DICK FILLMORE: I would like to ask Dr. Jaynes what tissues form the graft union in his nut-grafting technique?

RICHARD JAYNES: We obtain a union at both the cotyledon petioles or the extensor tissues which connect the cotyledons with the developing seedling and also directly with the cotyledonary tissue itself. The most rapid union formation and the place where the roots initiate is the cotyledon petioles or stubs which remain after the young seedling is cut away.

MARTIN VANHOF: I would like to ask Dr. Jaynes if he has planted the chestnuts and then grafted on the young seedlings during the normal growing season?

RICHARD JAYNES: Yes, we have tried that but have met with very varied degrees of success. We seem to have more success grafting and top working Chinese chestnut and in southern areas such as Georgia, and Maryland. However, in our area in Connecticut, we have not had good success. Conventional grafting has not proven feasible for any commercial nurseryman as yet.

MODERATOR CANNON: To start off the second portion of this morning's program we have Dr. Fred Lanphear who will speak on some new developments for weed control in transplant beds and field liners.

SOME NEW DEVELOPMENTS FOR WEED CONTROL IN TRANSPLANT BEDS & FIELD LINERS

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The problem of weed control in transplant beds and field liners cannot be adequately covered in a few minutes, but I would like to discuss some new concepts that are particularly relevant to the topic. Needless to say, the problem of weed control in nurseries is of great magnitude, particularly in relation to transplant beds. In fact, estimates of weed control cost have been as high as $6000/Acre/year for transplant beds where weeding was by hand. (1) Cost in field liners have ranged from $125.00 to $600.00/A/year with manual or mechanical means. It is imperative that these costs be reduced since the cost of manual labor is continuing to increase at a rapid rate. The appearance of herbicides on the scene provide some tremendous possibilities in solving this problem.

Basically, herbicides are plant poisons. Fortunately, they are selectively poisonous. This selectivity is based on a number of factors, including the ability of some plants to degrade the chemical or inactivate it in some way while others do not. One of the major factors in selectivity is the immobility in the soil once they are applied. This immobility allows the herbi-

cide to prevent or kill germinating weed seedlings near the soil surface without allowing the herbicide to move into the root zone of the desired plant. However, the more shallow-rooted plants are consequently more sensitive to herbicides. Young transplanted stock and field liners fall into this category.

Traditionally researchers looked for one herbicide that would control a broad spectrum of weeds without causing injury to the desirable plants. This is asking a lot from one chemical, since usually a herbicide will be effective on a particular group of weeds, such as the grasses, while being less effective on others. To make it more effective for a broader spectrum of weeds it was sometimes necessary to recommend higher rates. Unfortunately, higher rates increased both cost and possible toxicity.

I would like to illustrate an example of this and an alternative approach to increasing the concentration or looking for another "wonder" herbicide to do the total job.

Simazine is a herbicide that has been used extensively by nurserymen with varying degrees of success. At the recommended rate of 2-3 lb/A of the active chemical, which is equivalent to 50-75 lbs of the 4% commercial formulation, simazine will control a broad spectrum of weeds, but it also is toxic to many woody ornamentals such as *Euonymus* spp., *Forsythia* spp., *Lonicera* spp., and *Liqustrum* spp. At lower rates, simazine is effective on many weeds but will not control the grasses. Consider the possibility of combining simazine at the low rate with another herbicide that would be effective on the grasses. There is such a chemical available in the form of diphenamid. Diphenamid, which is available commercially as Dymid or Enide, is a very safe herbicide on most woody ornamentals but is ineffective on many weed species other than grasses.

As shown in Table 1, simazine at 1 lb/A was relatively ineffective on grasses as was diphenamid on broadleaf weeds. However, the combination of these gave complete weed control

Table 1 The effectiveness of simazine and diphenamid alone and in combination on weed control Applied on June 4, 1964

Herbicide treatment	Rate (lb/A)	Weeds Counted June 24, 1964	
		Grasses	Broadleaved Weeds
		Average number of weeds per square ft	
Control	0	117.2	104.8
Simazine	4	.5	.1
Simazine	1	15.4	5.6
Diphenamid	6	.1	7.1
Simazine	1	0	0
+ Diphenamid	6		

and at the same time lowered the concentration of simazine to a non-toxic level.

The reduction in injury using this combination of the herbicides simazine and diphenamid at reduced concentrations was shown on many species normally susceptible to simazine (Table 2). This principle of combining herbicides which is being explored in other crops opens new pathways in solving weed problems in nursery plantings.

Table 2 Tolerance of selected woody and herbaceous ornamentals to the combination of simazine (1 lb/A) and diphenamid (6 lb/A)

* *Euonymus fortunei* 'Coloratus'	— No injury
Vinca minor	— No injury
* *Forsythia intermedia*	— No injury
* *Ligustrum obtusifolium* 'Regelianmum'	— No injury
Pachysandra terminalis	— No injury
Sedum acre	— No injury
* *Ajuga* 'Metallica Crispa'	— 50% killed

*Frequently injured by recommended rate of simazine

However, as shown in Table 2, the combination approach does not solve all the problems since Ajuga was severely injured with the combination.

At the same time we were investigating the use of herbicide combinations, we became interested in a technique being used in England to increase the tolerance of plants normally susceptible to a particular herbicide. The technique, which has been used successfully on strawberry plants, utilizes activated carbon (charcoal) which is applied to the roots of the plant before planting. The principle on which this is based is similar to that of the activated carbon in a filter cigarette. The finely powdered carbon adsorbs many chemicals onto the surface, thereby inactivating them. Therefore, if a herbicide should move into the root zone of the newly established rooted cutting or seedling, it will be adsorbed by the carbon, thus preventing it from being absorbed by the plant and causing injury.

The technique has been used with different sensitive species, with varying degrees of success. As shown in Table 3,

Table 3 The effectiveness of activated carbon in preventing simazine injury to *Euonymus fortunei* 'Coloratus'

Treatment	% Injured	% Dead
Control	0	4
Simazine (3 lb/A)	50	8
Simazine (3 lb/A) + Activated carbon	8	4

the simazine injury at the 3 lb/A rate was greatly reduced by the use of activated carbon. Thus, the dipping of the roots or peat pot of young plants in a 10% slurry of activated carbon provides a method of decreasing the risk factor in the use of toxic herbicides, by actually increasing the tolerance of many otherwise sensitive species to herbicides.

The last technique I would like to discuss is the possibility of applying herbicides to transplant beds in combination with mulches. Mulches are frequently used to help reduce weeds and provide more favorable growing conditions. Yet mulches seldom completely control all the weeds. By incorporating a herbicide into the mulch it may be possible to get more complete control of weeds at the same time the mulch is providing other benefits such as increased moisture retention and reduced temperature fluctuations in the root zone.

The technique has been evaluated over the past 3 to 4 years in Indiana and New York (2). The results have been better than was expected. As shown in Table 4 the incorporation of dichlobenil (Casoron) in the mulch not only provided more effective weed control than either alone, it extended the weed control into the second year. This can be partially explained by the nature of dichlobenil which is quite volatile unless incorporated into the soil, mechanically or with irrigation.

Table 4 Persistence of herbicide activity when incorporated in a mulch on weed control in transplant beds

Treatment (June, 1965)	Time of Weed Counts			
	Aug 1965	Oct. 1965	May 1966	Aug. 1966
	Average number of weeds per sq ft			
Control	31.5	5.9	7.6	7.4
2″ peat moss	1.6	1.9	15.7	5.6
Dichlobenil (4 lbs/A)	7.4	3.2	7.2	6.8
2″ peatmoss + dichlobenil (4 lbs/A)	0	0	.1	1.2

The incorporation of dichlobenil into the mulch provides the same type of volatility barrier. Another advantage of the herbicide mulch combination is the relative ease of application. By mixing the herbicide into a mulch in the proper proportions, as indicated in Table 5, a uniform and accurate application can be achieved by just controlling the depth of the mulch.

The other important consideration is the effect of this technique on plant performance. In Table 6, the increase in growth of *Spiraea vanhouttei* as measured by fresh weight is quite apparent from increasing the depth of the mulch. Similar results were obtained with *Cotoneaster acutifolia, Lonicera zabeli* and *Weigela florida.* Part of this growth response may

Table 5 Proportion of herbicide to mulch in the preparation of mulches incorporated with herbicide

Desired Depth of Mulch	Area Coverage by 1 cu ft	Amount of Casoron* per cu. ft of mulch
inches	sq. ft.	gms/cu. ft.
1	12	12.50
2	6	6.25
3	4	4.17
4	3	3.13

*Casoron expressed in gms of commercial formulation (4%)

be due to the nutritive value of the mulch which contained 2 parts shredded bark to 1 part composted sawdust, which provides a slow release of nutrients. This suggests a 3 in 1 approach: weed control plus moisture retention and temperature moderation plus fertilization all in a single handling.

Table 6 *Effect of mulch-herbicide combination on growth of Vanhoutte spirea* *

Dichlobenil (lb/A)	Depth of Mulch (in) 0	1	2	4
	Average fresh Weight/plant (gms)			
0	17	15	37	59
2	—	17	—	—
4	20	15	42	59
8	—	—	—	63

*Similar results obtained with Cranberry cotoneaster, Zabel honeysuckle, and Rose weigela

In summary the incorporation of Cásoron in an organic mulch provides a relatively easy method of application. It is only necessary to control the depth of the mulch containing the proper proportion of the herbicide for effective weed control.

LITERATURE CITED

1 Johnson, Oscar S., 1967. Costs of Nursery Weed Control. Amer Nurseryman, July 15, 1967.
2 Bing, Arthur 1965 The Use of Herbicide with Mulches Proc Northeastern Weed Control Conference 19: 167-172

MODERATOR CANNON: The next speaker on the program is a person whom you all know, Dr. Sidney Waxman. Sid will speak on the use of fluorescent lights for propagation under semi-controlled environments.