

2. When applications are to be made manually measure out the quantities of herbicide for the proper mix and apply the correct volume of herbicide to a limited area for trial and practice purposes i.e. 100 sq. ft. or 1000 sq. ft. Make at least 3 trial runs before field application. Check for uniform coverage, at least by inspection and better by measuring the volume or weight of several samples collected from 3' x 3', or 5' x 5'. The more uniform the samples are the more likely that uniform results will follow. Danger of local over dosage is thus diminished and a familiarity with the appearance of correct distribution is gained before extensive applications are made.
3. Avoid over dosage and skips — over dosage damages or/and kills plants. Inadequate dosage is a waste of time and effort.
4. Reread and recheck recommendations for preparation, use and disposal of herbicides and containers. Give due regard to possible contamination of domestic and greenhouse water sources.

Prepared by,
 A. M. S. Pridham, Professor
 Department of Floriculture &
 Ornamental Horticulture
 Cornell University, Ithaca, New York
 and
 Arthur Bing, Professor
 Cornell Ornamentals Research Lab
 Farmingdale, L. I., New York

MODERATOR COGGESHALL: Thank you very much, Dr. Pridham. Our next speaker in this afternoon's symposium is no stranger to our Society. I am very happy to introduce Mr. William Flemer.

HERBICIDES — Nursery Tool, Not Panacea

WILLIAM FLEMER, III.
Princeton Nurseries
Princeton, New Jersey

Not so many years ago, the program chairman of a nursery meeting who wanted to give a glimpse of the future would cast about for a speaker who knew anything about herbicides. After a long search, if he was lucky he would locate a college professor or extension specialist who had put out some test plots and could make some tentative recommendations, well hedged with the advice to go slowly. Now most nurseries use herbicides as a matter of routine, and each one has its favorites as well as some special combinations which particularly suit that soil and climate. Experiment stations have files full

of data, dozens of different herbicides are manufactured on a large scale, and dozens more are discovered and introduced for test purposes each year.

Despite this great body of experimental work and resulting information, the universal herbicide has yet to be perfected. Furthermore under the multitude of weather combinations of temperature and rainfall, varying amounts of crop injury occur in nurseries each year. A number of basic principles have emerged however, and they should always be kept clearly in mind whenever herbicides are applied.

1. All herbicides are just what the term means — plant killers, not just weed killers, but lethal to crop plants also if conditions are not propitious.

2. Herbicides work best of all if one special condition obtains — i. e. if the crop plant is relatively large and the weeds are as small as possible, preferably newly germinated from the seed. The smaller the crop plant is, the weaker the herbicide must be and the more critical the time of application becomes. The larger the crop plant is, the stronger the herbicide can be used with impunity and the less critical the time of application becomes.

3. Herbicide applications are most useful and effective in a wet year, when cultivation is difficult anyhow, and are least effective if not a total waste of money in a drouth year unless irrigation can also be applied following herbicide treatment.

4. Despite publications which plainly state otherwise, cultivation is necessary for optimum growth of nursery crops in the field. Blanket application of herbicides covering the entire row area will not replace the necessity to cultivate and are a considerable waste of material and money. Banded applications of herbicides on the area where the nursery crop is actually growing and cultivation of the rest of the row area will give far better results with a saving of $\frac{3}{4}$, or more of the material costs.

5. Safe and effective herbicide application is a job for an experienced specialist who has carefully studied this field and who is consistently cautious and careful in all applications. There are so many variables such as soil moisture, time of year, temperature, subsequent rainfall, speed of the applying device, and rate of application, that this is obviously no job for a dullard or a careless man.

6. A sufficient number of check rows should be left untreated in each block of stock each year so that if any abnormality develops in the crop, it can be easily ascertained whether the herbicide or some other cause was responsible.

Within the framework of the observations above, there is no question that for many nursery crops especially for roses and the various conifers which are very resistant, the development of herbicides has considerably reduced weed control costs. They have been less useful for broadleaf evergreens,

especially young plants. At present it seems doubtful if herbicides will find much of a place in seedling beds except for treatment long in advance of sowing. Really safe and effective treatment for plants grown in containers has also yet to be developed. It is relatively easy to develop fool-proof herbicides and rates of application for standard farm crops grown on enormous acreages such as cotton, soy beans, and corn. The problem is vastly more complex for the average nursery with its wide diversity of crops, some coniferous, some broadleaf, some evergreen, some deciduous, and all at different stages of development. There is consequently no single herbicide or rate of application which can be used "for nursery crops" but rather many different chemicals have a place at varying rates of application. Some chemicals can be used in combination with each other. This sometimes exerts an apparent synergistic effect and superior results can be obtained at lower rates of application than for the same chemicals used singly. In any case, accurate records and constant experimentation should be the watch words of any herbicide program.

Our methods and materials at Princeton are not necessarily the best ones for other areas and climates. For example Neburon 50% wettable powder has long been the backbone of our herbicide program for deciduous shrubs, small trees, and conifers. We have had good weed control and minimal injuries with banded applications of this material, not 100 per cent weed control, for this is a condition we studiously avoid. However other workers have reported poor to no weed control with Neburon and the manufacturer has recently stopped making it. Apparently we were the only large user left and the volume sold was insufficient to merit continued manufacture.

The conclusion of this talk summarizes the herbicides we use for the crops we grow, with rates of application and materials costs per acre. I have purposely not given labor of application costs per acre, as these can vary so widely depending upon the equipment used. Such equipment can be the man walking down the rows with a cyclone seeder (and invariably with a fixed lunatic smile on his face) usually shown in nursery herbicide advertisements. Or it can be a multiple-row sprayer with a boom of nozzles spraying 4 or more rows at a time. The resultant variation in costs of application are obvious.

At the present time, we are using Chloro IPC as a post planting treatment for newly set out deciduous shrubs, conifers, and budding understock. In banded applications of 5% granules at an active ingredient rate of 8 lbs. per acre, C.I.P.C. costs \$12.00 per acre for material. Our present applicator treats only one row at a time and we are working on a multiple row device.

For all treatments of coniferous evergreens planted the previous spring and in subsequent years, we are again using Simazine 80% wettable powder. However we use very low

rates of application, only two lbs. active ingredient per acre in bands, and the cost is low too at \$2.50 per acre for material. Here we can use a 3 row sprayer boom and labor costs are reasonable. We think we see some yellowing of Mugho Pine and possibly White Pine from this treatment, but this needs verification. After a small scale disaster with some newly planted Taxus many years ago, we learned not to use Simazine in that situation. Check rows clearly showed what the trouble was.

We have tried out a fair acreage with Casoron 5% granules. On the basis of present findings, the results have not been better than some other materials. In 4 foot rows banded at 8 lbs. actual ingredient per acre, the cost is very high at \$26.00 per acre. Full coverage of the rows as a substitute for cultivation would be 4 times higher.

Diuron 80% wettable powder at 2 lbs. Actual Ingredient per acre, and Simazine at the same formulation and rate, in banded rows find a use in major and minor tree crops. The cost of materials for 4 foot rows is approximately equal for both at \$2.50 per acre for materials. Residual effect is good. Late fall or winter applications are made in combination with liquid Dinitro (Dow Premerge) at 3 gallons per acre in bands. This very useful additive burns off the rosettes of winter annuals and such deep rooted weeds as dock. It is not supposed to have any residual effect, but we have found that it does, especially in a very early spring application.

Dinitro must be used with great care in the spring. We have had some sad experiences in the past when wet weather delayed application until after the crop plant buds had broken dormancy. The buds must be truly "hard" dormant. Such "open" or some what leafy buds as are found in *Viburnum prunifolium*, *lentago*, and *cassinoides* do not tolerate Dinitro.

Larger trees in wide rows are very tolerant of herbicides. Such crops are ideal from the herbicidal point of view, for here you have very large resistant crop plants which will stand almost any herbicide lethal to young weeds. Many years ago we were advised to spray such large trees with Sodium arsenite. This treatment surely controlled all weeds but it also burned the bark off of the trees and our losses in Red and Scarlet Oaks were phenomenal. The whole painful experience taught us to take absolutely no recommendations without extensive small scale trials. The expert who advised us is now in another line of work, as you might guess.

We have not yet found a treatment which will kill out Chrysanthemum weed established in most nursery crops. Clearing the land of nursery stock and cover cropping with repeated very deep plowing is perhaps costly, but it is still the way to eradicate this weed rather than merely suppress it, at least under our conditions. Similarly, a field must be cleared completely prior to any really effective attack on bindweed and Canada Thistle. Nothing we have tried has had much

effect on Nut Grass. Perhaps somebody will give the answer during or after this symposium.

In summary, I must reiterate that herbicides are a useful tool but not yet a panacea. Skill, experience and extensive knowledge of the subject plus a careful and orderly mind are prerequisites for success.

JOERG LEISS: What concentration of Dinitro did you use?

BILL FEMER: We used three gallons per acre diluted in water, in four foot rows, banded application and costs \$4.00 per acre. In eight foot rows, that is with big trees, the cost is \$2.00 per acre. That is for materials only, I don't have the application costs.

JIM WELL: How do you band granular material?

BILL FLEMER: It is an applicator with a little hopper with two big wooden wheels which straddle the row. It's pulled by a Farmall tractor. The big solid wood wheels which are made of plywood prevent the granules from spreading out particularly on a windy day. The wheels are 12 inches apart, with the hopper in between. The material falls from the hopper in between the wheels and just bands a 12 inch strip where the plants are. We have also used a little rubber flap that snaps the foliage and knocks the granules off. It's a very simple device, commercially available.

RALPH SHUGERT: When do you apply Casoron?

BILL FLEMER: We apply at varying times. We applied some July 1st, some on August 15th, and we've also made fall applications.

RALPH SHUGERT: The only reason I mentioned this is because the Casoron representatives are recommending late, late fall applications. Apparently in the Midwest and Plains area there has been a slight bit of trouble in late spring and summer application.

BILL FLEMER: Yes, you have to be very careful about the rate when you put on summer applications.

VOICE: Have you used Treflan?

BILL FLEMER: We have used Treflan with mediocre results. We had some crop injury and spotty weed control. It may be due to the dry summers we have been having.

JIM ILGENFRITZ: Do you have any injury on *Euonymus* when you use simazine?

BILL FLEMER: Yes, we do. Marginal yellowing, tremendous slow down in growth and we don't use simazine on any *Euonymus*, not even on *E. elata*.

KNOX HENRY: My experiences with Treflan has not been identical with those of other nurseries. We had several tests plots going from 1/2 the recommended rate to up to 10 times the recommended rate. In no case could we find any conclusive results to prove that it was of any real commercial value. We were very disappointed.