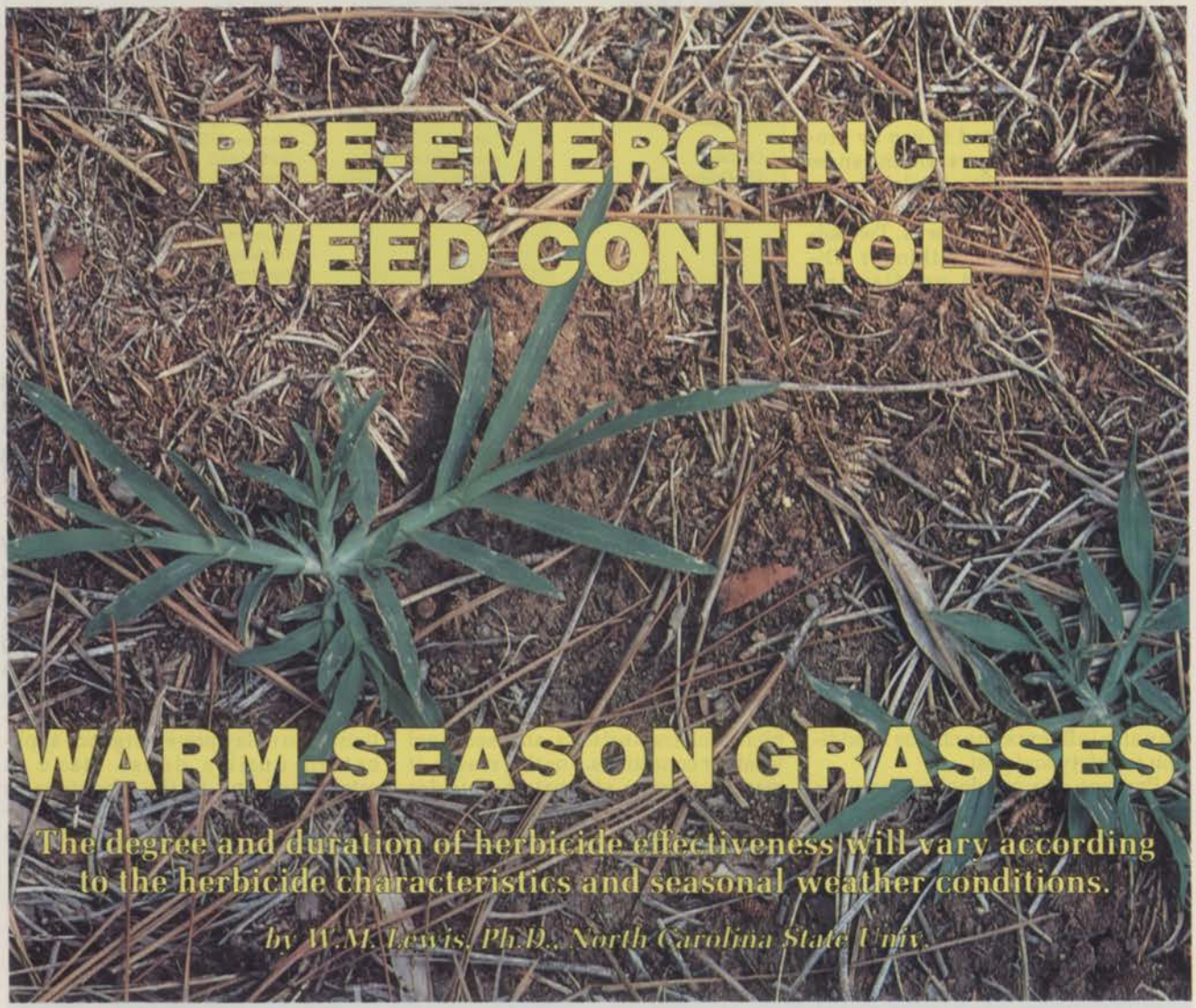


PRE-EMERGENCE WEED CONTROL

WARM-SEASON GRASSES

The degree and duration of herbicide effectiveness will vary according to the herbicide characteristics and seasonal weather conditions.

by W.M. Lewis, Ph.D., North Carolina State Univ.

Goosegrass and smooth crabgrass (shown above) are two of the most common weeds found in warm-season turfgrasses. Specific management practices lead to aesthetically appealing turfgrasses.

The first step in a weed management program is to produce a healthy vigorous turf, one competitive with weeds. This may be done by matching proper warm-season turfgrass species or cultivars with their intended use—whether a home lawn, athletic field, commercial landscape or golf course fairway.

Grass selection may also be related to its intended level of management (amount and frequency of fertilization, needed irrigation and mowing height and frequency).

Insect and disease problems should also be reduced.

Once these practices have been put into action, the turf manager is ready to consider the need for pre-emergence herbicides.

Frequently, the need should be determined by observations made on the site the previous season. Applying pre-emergence herbicides year after year without any consideration to the existing weed problems is not good management. Carefully selecting specific management practices leads to an aesthetically appealing and serviceable warm-season turfgrass.

Available herbicides

Pre-emergence herbicides are the

backbone of a weed management program. They are primarily used for the control of smooth and large crabgrass and goosegrass, though many will control certain other summer annual weedy grasses. Also, they provide pre-emergence control of annual bluegrass when applied in the fall.

A number of herbicides or herbicide combinations are registered for pre-emergence use in established warm-season turfgrasses (Table 1). This listing contains examples of common and trade names of pre-emergence products.

Many herbicides are also formulated on fertilizer carriers. Certain herbicides are limited to use by professional turf managers which can be determined by reading the label.

Oxadiazon (Ronstar) is not registered for use on home lawns. Two additional herbicides, dithiopyr (Dimension 1EC) and prodiamine (Barricade 65 WDG) may be registered for use in the 1991 season.

The emphasis is on application to established turfgrass because none of the herbicides are registered for application at time of sprigging, sodding or seeding warm-season turfgrasses. There is one exception, however: siduron may be used when sprigging zoysiagrass.

Herbicide selection

When selecting a herbicide, first consider turfgrass tolerance (Table 2) and the grassy weeds present on the site. Then consider the effectiveness of the herbicides on those weeds (Table 3). The method or ease of application may also influence the choice in addition to safety and cost.

Perhaps one overlooked factor is the tolerance of trees and ornamentals in the landscape. Most labels list tolerant ornamental species. This opens up another possibility of selecting a single herbicide for pre-emergence grassy weed control in the turf as well as the ornamental plant beds.

With the exception of atrazine, simazine and oxadiazon, the effects of the pre-emergence herbicides are associated with inhibiting root growth in the germinating weed seeds. Root inhibition has also been observed in desired turfgrasses; for example, in the growth of new roots along the stolons of bermudagrass and centipedegrass.

The degree and duration of the effects will vary according to the herbicide characteristics and seasonal weather conditions. For this reason, it may be wise to alternate herbicides from year to year or—maybe even more important—to be very cautious in determining the need for a pre-emergence herbicide in any year.

In heavily-trafficked areas having thin open stands, a pre-emergence herbicide may interfere with the stand filling in and the stolons rooting properly. Post-emergence control would be the best approach for this situation.

Frequent light applications of MSMA may be used in bermudagrass in an effort to control recently germinated crabgrass and goosegrass. In centipedegrass, sethoxydim (Poast) applied as a post-emergence provides control to crabgrass and goosegrass. The other alternative in these situations is to delay pre-emergence application until a dense stand is established and in the meantime to concentrate on starting the proper management practices to encourage that dense stand.

Table 1.

Examples of Common and Trade Names of Pre-emergence Herbicides for Warm-Season Turfgrasses

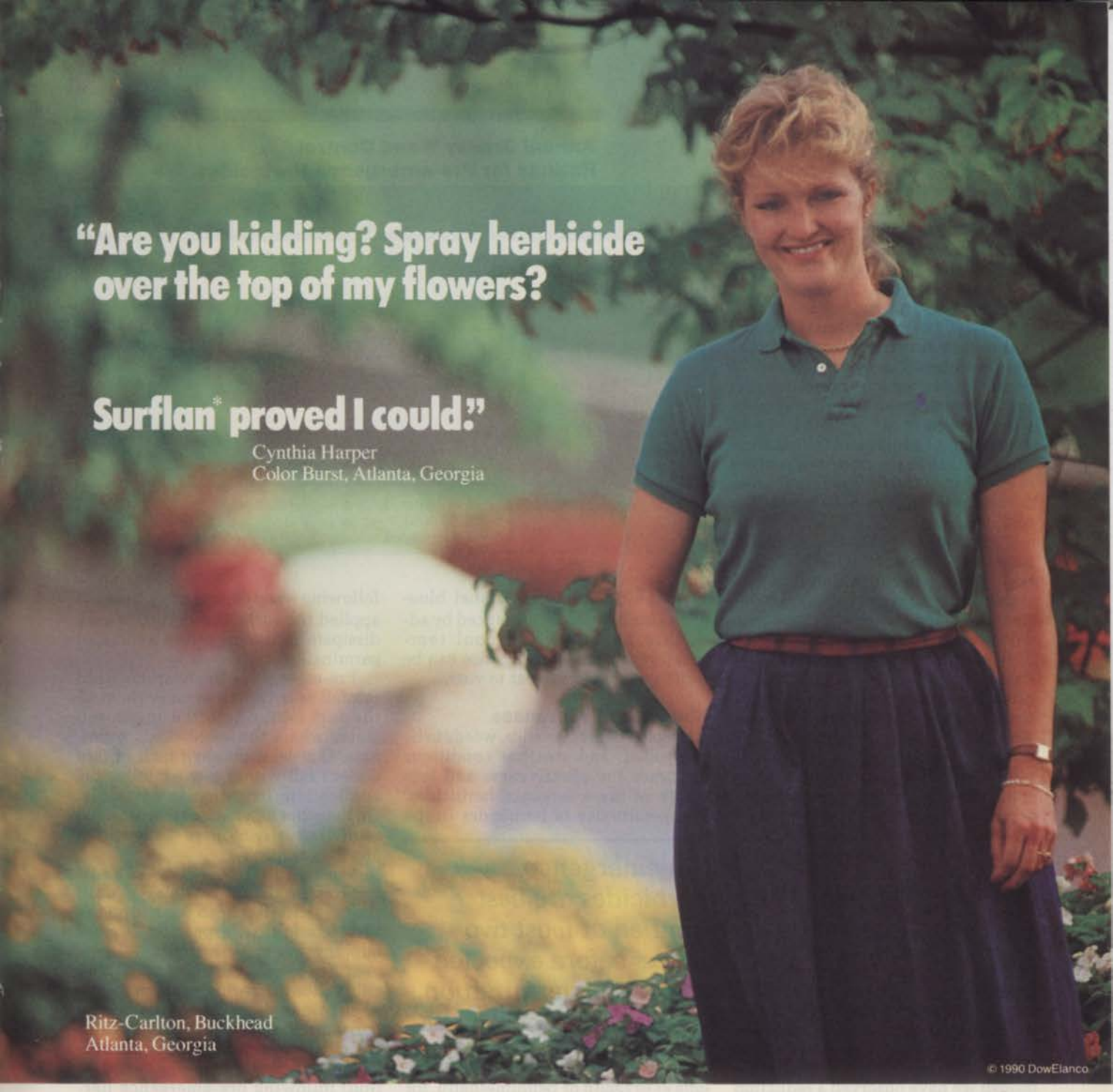
Common Name	Company	Trade Name and Formulation
Atrazine	Ciba-Geigy	AAtrex 80W, 4L, 90DG
	Security	Purge II 2L
Benefin	Dow/Elanco	Balan 2.5G, 60DF
	Lesco	2.5 Benefin Granular
Benefin + oryzalin	Dow/Elanco	XL 2G
Benefin + trifluralin	Dow/Elanco	Team 2G
Bensulide	ICI	Betasan 4E LF, 3.6G, 7G, 12.5G
	Lesco	Lescosan 4E, 7G
	PBI/Gordon	Bensumex 4LF
Bensulide + oxadiazon	Scotts	Goosegrass/Crabgrass Control 6.5G
DCPA	Fermenta	Dacthal 75W, 6F
Napropamide	ICI	Devrinol 50WP, 2G, 5G
	Lesco	Devrionol 5G Ornamental
Oryzalin	Dow/Elanco	Surflan 4AS
Oxadiazon	Rhone-Poulenc	Ronstar 2G, 50WP
Pendimethalin	Lesco	Pre-M 60 DG
	Scotts	Halts 1.71G
		Southern Weedgrass Control 2.45G
		Turf Weedgrass Control 1.71G
		Weedgrass Control 60WDG
Simazine	Ciba-Geigy	Princep 80W, 4L, 90DG, 4G

Table 2.

Tolerance of Established Warm-Season Turfgrasses to Pre-emergence Herbicides for Control of Annual Weedy Grasses

Herbicide	Bahiagrass	Bermudagrass	Centipedegrass	St. Augustinegrass	Zoysiagrass
Atrazine	NR	T	T	T	T
Benefin	T	T	T	T	T
Benefin + oryzalin	T	T	T	T	T
Benefin + trifluralin	T	T	T	T	T
Bensulide	T	T	T	T	T
Bensulide + oxadiazon	NR	T	NR	NR	T
DCPA	T	T	T	T	T
Napropamide	T	T	T	T	NR
Oryzalin	T	T	T	T	T
Oxadiazon	NR	T	NR	T	T
Pendimethalin	T	T	T	T	T
Siduron	NR	NR	NR	NR	T
Simazine	NR	T	T	T	T

T = tolerant when used properly according to the label; NR = not registered for use on this turfgrass.



"I was hesitant to try it at first. I thought, surely, there would be some injury to my flowers. But Surflan herbicide convinced me otherwise. It didn't harm them at all when we sprayed directly over the top.

"Surflan wasn't so gentle to the weeds. We used to have a real problem with crabgrass and foxtails. We'd have to go in and pull them all by hand. It was so time-consuming. I figured I was paying close to $50 for each thousand square feet just for labor.

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Application timing

Pre-emergence herbicides are best applied at least two weeks before expected weed seed germination. In areas where there is a crabgrass history, pre-emergence herbicides are applied in the spring when soil temperatures approach 53°F. Goosegrass germination is usually two weeks later than crabgrass.

Crabgrass and goosegrass germinate first in thin open stands of warm-season turfgrasses. Germination is delayed and/or reduced in dense stands, which is another reason for considering all cultural practices as part of a total weed management program. Moving from the southern to the northern portion of the warm-season zone, crabgrass may germinate from late January to early April.

Frequently, application timing is correlated with a biological indicator. For example, in North Carolina, pre-emergence crabgrass herbicides should be applied by the time dogwoods are in full bloom.

Research at North Carolina State University has shown that split applications generally out-perform a single pre-emergence application. An example of a split rate may be 1.5 pounds in early spring and 1.5 pounds eight weeks later, if the usual single spring application rate is 3 pounds active per acre. Split applications of benefin + trifluralin, oryzalin and pendamethalin have given acceptable goosegrass control.

Some turf managers apply one pre-emergence herbicide early in the spring and a second herbicide eight weeks later in an attempt to increase safety to the turf. We have not observed any adverse effects on ryegrass mixtures overseeded in bermudagrass in September or October following a March-to-May pre-emergence herbicide application, though we have observed a reduction in stand density of fall overseeded ryegrass from spring applications of oryzalin and benefin + oryzalin.

Our tests have also shown that applications can begin six to eight weeks before expected crabgrass germination with favorable control, because under cool soil temperatures little if any herbicide degradation occurs during this period. This would not hold true farther south in the warm-season turfgrass area. In fact, in some areas crabgrass can germinate year-round under favorable conditions.

Applications of herbicides for pre-emergence control of annual bluegrass and certain winter annual broadleaf weeds may be from late August to early November, depending on geographical location. Annual bluegrass germination is influenced by adequate moisture and cool temperatures. Time of emergence can be quite variable from year to year.

TABLE 3.

Annual Grassy Weed Control Ratings for Pre-emergence Herbicides

Herbicide	Crabgrass	Goosegrass	Annual Bluegrass
Atrazine	P	P	E
Benefin	G	F	G
Benefin + oryzalin	G	F-G	G
Benefin + trifluralin	G	F	G
Bensulide	G	P	G
Bensulide + oxadiazon	G	G	G
DCPA	G	F	G
Napropamide	G	G	G
Oryzalin	G-E	G	G
Oxadiazon	G	G	G
Pendimethalin	G-E	F-G	G
Siduron	G	F	NR
Simazine	P	P	E

Weed control effectiveness: E = excellent (90-100%), G = good (80-90%). F = fair (70-80%), P = poor (<70%), NR = not registered.

Herbicide effectiveness

Herbicide characteristics, weeds to be controlled, and weather conditions influence the effectiveness and longevity of pre-emergence herbicides. The persistence of herbicides in the soil differs. Benefin does not persist as long as oryzalin or pendimethalin, for example. Split or repeat herbicide applications help to maintain threshold levels for season-long grassy weed control.

Pre-emergence herbicides are best applied at least two weeks before expected weed seed germination.

As indicated in Table 3, with the exception of atrazine and simazine, pre-emergence herbicides provide good to excellent control of crabgrass. However, the ability to control goosegrass varies. For effective goosegrass control, a herbicide rated "good" should be applied. Single applications of oxadiazon and bensulide + oxadiazon have provided favorable goosegrass control in North Carolina tests.

If a pre-emergence herbicide is to be effective, it must be applied prior to weed seed germination. Applications following weed emergence will fail. If applied too early, the herbicide may dissipate or degrade before weed seed germination.

Pre-emergence applications need rainfall or irrigation to move them off the turf foliage into the upper soil layers where the weed seeds germinate. If at least one-half inch of rain doesn't fall within a week following application, irrigation is advisable. On the other hand, excessive seasonal rainfall usually reduces the length of effective control.

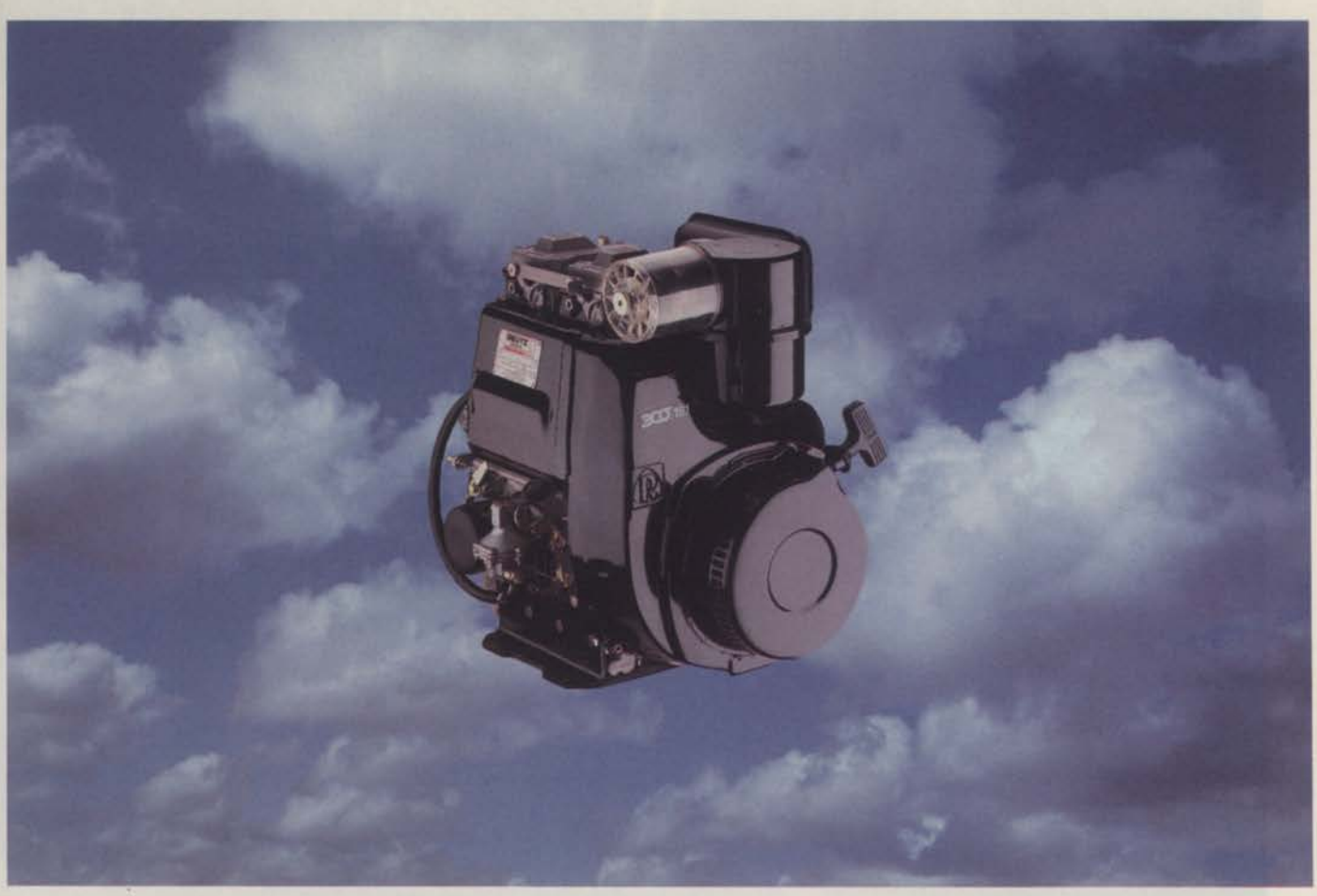
Mowings of warm-season turfgrasses should be delayed until the herbicide has been washed off the turfgrass foliage, especially if grass clippings are to be removed.

It has been a common belief that cultivation following pre-emergence appications disrupts the herbicide barrier in the soil and then stimulates weed germination. However, according to test results, coreing (aerification) following pre-emergence herbicide application does not affect herbicide performance, providing the soil cores are returned.

Metolachlor (Pennant 7.8E) has been registered for pre-emergence yellow nutsedge control on golf fairways, sod farms and commercial lawns, but not on residential turf. It may be applied to bahiagrass, bermudagrass, centipedegrass and St. Augustinegrass.

Choosing the appropriate pre-emergence herbicide requires knowing the tolerance of the warm-season turfgrass to the herbicide.This must be matched with the weeds. **LM**

Dr. Lewis is a professor of crop science at North Carolina State University



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PRE-EMERGENCE WEED CONTROL

COOL-SEASON GRASSES

Annual weed control requires a sound knowledge of the grasses and weeds in question, and discriminating cultural practices.

by Nick Christians, Ph.D., Iowa State University

Many of the annual weeds we encounter in cool-season turf species are actually warm-season grasses.

Unlike the cool-season turfgrasses that thrive in spring and fall, warm-season grasses such as crabgrass, goosegrass and foxtail thrive during the summer.

Warm-season annuals die early in the fall with the first cool weather. Cool-season grasses thrive in the fall and early spring. Fertilizer applications at this time will help thicken cool-season lawns and make them more resistent to annual weed encroachment in the late spring. Fertilizer applications during mid-June to mid-August to lawns with some annual grasses and broadleaf weeds don't encourage the lawn grasses but do benefit the warm-season weeds.

High-phosphorus diet

The proper fertilizer can also help discourage annual weeds.

When the lawn is established, "starter" fertilizers high in phosphorus (P) are used, such as a 13-25-6 or a 10-20-10. Once the grass plant matures and forms an extensive root system, however, it is able to remove phosphorus from the surrounding soil; then fertilizers with analysis much lower in P are generally sufficient (i.e., 20-3-15 or 18-5-9).

Application timing

Fertilizing mature lawns with high phosphorus fertilizers does little to benefit the turf, unless the area is shown by a soil test to be low in that element. Germinating annual weeds thrive on high P fertilizers just as do germinating perennial grass seedlings.

Although turf deficient in P may benefit from "winterizing" treatments, most lawns have sufficient phosphorus in the soil. So more will not improve the turf's winter survival; however, the resulting high P levels on the soil surface will help germinating weed seeds in the spring.

Importance of mowing

Mowing itself can serve as a weed control. Many of the serious agricultural weeds are of no consequence in turf areas because they cannot tolerate continuous mowing. Excessively low mowing heights, however, will reduce the turf's competitive advantage and allow annual weeds to become established regardless of whether herbicides are used, as oserved at Iowa State University in late summer studies. (Kentucky bluegrass mowed below 1½ inch will often become infested with crabgrass, regardless of the presence of pre-emergence herbicides.)

A good dense stand of turf is one of the best weed controls, and mowing to meet the turf's requirements is one of the best ways to assure a dense stand.

Cultural practices

Cultivation techniques such as core aerification can work both ways on weed infestation.

Compacted soils have a detrimental effect on the turf and often become infested with annual weeds. Using herbicides on compacted areas makes little sense, unless the compaction problem is dealt with first. Aerification reduces compaction and favors the turf, thereby helping to control weeds.

Improperly timed cultivation can potentially aid weed infestation. Any practice that opens the turf and brings annual weed seed to the surface during the peak weed germination period is likely to benefit the weeds more

than it does the turf.

Recent research has shown that spring aerification following pre-emergence herbicide application does not disrupt the barrier established by the herbicide as much as once believed. It makes good sense, though, to avoid this time if possible. Late summer to early fall is still the best time to aerify cool-season lawns.

Irrigation strategies

A sound knowledge of grass species and weeds can also be used to design an irrigation strategy that will help prevent weeds.

In an established, well-rooted lawn it makes little sense to irrigate to keep the surface continuously moist during the germination of annual weeds. Some surface drying will generally have no detrimental effect on perennial lawn grasses, but will have an impact on newly-germinated weed seed that are struggling to survive.

Turf infested with fungal patch diseases may benefit from light, frequent watering before and during disease activity. Proper use and timing of light, frequent watering programs is recommended on lawns where patch diseases have been a problem. On lawns where patch diseases have not historically been a problem, deep, infrequent watering is still the best practice.

Proper irrigation at other times can also help prevent weed problems. Kentucky bluegrass lawns can survive extended drought periods by going into summer dormancy. But spurge and oxalis often infest these lawns in late summer resulting in callbacks and the need for more herbicides. Using irrigation water to keep the lawn growing can help insure against these weed problems.

Watering cool-season lawns during dry fall conditions can also be a sound management practice.

Dry autumns have been a problem in the Midwest during three of the last four years. This is one of the best times for cool-season grasses to become re-established in the absence of competing annual weeds. This time of year is particularly important on lawns damaged by summer drought.

Proper fall fertilization and watering can help make the lawn more resistant to weed infestation in the spring.

Easy on perennials

Using cultural techniques can help prevent a weed problem. However, cultural controls are rarely 100 percent effective.

Insect and disease damage, adverse weather conditions, physical damage to the lawn, and a variety of other factors can injure even the best managed turf and open it to weed establishment. For these situations, herbicides can prevent weed infestation if properly used.

Table 1 lists a variety of pre-emergence herbicides that can be used on cool-season lawns to help prevent annual weeds. The activity of these materials is such that they do little, if any, damage to the perennial grasses in the turf, but are deadly to the germinating annuals.

(For a detailed discussion of these herbicides, see, "Cool-season weed control poses special challenge," *Lawn Care Industry* magazine, Feb., 1990.)

Some of the materials in this group have unique characteristics.

Siduron, for instance, is the only material in the group that can control annual weeds selectively at the time of lawn establishment. This material is particularly useful for spring seedings.

Isoxaben is marketed under the trade name Gallery. It is particularly effective against knotweed, spurge, oxalis and other annual broadleaf weeds. Isoxaben has limited activity at labeled rates against annual grasses and will generally fit into the lawn care program as a supplement to standard pre-emergence herbicides. Where annual broadleaves have been a problem in the past, this material provides a new tool that can be used effectively if properly timed.

Widening the window

Much of the research on annual weed control in the 1980s was aimed at "widening the window" of application (Figure 1).

The pre-emergence herbicides in Table 1 will control annual weeds if applied before weed germination, but most provide little if any post-emergence activity on weeds that have already germinated. These materials are very useful in situations where they can be properly timed before weeds germinate.

A breakthrough

In the early 1980s, MSMA (monosodium methanearsonate) and DSMA (disodium methanearsonate) were the only materials available for post-emergence control of summer annual weeds in turf. The weed control from these materials was quite inconsistent in much of the Northern region and often resulted in phytotoxicity to the turf. Pre-emergence applications were far preferable during this time, and these post-emergence materials were used only as a last resort.

Fenoxaprop-ethyl, marketed under the trade name Acclaim, was released in the mid-1980s. It was the first really effective post-emergence herbicide for controlling annual grasses in cool-season lawns.

This material broadens the window of application by allowing lawn care specialists to effectively treat germinated crabgrass in its early stages. Customers whose lawns could not be treated before crabgrass germination and customers who signed up for the service after the time of pre-emergence application no longer had to go

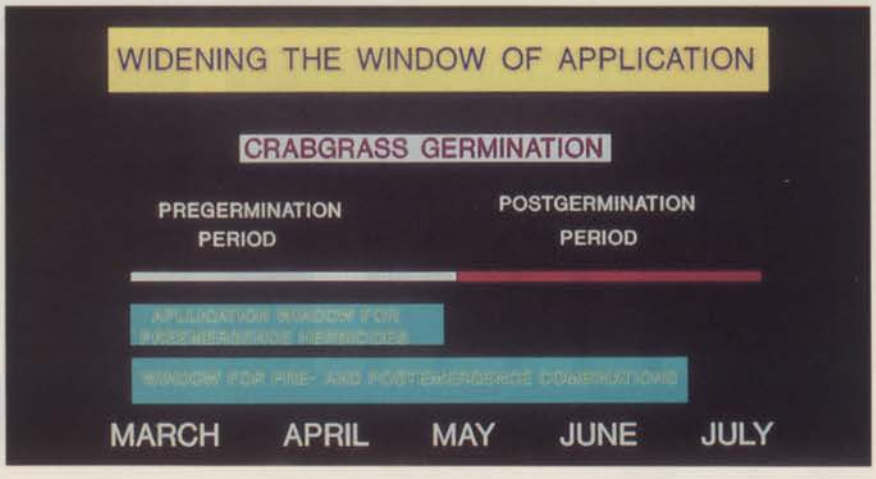
TABLE 1

Pre-emergence herbicides currently in use in cool-season turf

COMMON NAME	TRADE NAME	COMMON NAME	TRADE NAME
DCPA	DACTHAL	OXADIAZON	RONSTAR
BENEFIN	BALAN	PENDIMETHALIN	PRE-M, WEED GRASS CONTROL
BENSULIDE	BETAMEC-4, PRE-SAN, BETASAN	TRIFLURALIN/BENEFIN	TEAM
		SIDURON	TUPERSAN
ISOXABEN	GALLERY		

Source: The author

FIGURE 1



through the entire season with a lawn filled with warm-season annuals.

Fenoxaprop-ethyl has had some limitations. It is incompatable with many broadleaf herbicides such as 2,4-D. It has no pre-emergence activity, and it is not very effective following drought stress of the target species. But it has still been widely used in the cool-season region. **LM**

Dr. Christians is a professor of horticulture at Iowa State University.

New pre-emergence herbicides are becoming available which "widen the window" of time for effective applications.

New control products

DIMENSION: Dithiopyr is a new material that will be marketed on a limited basis in selected states in 1991 under the name Dimension. Research on this product has been under way at various state universities since the mid-1980s under the experimental name MON 15100.

Dithiopyr is a very effective pre-emergence herbicide that provides reasonably good post-emergence control of germinated crabgrass. The extent of the post-emergence activity varies with location, but I have found it to provide excellent post-emergence control in most years at the Iowa State University turfgrass research area.

Dithiopyr has two important advantages over older products:

- it can provide both pre- and post-emergence activity, and
- it does so at a lower rate of application than most herbicides. The recommended application rate will be 0.5 lbs. AI/acre as compared to 1.5 to as high as 10 lbs. AI/acre with earlier materials.

QUINCLORAC: Quinclorac, an experimental product that has been given the potential trade name Impact is another of the new products that may possibly widen the window of application.

This material provides excellent post-emergence control of crabgrass in its early stages and provides excellent control of some broadleaf weeds, particularly white clover. Quinclorac, with little pre-emergence activity, would have to be combined with a pre-emergence material if it is applied at a time when crabgrass is still germinating.

Quinclorac has been found in recent experimental work to provide very good activity in the granular form and may well find a place in the future.

Similar problems during drought

Research at Iowa State University on both dithiopyr and quinclorac indicate that these products are likely to experience problems controlling crabgrass that has been subjected to drought periods. Fenoxaprop-ethyl has similar problems.

Figures 2 and 3 show the results of post-emergence weed control studies following an extended drought period (Fig. 2) and following a period in which no drought stress was observed (Fig. 3). Crabgrass subjected to dry conditions before treatment was much harder to control than the crabgrass that experienced no drought conditions. More work will be needed to understand this reduced control, but this should be considered whenever post-emergence crabgrass control is needed.

Changing standards

With the new tools being developed, the potential exists for a change in the standard lawn care program.

In the past, a standard program included a pre-emergence application in the first round, often followed by an additional application in the second round to assure complete control through the season. With the new post-emergence materials being developed, the possibility exists that the early pre-emergence application could be eliminated and replaced with a single application in the second round that would control annuals both before and after emergence.

The new products will have to prove themselves in the market place, but if this type of program can be used effectively, it could potentially reduce the amount of herbicides that the industry now applies to lawns and could reduce cost. These possibilities will be worth investigating in future seasons as new herbicides reach the market.

—Dr. Christians□

FIGURE 2

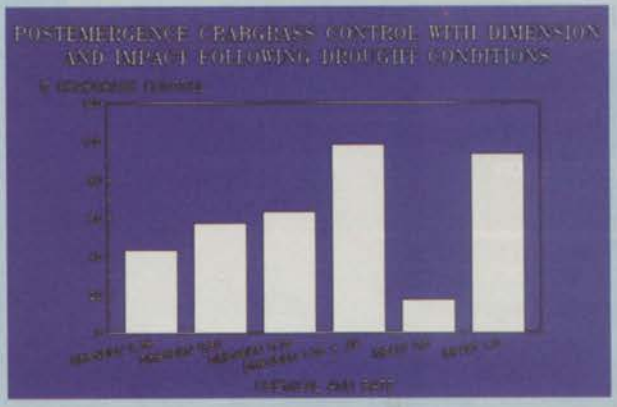


FIGURE 3