

HEADS-UP APPLICATION

It's usually your fault when a herbicide fails to control a weed. A better understanding of herbicides and weeds will help you

BY JOSEPH C. NEAL

Contrary to popular opinion, it's rare for a herbicide to fail to control a weed that it's supposed to control. The "it didn't work" lament is usually the result of either applicator error or environmental conditions beyond our control. An understanding of what makes herbicides fail to work can provide clues to how we can avoid those situations.

Identify the weed correctly

The first task in any pest management program is to correctly identify the pest. Most herbicides are selective — that is, they control some plants and not others. Accurate weed identification provides you with the information you need to make an informed decision.

For example, Dimension (dithiopyr) controls emerged crabgrass but doesn't control emerged goosegrass. Can you tell the difference when these plants have only three or four leaves? Can you accurately identify the broadleaf weeds? Confront (triclopyr +

clopyralid) controls buckhorn plantain but doesn't control black-seeded plantain (*Plantago rugelii*). Can you tell the difference between these two weeds?

There are many manuals to help you with weed identification. Table 1 lists some of the manuals I recommend for turfgrass and landscape professionals, but check with your local cooperative extension office for the best manual for your area. If you have internet access, there are several Web sites with weed photographs. Start your search for weed identification guides at the Northeastern Weed Science Society page (<http://www.ppws.vt.edu/newss/newss.htm>).

Choose the right product

Once you identify your target, you need to select the correct control measure. Just about every cooperative extension office, and most trade journals, provide regular updates on turf herbicide effectiveness on weeds. Charts showing broadleaf weed susceptibility to post-emergent herbicides are common. For grass weed control, most preemergence herbicides work well. To determine which pre-emergent herbicide is best for annual broadleaf weeds, however, you'll have to look harder (you might even have to read some labels). Contact your local cooperative extension office for the latest recommendations for your region. For herbicides in landscape beds, I recommend my book, "Weed Control Suggestions in Christmas Trees, Woody Ornamentals and Flowers," Skroch, Derr and Senesac. To order, send \$7.50 (this includes shipping and handling) to Publications, NCSU, Box 7603, Raleigh, NC 27695-7603. Similar publications are also available from Pennsylvania, Ohio State and Cornell (NY) cooperative extensions.

Top 20 reasons why herbicides fail

Apply the herbicide accurately and uniformly

Choosing the right herbicide is much easier than applying it accurately and uniformly. Herbicides are applied with sprayers or granular spreaders to achieve a specified amount on a given area (such as quarts per acre or pounds per 1,000 sq. ft.). The best way to make sure you're applying the right amount of herbicide is to calibrate your sprayers and spreaders. If you're not sure how to do this, contact your local cooperative extension service. Also, pesticide dealers/distributors are often willing to help you calibrate your equipment. Even if you have calibrated your equipment, it's always good to do a second check on the calibration by calculating how much area you're treating and estimating the amount of herbicide (or spray) it should take to treat that area. When you're finished treating, the amount you used should closely match the amount of your estimate.

Applying the right amount of herbicide per 1,000 sq. ft. is only part of the answer to distributing herbicide uniformly over the area. I recently measured the output of granular spreaders on several job sites by randomly placing 1-sq-ft. pans throughout the treatment area, then weighing the amount of herbicide in each pan. At one site, there was a 250% variability between catchpans with the doses sometimes reaching twice the labeled rate!

1. Not reading and/or following label specifications
2. Improper weed identification
3. Improper herbicide selection
4. Improper method of application
5. Improper timing of application
6. Unfavorable temperature and/or moisture conditions affecting poor weed growth
7. Age and growth stage of the weed plant — young vs. mature target weed
8. Temperature too hot or too cold
9. Skipped area — spot treating/poor overlapping resulting in poor coverage
10. Foliage not wet — product failed to penetrate leaf hairs
11. Low concentration of mix — not enough active ingredient to manage weed
12. High concentration of herbicide killed the top, not the roots
13. Wind drift — failure to deliver herbicide to the target
14. Rain following application washed off treatment
15. Product too old — deactivated
16. Product caked — spoiled
17. Product separated into layers
18. Chemical and/or physical incompatibility
19. Alkaline (high pH of water) hydrolysis and herbicide degradation
20. Droplet size too large — some herbicides perform better if particle size is finer

So how do you improve uniformity? Check your sprayer and spreader output patterns. Make sure your applications are made with the correct overlap. Flood jet spray nozzles should have 100% overlap but flat fan nozzles require 25% to 30% overlap. Granular spreaders are variable; I strive for 100% overlap and treating the entire area twice (1/2 dose per application) in perpendicular directions.

I believe calibrating sprayers and spreaders and paying attention to application uniformity could eliminate 90% of herbicide "failures" and dramatically reduce "call backs."

Timing is everything

Preemergent herbicides are applied before weeds emerge. But do you know when your weeds emerge? Summer annual weeds (like crabgrass) germinate in the spring and early summer; winter annual weeds (like henbit) germi-

nate from late summer through early spring depending on your local weather patterns. Preemergent herbicides must be applied and incorporated by rainfall before weeds germinate. If applied after germination, most preemergent herbicides provide little control. Indicator species such as dogwood bloom or forsythia bloom have been used for years to indicate when the weather is conducive to summer annual weed germination. For winter annual weeds, preemergent herbicide applications should be made by mid- to late-August.

Preemergent herbicides for crabgrass control can be applied earlier, too. Several researchers (Watchke at Pennsylvania State University, Lewis at NC State University and Senesac and I while at Cornell University) tested winter applications of preemergent herbicides and found they worked as well as the "optimum" timing for that region.

Weed control longevity is more a function of the herbicide choice than how early it's applied. Dimension (dithiopyr), Barricade (proflumicarb) and Pre-M (pendimethalin) provide longer crabgrass control than Balan (bifenox) or Team (bifenox + trifluralin). Whether or not you need to reapply the preemergent herbicide and when requires an understanding of local conditions.

Post-emergent herbicides are applied after plants emerge, but the timing of those applications have a significant impact on control. Young, actively growing weeds are more easily controlled than older, well-established plants. For example, the recommended rates for Acclaim Extra range from 3.5 oz. per acre to 39 oz. per acre, depending upon crabgrass growth stage (see Figure 1). Corn speedwell (*Veronica arvensis*) is difficult to control in spring because it's nearing the end of its life cycle and is not growing



PHOTOGRAPH COURTESY: J. C. NEAL

Young, seedling crabgrass plants (such as the 4-leaf seedling on the left) are controlled with low doses of post-emergent herbicides. Tillered plants like those on the right will require higher doses and perhaps multiple herbicide applications.

rapidly, but it's much easier to control in fall when the weed is young and actively growing. To control bermudagrass in plant beds, treat with a post-emergent grass herbicide in spring when the weed has about 6 to 8 in. of new growth; later applications will result in poorer control. The key to optimum timing for most post-emergent herbicides is to apply when weeds are actively growing.

When controlling perennial weeds, the goal is to kill the plant's underground portion. To do that, we use systemic herbicides that move from the foliage to the roots and storage organs. The season and growth stage

of the weed can have a tremendous effect on how well the herbicide will translocate. Glyphosate (Roundup Pro and others) controls most weeds, but you'll get better control if you apply when plants are most susceptible. Most deciduous woody vines and rhizomatous perennial weeds (such as mugwort) are controlled by late summer or early fall applications, but spring applications only burn the tops of plants. In contrast, late summer applications won't control the evergreen vine greenbriar (*Smilax* spp.); spring applications are more effective on such evergreen weeds.

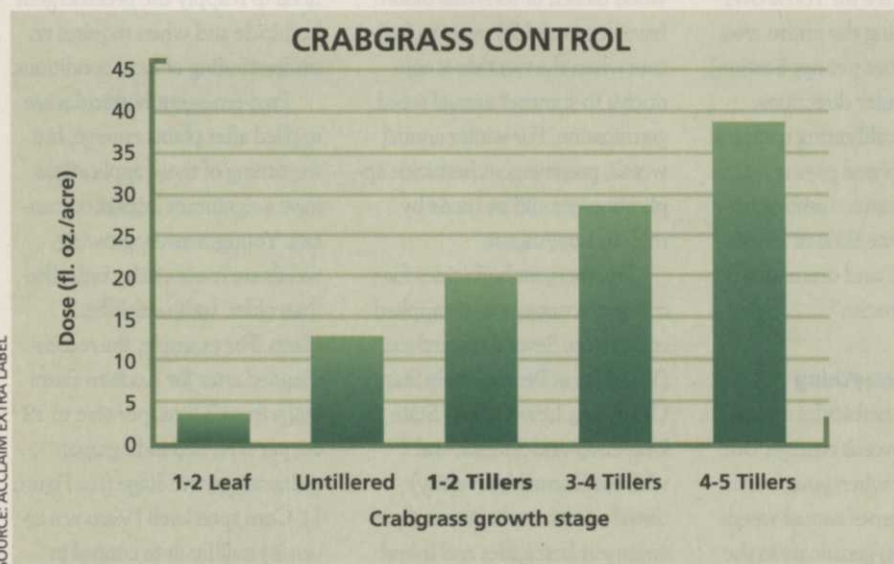
The environment

Much is made of soil type, humidity and temperature effects on weed control, but, in my opinion, the most important environmental factor that affects herbicide performance is water — too much, too little, too soon or too late. Irrigation and rainfall affect both preemergent and post-emergent herbicides but in different ways.

Preemergent herbicides require rainfall for incorporation, but too much of a good thing can be a problem. In saturated soils, many of our common preemergent herbicides decompose rapidly. In as little as two weeks of saturated conditions, many preemergent herbicides have decomposed and are no longer present in concentrations high enough to control weeds. So providing proper soil drainage will not only improve turfgrass growth and reduce weed encroachment but improve pre-emergent herbicide performance.

Too little rain can affect preemergent herbicides in two ways — lack of incorporation and volatilization. Preemergent herbicides must be incorporated by rainfall or irrigation within a few weeks of application. If this doesn't occur, the herbicide remaining on the surface may volatilize or be degraded by sunlight (or both). A prolonged drought can result in hot, dry soils that promote volatilization of herbicides. Furthermore, if there's soil moisture but no rain or irrigation after herbi-

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SOURCE: ACLAIM EXTRA LABEL

Figure 1. As crabgrass grows, higher herbicide doses are required to obtain control. This chart illustrates the doses of Acclaim Extra recommended to control different sized crabgrass plants.

TABLE 1. SUGGESTED WEED IDENTIFICATION GUIDES FOR TURF AND LANDSCAPE INDUSTRIES

Weeds of Southern Turfgrass

Publication Distributions Center
 IFAS Building 664
 P. O. Box 110011
 University of Florida
 Gainesville, Florida 32611
 (904-392-1764)
 \$8.00 / Particularly useful for weeds of turf and landscapes in the Coastal Plain but appropriate for turf throughout Southeastern US. Color photographs and brief descriptions of each species.

Weeds of the West

University of Wyoming
 U.W. Coop. Extension Service Bulletin
 Room
 University of Wyoming
 PO Box 3313
 Laramie WY 82071-3313
 \$24.50 / A full color guide focused primarily on weeds of western US agriculture. Multiple color photos of each weed and brief descriptions are included. There is no key.

Color Atlas of Turfgrass Weeds

Ann Arbor Press
 310 North Main Street
 P.O. Box 20
 Chelsea Michigan 48118
 800-487-2323
 \$79.95 (plus shipping) / A color guide to turfgrass weeds. This guide covers weeds of warm-season and cool-season areas. Several photographs of each species and brief descriptions. Control guidelines are included.

Weeds of the Northeast

Cornell University Press
 P.O. Box 6525
 Ithaca, NY 14851_6525
 607-277-2211
 \$29.95 (+ shipping) / Appropriate to the Northern tier of the US (south to North Carolina) and southern Canada. About 300 species are covered. Several color photographs and drawings for each species, descriptions, and identification keys.

Weed ID Guide

Southern Weed Science Society
 1508 West University Ave.
 Champaign, IL 61821_3133
 \$97.00 (includes all six sets of weed sheets, index and a binder)
 CD_ROM Weeds of the United States is \$120 A 'high-end' and relatively expensive resource, this is available in notebook form (so it can be continually updated) and also a CD_ROM. High quality photographs with brief descriptions. No key is included.

NEWSS web site

<http://www.ppws.vt.edu/newss/newss.htm>
 The Northeastern Weed Science Society web site has a listing of internet sources for weed identification guides.



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 cides are applied, weeds may germinate before the remaining herbicide is incorporated. As previously noted, one key to getting the most out of post-emergent herbicides is to make

applications when weeds are actively growing. Drought reduces weed growth and consequently reduces post-emergent herbicide performance. Drought has been shown to reduce the effectiveness of just about every kind

of post-emergent herbicide: contact and systemic, broadleaf and grass products, soil-applied and foliar applied. The answer to this problem is to supply water to get the weeds growing again, or delay applications until rain

occurs. To increase the effectiveness of most herbicides, make applications about two days after irrigation or rainfall (see Figure 2), and try to keep the soil moist for at least two days after treatment.

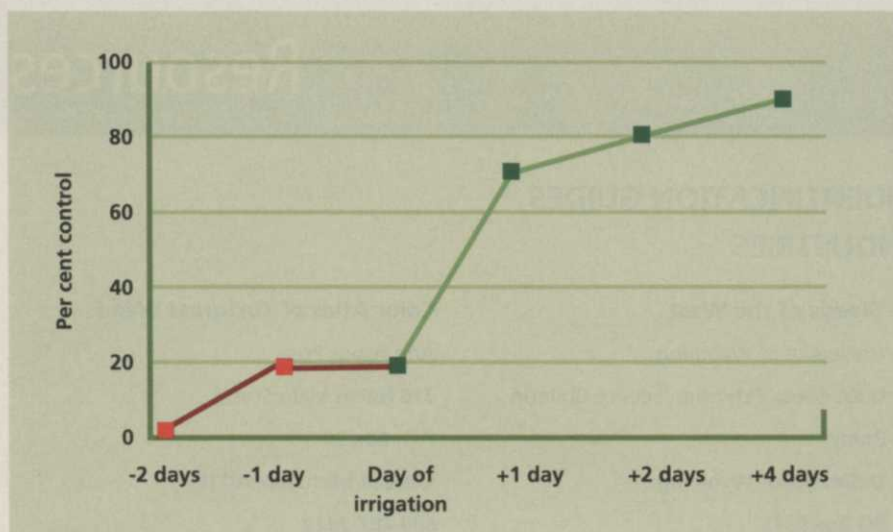


Figure 2. Drought reduces post-emergent herbicide efficacy. During drought, improve post-emergent herbicide efficacy by treating one to two days after irrigation or rainfall. This chart shows how the interval between application and irrigation can affect crabgrass control with Drive (quinclorac). Similar trends can be seen with other post-emergent herbicides.

Rainfall or irrigation too soon after an application can also reduce post-emergent herbicide performance. This is particularly true for glyphosate (Roundup Pro) and glufosinate (Finale). Rain within four hours after

treatment can reduce weed control, particularly on weed species with waxy leaves such as oxalis, clover and spurge. In contrast, typical intervals for post-emergent broadleaf herbicides (such as 2,4-D and Confront) are 30

minutes to one hour. For post-emergent grass herbicides (like Acclaim Extra, Fusilade, Envoy and Vantage), about 20 to 30 minutes after treatment is sufficient for the herbicide to absorb into the foliage. Check herbicide labels for recommended "rain-free intervals" for the products you're using.

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Herbicide resistant weeds

While herbicide resistance is not widespread in turf and landscape settings, it has been documented in golf course turf. Simazine resistant annual bluegrass has been around for several years. Researchers at North Carolina State University recently documented a case of dinitroaniline-resistant annual bluegrass in golf turf. In New Jersey, Acclaim-resistant crabgrass has been confirmed.

This didn't happen overnight. In some weed populations, there are a few individual plants that are tolerant (or perhaps even resistant) to herbicides. If you continue to use the same herbicide year after year, the only weeds capable of reproducing will be those that carry the trait for resistance. Slowly, turf managers notice that the herbicide doesn't work as well as it used to. If this scenario

continues, the resistant weed type will dominate the stand. This can be avoided by rotating modes of action — rotating herbicides will not be sufficient. For example, all dinitroaniline herbicides (including Balan, Prem, Barricade, Surflan and Team) have the same mode of action. Dimension's mode of action is similar. Consequently, the dinitroaniline-resistant annual bluegrass in North Carolina is resistant to all of these herbicides. However, Ronstar (oxadiazon) has a different mode of action and will control this type of annual bluegrass.

Reliance on a single herbicide mode of action for many years will lead to resistant populations. Rotate herbicide modes of action every few seasons. If you suspect you have resistant populations, contact your local cooperative extension service representatives and develop a resistance management plan.



Rain or irrigation too soon after herbicide application can wash the herbicide off before it can penetrate. This is especially true for weeds with waxy leaves such as woodsorrel (*Oxalis corniculata*) pictured here.

This plan should include several management strategies that will prevent development of resistance to the new herbicide. **LWM**

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