

HUNTER BOULO: After 15 days in late spring or early summer, roots are beginning to form and within 7 to 8 weeks the cuttings are able to be taken out of the mist.

VOICE: Is there any advantage to removing that top half inch or so of the cutting that droops?

HUNTER BOULO: Yes, we like to do it if we get time — to cut down on the wilting and to get a soft pinch; we have a two-inch leafy cutting. We don't remove the lower leaves either.

VOICE: Does anyone use bottom heat to root azaleas?

FOUNT MAY: No, not for azaleas.

DICK STADTHERR: Do you remove the flower bud, if it is present, on a cutting?

HUNTER BOULO: I believe it would be advantageous to do so; the flower will sap the strength of the cutting and, as I said, we try to pinch the tips off if we can.

FACTORS INFLUENCING HERBICIDAL ACTIVITY

P.L. NEEL

*University of Florida
Agricultural Research Center
Ft. Lauderdale, Florida 33314*

Inasmuch as we are concerned with ornamental plants or dooryard fruits rather than commercial food and fiber crops I shall limit my remarks to those factors and those herbicides of potential interest relative to their use in nursery production situations. Before I proceed further, I must point out that it is illegal to use any pesticide in a manner inconsistent with its label recommendations, under penalty of law. Herbicides are classified as pesticides under EPA regulations and no herbicide is currently registered for use on container-grown ornamentals, while only a few are recommended for use on certain field-grown stock or established landscape plantings. Nevertheless, there are several herbicides which have been used experimentally on many container or field-grown species safely and efficaciously. We should not, however, forget that there are other methods for effectively controlling weeds or reducing their numbers; a herbicide program should be integrated with these and not solely relied upon. These methods include frequent shallow cultivation, the use of mulches, mowing, keeping weeds down in perimeter areas to prevent reinfestations of crop areas, early removal of initial invaders to prevent their going to seed, the use of naturally weed-free media components and/or the use of sterilized media, and filtering irrigation water to re-

move weed seeds when such water is used from ponds, ditches, lakes or streams.

The name herbicide literally means "plant killer"; their use demands respect. Proper usage requires that: 1) the dosage be correct; 2) the chemical used is the correct one for the crop and the weeds; 3) the application equipment is properly calibrated and adjusted; 4) the herbicide be applied to the proper place — the weed foliage or the soil surface; and 5) the material is applied at the proper time in the life of the weed (applying a pre-emergence herbicide *before* weed seeds germinate).

Herbicide usage may be classified as being pre-emergence or post-emergence with respect to the weeds. A preemergently used herbicide (alachlor, napropamide, trifluralin, oxadiazon, to name a few), to be effective, must be applied before weed seeds germinate. These materials act upon the very young seedlings as they pass through and emerge from the treated soil. Such herbicides may be absorbed by the roots, shoots, or seeds themselves. A post-emergently used herbicide (paraquat, glyphosate, 2,4-D, dicamba, diquat, for example) is applied to the foliage of already-growing weeds. These are absorbed through the foliage and, with some materials, also through the roots if spray enters the soil. Paraquat, glyphosate, and diquat are "tied up" (absorbed) almost immediately by organic matter, clay and other colloids in the soil and are therefore not available to roots growing in soil accidentally treated with these materials.

The very small particles of the soil mentioned above (clay, humus, colloids) have electrical charges upon their surfaces which interact with many types of herbicide molecules which are electrically charged. The cation exchange capacity (C.E.C.) of the soil, which is the measure of these colloidal materials, is thus a good indicator of the ability of the soil to "tie up" and reduce the herbicidal activity of applied chemicals. High organic content soils, such as are frequently used in container nursery production systems therefore generally require from 2 to 4 times the rate of herbicide for effectiveness as is indicated for field use. While this property might be considered to be a drawback to herbicide use, it does provide a safety factor to roots located below layers of soil which contain herbicides. It also provides a means of correcting an overdose, or of "cleaning up" a treated area. Activated charcoal applied to herbicide-treated soil at rates around 300 lbs/acre (336 Kg/ha) has been shown to effectively neutralize a number of herbicides.

Herbicides are either applied as granules to the soil surface or as liquids to foliage and/or soil. Granules generally contain from 2 to 15% active ingredient by weight, and liquids (emulsifiable concentrates, etc.) from 2 to 6 lbs active per gallon. Granules offer several advantages to the user. Applications are

relatively inexpensive and the granules usually fall off the crop foliage where they could cause some damage if they remained. The use of granules on crops which have whorls of leaves which can act as funnels is to be avoided; considerable damage has been done to *Dracaena* crops in Florida because of granules being funneled down into the bud. Some form of directed application would have to be used with such a crop to avoid this problem. Application of herbicide granules to wet foliage can also cause the plant injury because the granules stick to the foliage.

Liquid formulations can be applied as directed sprays through precision spray equipment or through the irrigation system over the crops if the foliage is not sensitive to the material. Wetting the foliage a few minutes prior to injecting the herbicide into the irrigation system and then rinsing the foliage with pure water after the injection will minimize the amount of herbicide absorbed by the foliage from the "herbigation" water.

Numerous tests with preemergence-type herbicides on containerized plants have shown that most injury symptoms manifest themselves as reduced growth, with some shoot tip kill and/or leaf burning at excessive rates on more susceptible plants. Chlorosis may also occur with certain chemicals; if the roots of sensitive plants are examined, frequently they will be injured or appear deformed. While most preemergently used herbicides do remain held in the upper inch or so of the soil for several weeks, they will gradually be moved down through the soil profile by irrigation or rain water, and can adversely affect growth rates of sensitive species.

No herbicide will control all weed species; the spectrum of control is different for nearly every one. If one herbicide is used exclusively, it will not be long before weeds resistant to its effects become a problem. For this reason more and more investigators are beginning to look at herbicide combinations as a way to get more complete weed control. Presently a combination of alachlor and simazine is being studied in several states. Preliminary results show promise on plants tolerant to simazine.

One should not use excessive rates of a herbicide in order to achieve 100% weed control; the risk to the crop is too great. Rather, herbicide usage rates should be such that weeds are 75-95% controlled, with hand pulling or some other means providing the remainder. I know of several nurserymen who are using alachlor successfully in this way and who tell me that the number of man-hours spent on weeding in their nurseries has dropped by 80% since they began using it.

Herbicides most often receiving favorable comments by nurserymen and researchers with regards to their safety on

many plants and reasonable weed control are alachlor (Lasso[®]), trifluralin (Treflan[®]), napropamide (Devrinol[®]), oryzalin (Surflan[®]), dichlobenil (Casoron[®]) and oxadiazon (Ronstar[®]). Tests by others and myself with oxadiazon have shown it to be one of the safest and most efficacious herbicides of those most commonly evaluated. It may receive an ornamentals label in 1977.

Experimentation has shown that the effective rates of use for most of these materials fall between 2 and 8 lbs ai/A (2.2 - 9.6 Kg/ha) applied every 4 to 8 weeks. Most of the above named materials could be applied (by mistake) at double these rates with injury symptoms of sensitive species showing up mainly as reduced growth.

What makes the use of one material "safe" and another hazardous? Some materials simply do not get down into the root zone in sufficient quantities to cause damage. Other materials in the root zone might not be absorbed by the roots, or, if absorbed, they might be inactivated in the roots by chemical reactions (forming insoluble salts), or by metabolic reactions (detoxification). Even if a herbicide is absorbed by the roots, it must interfere with some vital function to be effective. Many soil-applied herbicides exert their effect in the shoot portion of the plant and must therefore be translocated into the shoots or, as in the case of a germinating seedling, the shoots must come into contact with the material. Some herbicides are not translocated from the roots of resistant plants in sufficient amounts to be herbicidally active. Then, of course, there are those sensitive species which freely absorb the material and translocate it to sensitive sites and are thus injured or killed. The exact means by which most herbicides act is known in relatively few cases at present. Some affect photosynthesis; others affect the ability of cells to divide properly, or the ability of cells to produce one or more essential metabolites or the growth hormones.

Many of you have tried herbicides; perhaps some of you got poor results or plant damage. I hope that this discussion might help you to understand some of the many factors involved in herbicide use and/or misuse. A cardinal rule for anyone wanting to use any product which is new to him is to critically try it first on a few plants of each species with conditions similar to those under which the material is intended for use. Then if it works well for you, go ahead and expand the scope of utilization if the product is registered for the use intended.