PROPER MATERIAL, CLOSE OBSERVATION PREVENT FAILURES IN HERBICIDE USE

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Most nurserymen and landscape contractors who regularly use herbicides in their businesses have experienced occasions where the herbicide did not perform to their expectations. Many of these herbicide failures are not failures of the herbicide itself; more likely the conditions under which the material has been applied is usually responsible for this "so-called failure." When one takes time to consider all of the external forces that can ultimately affect herbicidal action, it's a miracle they work at all!

Three major degradation processes, photo, chemical and biological decomposition, can occur which can alter the structure of the herbicide molecule and eventually its selectivity and activity. Biological decomposition includes the breakdown of the herbicide by living organisms in the soil; chemical decomposition is an altering of the chemical structure of the herbicide in the absence of any living organism; and photo decomposition is the degradation of the molecule by any chemical processes requiring radiant energy from the sun.

In addition, there are several major transfer processes that affect herbicide activity once the herbicide has been introduced into the environment. The herbicide can be absorbed by plants and animals, retained in vegetation and transferred to the harvested products, absorbed on soil colloids and thus rendered unavailable, volatilized into the atmosphere, or lost through surface runoff and leaching, eventually to end up in the water table.

Not only can these above factors alter herbicidal activity, but the chances for human error are present right from the initial selection of the herbicide, through its application and following into crop management.

The discussion that follows is not meant to be an excuse for previous herbicide failures you might have experienced, but rather to help you draw attention to those variables which may help you avoid a costly failure with your herbicide program in the future.

Weeds

Above all, proper herbicide selection is paramount in achieving a successful weed control program, whether it is for container grown nursery crops or the plants in an established landscape situation. Never forget that herbicides are very selective and while some are noted for their annual grass control, others control only broadleaf weed species. Still, other herbicides have a relatively broad spectrum in terms of the weed species they will control. Knowing what weed species are present in any particular situation will ultimately help in choosing the proper herbicide for the job. The herbicides listed in Table 1 illustrate the fact that herbicides vary with regard to their ability to control particular weed species. For example, selecting DCPA (Dacthal) to control broadleaf weeds will almost certainly produce unsatisfactory results.

In addition to considering the major weed species present in any given nursery or landscape situation, the applicator must constantly be reminded of the fact that the weed spectrum will change with repeated application of a single herbicide. Surely every nurseryman and landscape contractor can cite examples of the elimination of one troublesome weed pest only to observe the encroachment of another weed species. For this reason, the development of a program of alternative herbicides which can be used in particular situations should be carefully considered.

Crops

We all realize that an herbicide may effectively control weeds around one plant species while severely damaging another. For example, dichlobenil (Casoron) may be used on junipers to effectively control many perennial weed species. However, this herbicide will cause severe injury if used around Japanese holly. The application of herbicides to various crops is, by far, one of the most exacting tasks that a grower must perform. The aim is always to injure or kill the weeds while at the same time not causing any crop damage.

Once a grower has decided on the herbicide that is specifically labelled for use on his crops or in a particular landscape situation and has an exact knowledge of the weeds which are present, he is ready to apply an herbicide, that is tailor-made for the job.

Time of application

All herbicides have an optimum time for application. **Preplant** herbicides such as trifluralin (Treflan) are applied prior to the planting of the crop, while **preemergent** herbicides, such as diphenamid, oryzalen and oxadiazon (Enide, Surflan and Ronstar, resp.) are applied prior to the emergence of weeds. With nursery crops and in landscape situations we generally think of preemergent herbicides as being used on established crops prior to weed emergence. **Postemergent** herbicides, like paraquat and glyphosate (Roundup), are applied after weeds have emerged from the soil.

Most nurserymen and landscape contractors have seen numerous examples of correct and incorrect timing of herbicide applications. As an example, most nurserymen realize that in order to achieve successful weed control with dichlobenil (Casoron) it must be applied at temperatures

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below 50°F. Similarly, we might cite chlorpropham (CIPC) as an herbicide which can cause a great deal of damage if applied at the wrong time of the year. This material is labelled for use on dormant plants, and if applied during periods of active growth, can cause severe injury.

Likewise, time of application in terms of weed seed germination can greatly influence the degree of control achieved from an herbicide application. For example, simazine (Princep) applications during the late fall or early winter after the emergence of the cool-season broadleaf weeds will be less effective than if it had been applied in the early fall prior to their germination. Thus, using the proper herbicide at the proper time can help insure good weed control.

Amount of herbicide used

As we all know, herbicides in contrast to fungicides and insecticides, generally have a very narrow range of activity, between acceptable weed control and crop injury. Few herbicides can be used at higher than recommended rates to insure weed control without causing excessive crop injury to cultivated ornamental plants.

Soil type

More than any other factor, soil type has great influence on herbicidal activity. While herbicides are sold nationwide, no two soil types react exactly the same when it comes to herbicide performance. For example, triazine herbicides (Simazine and Atrazine) are generally considered to be more effective on soils with a higher content of clay, while materials like trifluralin (Treflan) are more effective on sandy soils.

In addition, weed control with preemergent herbicides can be influenced by the surface condition of the soil at the time of application, but the soil should be freshly tilled or disced. Also, if granular preemergent herbicides are being used, the soil surface should be relatively smooth at the time of application in order to achieve a uniform distribution.

Table 2. Rate of trifluralin (Treflan) required to achieve desired weed control in soils with varying organic matter levels.[1]

Percent organic matter in soil	Trifluralin Required/acre (lbs/active)
1	¼
2	½
3	¾
4	1
6	1½
6	2
16	4

[1] Adapted from G.F. Warren, 1973. Action of herbicides in soil affected by organic matter. Weeds Today, Vol. 4(2): 10:12.

Soil organic matter

More than any other soil constituent, the level of soil organic matter determines the activity of herbicides. If in the selection of the herbicide or in the calculation of the rate to apply, soil organic matter is ignored, be prepared to observe some erratic results.

The importance of soil organic matter lies in its capacity to attract and hold a variety of molecules on its surface through the process of absorption, or more simply, the sticking of the herbicide to the surface of the organic matter such that it is not free to move in the soil solution and is thus less available to be absorbed by plants.

Generally, if soils have been amended with large amounts of organic matter, the rate of herbicide application will need to be increased. For example, trifluralin (Treflan) must be increased in its rate of application in order to achieve weed control in soils with high amounts of organic matter. Specifically, studies on nursery crops grown in media with varying organic matter levels require higher than recommended rates of trifluralin in order to achieve satisfactory weed control in comparison to similar crops grown in low organic matter medium (Table 2). These studies have shown that with container grown nursery crops, a range of 1-2 lb aia of trifluralin is necessary to achieve satisfactory weed control.

Table 1. Weed Species Responses to Herbicides[1]

Herbicides (Common name — Trade name)	COMMON WEED FAMILIES					
	Amaranthaceae (Pigweed Family)	Compositae (Daisy Family)	Cruciferae (Mustard Family)	Gramineae (Grass Family)	Leguminosae (Pea Family)	Euphorbiaceae (Spurge Family)
Alachlor (Lasso)	*	O	O	*	O	X
DCPA (Dacthal)	X	O	O	*	O	*
Dichlobenil (Casoron)	*	*	X	X	X	X
Diphenamid (Enide)	*	X	O	*	O	O
EPTC (Eptam)	*	X	O	*	O	*
Simazine (Princep)	X	*	*	O	?	O
Trifluralin (Treflan)	*	O	O	*	O	X

Key: O = not controlled; X = partially or erratically controlled; * = controlled.

[1] Reprinted in part from Lange, O.H., 1971. Agrichemical Age 14(4):5.

Weather conditions

Generally, weather conditions during and immediately after application of the herbicide have a great deal to do with the success or failure of a herbicide program. Of all of the environmental factors that influence herbicidal activity, temperature and moisture play a major role in determining the success or failure of the program.

Actually when we realize the great diversity of conditions under which herbicides are applied in the nursery or landscape situation, it's a wonder that there are so many weed control successes. At the time of herbicidal application, soil temperature may vary from 40-100°F.; soil moisture from air-dried to flooded; relative humidity from 10-100%; sunlight from 500-10,000 ft candles; and a wind-speed from 0-30 mph. Under such a wide range of possible weather conditions at the time of application, we spray a few ounces of herbicide on a half million or more weed seeds per acre and the majority of the time are rewarded with excellent weed control.

Temperature

Preemergent herbicides perform best at soil temperatures that promote rapid, uniform weed seed germination. Cool soil temperatures that delay weed germination can reduce the effectiveness of preemergent herbicide activity.

Also preemergent herbicides such as EPTC and Trifluralin (Eptam and Treflan) volatilize rapidly as soil temperatures increase, and as such, weed control effectiveness is reduced. In the case of Eptam and Treflan, these volatilization losses can be reduced by cultural practices, such as incorporation into the soil immediately following application.

Temperature also influences the performance of postemergence herbicides. In general, these materials work better at warmer air temperatures. The major influence of temperature on postemergent herbicides is on the rate of uptake into the plant. This effort is offset to some extent by the increased rate of drying of the herbicide on the leaf surface at higher temperatures, as once the spray dries, the penetration of the herbicide into the plant is reduced. Generally with the postemergent herbicides, fast movement into the plant is favored by high temperatures, and as a result more favorable weed control can be obtained if the temperature is high at the time of application.

In addition, the thickness and chemical composition of the cuticle of the leaf is influenced by temperature. Cool nights and moderate day temperatures often favor this increased cuticle thickness in some weed species, thereby reducing postemergent herbicide penetration into the plant, and ultimately effecting herbicidal activity.

Moisture

Adequate soil moisture prior to the time of herbicide application stimulates uniform and vigorous growth of weeds. Dry soil conditions cause uneven weed seed germination, and often result in poor weed control following herbicide application. As a result, proper timing of preemergent herbicide ap-

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plication in regard to soil moisture levels can help insure good weed control.

In addition, rainfall or irrigation is essential for successful preemergent weed control. Water is necessary to carry the herbicide into the top ½ inch of the soil where the maximum number of weed seeds will germinate. A delay in rainfall of more than a few days following application may severely reduce the degree of weed control achieved. Of course, with irrigation this is not a problem.

For many preemergent herbicides, a period of 10-14 days without moisture to incorporate them into the soil following application, is often the cause for complete failure. During this period without rainfall, the herbicide may actually be destroyed by exposure to sunlight while it lies on the soil surface, or weeds may germinate and emerge without taking up the herbicide.

In contrast, heavy rainfall of several inches or more soon after preemergent applications can be detrimental in regard to herbicidal activity, in that it may carry the herbicide beyond the zone of major concentration of weed seeds in the soil or may actually remove the herbicide from the site of application in runoff water.

Herbicide programs

The ideas conveyed so far have dealt with the reasons for success or failures with herbicide applications. Nurserymen and landscape contractors must strive for a program utilizing selected materials applied singly or in combination in order to achieve year-round weed control. In most nursery and landscape situations there is a need for fall or early winter applications in order to reduce winter broadleaf weeds, followed by spring and summer applications to control annual and perennial weeds.

In addition, it should be pointed out that observation and good record keeping is a key to a successful weed control program. The nurseryman or landscape contractor should not be looking for 100% control with his weed control program since this could ultimately result in soil sterilization, but rather for control in the 90-95% range. Thus, by carefully observing when weeds are beginning to reinfest a treated area, the nurseryman or landscape contractor can carefully plan and time his reapplications to suit his herbicide program in order to insure success.

Also, each user should use the material under test conditions for 2 to 3 years on small areas in order to better understand its use. Remember that all of the above factors we have discussed will affect the degree of weed control achieved. **WTT**