western Washington. Applied in June to freshly worked soil at 8 and 16 pounds, 75% and 98% control, respectively, was in evidence one year later. A two year treatment at the same rates seems to have completely eliminated it from the plots. Less control was obtained when it was applied to emerged horsetail in September.

Preliminary tests in which the 50% wettable powder at 12 and 16 pounds, and the 4% granules at 150 pounds and 200 pounds were incorporated into the soil, show 100% kill of quackgrass for all treatments. Plots badly infested with this perennial weed were rotovated thoroughly in May just previous to application.

*Herban 80 W* has been on test for five years. It has fairly long residual life and has given good to excellent all summer control of most annual weeds at rates of 4 and 8 pounds, respectively.

No plant damage was observed on the following shrubs at 8 pounds: *Osmanthus Delavayi*, *Pieris japonica*, *Rhododendron mucronatum*, 'Blue Diamond', 'Bowbells', 'Jock', 'Sapphire'; 4 pounds: *Azalea* 'Caroline', 'Hinodegiri', 'Mollis', 'Rosebud', *Rhododendron pemakoense*, *Ilex crenata*, *Viburnum Davidii*.

Plant performance of the majority of the shrubs tested with the above chemicals at the desirable rates has been consistently better in comparison to untreated shrubs. It is a well known fact that weeds deprive plants of moisture, nutrients, sunlight, and interfere with their root development, thereby resulting in reduced plant growth and poor quality plants. It is inevitable

that the use of weed killing chemicals will have an enormous influence on future ornamental nursery operations.

MODERATOR FURUTA: Thank you, Arthur, for a most interesting presentation. We will now open our question and answer period on the talks we have heard so far this morning.

MR. DAVID ARMSTRONG: I would like to ask Harry Kohl what is the effect of air pollutants on CO<sub>2</sub> in the air and what is the natural level of CO<sub>2</sub> in the air.

DR. HARRY KOHL: The natural level of CO<sub>2</sub> in the air is about 300 parts per million. The effect of pollutants on CO<sub>2</sub> is nothing — directly — but the air pollutants can affect the photosynthetic mechanism and make it impossible for carbon dioxide to do anything valuable.

MR. JOHN DRUECKER: What is the effect of the various pre-emergence weedicide chemicals on large-leaf rhododendrons? Have you had any experience with them?

DR. ARTHUR MYHRE: No. The only rhododendrons we have used like those are the large-leaf Cynthia; some of these large-leaved rhododendrons seem quite tolerant — things like Sapphire, Jock, and Beau Belle; but in our experiments we have limited amount of ground. It would take acres and acres to try all these different plants. We try to hit the high spots and take one or two rhododendrons. Generally the broad-leaved evergreens tend to be quite tolerant to the chemicals we used — at least with the varieties that we had.

DR. O. A. BATCHELLER: In connection with Peter Lert's comments about growth control in plants and the use of maleic hydrazide, one of our students wrote an undergraduate thesis on foliage plants; with *Aralia elegantissima* and *Dieffenbachia* he found beautiful control. It gave branching on *Dieffenbachia*. On *Aralia elegantissima* there was beautiful breaking and plant compaction. I feel this is a perfect thing for indoor pot plant growers.

MODERATOR FURUTA: At this time I would like to turn the program over to your next moderator, George Dobbins, so we can get on to the next group of speakers.

MODERATOR DOBBINS: Our first speaker on this symposium on Propagation by Seeds and Spores will be Percy Everett, who we really don't need to introduce at all because you all know him, our past leader, from the Rancho Santa Ana Botanic Garden in Claremont, California. He was given the title "Native Plants of Commercial Value". Percy:

## NATIVE CALIFORNIA PLANTS OF COMMERCIAL VALUE

PERCY C. EVERETT

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I am not quite sure how the title of my discussion fits into a "symposium on propagation by seeds and spores" as it will deal in only a minor way with the role of seeds in the production