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WEED CONTROL

Maximize your preemergence herbicide performance

By Tim R. Murphy

Preemergence herbicides persist in the soil and control susceptible weeds for two to six months. The level of control depends on the specific herbicide and rate being used, soil physical and chemical properties, soil moisture levels, soil temperatures, as well as the species of turfgrass. Additionally, the type of herbicide formulation and uniformity of application also has a major influence on the level of control achieved.

Each year there are instances where for some reason preemergence herbicides fail to control weeds or injury occurs to turfgrasses. Why?

Let's examine the factors that will maximize the effectiveness of a preemergence herbicide.

Application before germination

Preemergence herbicides must be applied prior to weed seed germination. The mode of action for most preemergence herbicides (e.g., bensulide, benefin, dithiopyr, oryzalin, pendimethalin, prodiamine) is the inhibition of certain phases of cell division during the seed germination process. As the weed seed germinates, the herbicide is absorbed by the root or shoot, cell division is blocked, growth is inhibited and eventually the immature seedling dies.

In general, sprayable and granular formulations of preemergence herbicides are equally effective in controlling susceptible weeds.

Emerged weeds visible at the time of application are not controlled by preemergence herbicides. Although the majority of herbicides may be classified as preemergence or postemergence chemicals, atrazine, simazine, dithiopyr, ethofumesate, and pronamide are exceptions.

Dithiopyr will control seedling crabgrass (prior to tiller development), but will not control seedling goosegrass. Both atrazine and simazine exhibit preemergence and postemergence control of a wide range of winter annual broadleaf weeds and annual bluegrass. Similarly pronamide has preemergence and postemergence activity on annual bluegrass.

Germination factors

Application timing counts. The various species of crabgrass and goosegrass are among the most troublesome annual grass weeds in turf.

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Crabgrass initiates spring germination when soil temperatures at a four-inch depth reach 53 to 58°F. Goosegrass germinates at soil temperatures of 60 to 65°F. Because of higher temperature requirements for germination, goosegrass normally germinates two-to-eight weeks later in spring than crabgrass. The old rule of thumb is to apply the preemergence herbicide two weeks before crabgrass seed germination. However, recent research has shown that most preemergence herbicides can be applied in December and January and still provide high levels of crabgrass control the following summer months.

Preemergence herbicides are degraded primarily by soil microorganisms. Degradation is higher under warm, moist soil conditions and lower under cool, dry soil conditions. The low activity of soil microorganisms involved in herbicide decomposition during the cold, winter months is a major reason why preemergence herbicides can be applied in December and January several weeks in advance of crabgrass and goosegrass seed germination and still provide high levels of control the following summer.

Repeating applications

Application frequency also plays a role. Repeat applications have been shown to increase control of crabgrass and goosegrass, particularly if soil seed populations of these species is high.

While research has shown that December and January applications can provide effective control of crabgrass in the following summer months, research has also shown that applying at one-half the recommended rate at the normal application time and again six to eight weeks later will improve crabgrass and goosegrass control for most products.

Some research has also shown that after the use of normal herbicide application rates for one or two years, subsequent yearly rates may be reduced. B. J. Johnson (1982) showed that in properly maintained bermudagrass, herbicide rates required to control crabgrass or goosegrass could be halved or eliminated in subse-

TABLE 1. SOUTHERN CRABGRASS CONTROL

Influence of formulation particle size on southern crabgrass control 6 months after treatment with preemergence herbicides. (Kelly and Coats, 1999)

Particle Size	Oxadiazon[1]	Dithiopyr	Oryzalin	Prodiamine
number/gram		0.5 lbs. ai/acre	3.0 lbs. ai/acre	0.75 lbs. ai/acre
		(%)		
23	58	66	42	43
58	67	75	64	71
165	72	75	62	74
465	72	84	74	81
1,310	70	82	75	82
3,728	66	75	75	83
10,606	68	82	76	83
LSD (0.05)	**7**	**8**	**8**	**7**

1 CONTROL RATINGS ARE FROM 1995 AND WERE AVERAGED ACROSS OXADIAZON RATES THAT RANGED FROM 1.0 TO 6.0 LBS. AI/ACRE.

quent years when a normal rate was applied the first year.

Tolerance considerations

Remember turfgrass tolerance characteristics. When considering any herbicide, the first consideration is the tolerance of the desirable turfgrass species to the chemical in question. As a general rule, preemergence herbicides are not as phytotoxic to established turfgrass species as postemergence herbicides. Notable exceptions are atrazine, simazine and pronamide on cool-season grasses. Additionally, the tolerance of fall-seeded tall fescue to several preemergence herbicides is low. Research has shown that tall fescue seeded from mid-September through mid-October was tolerant to most preemergence herbicides applied the following early March (Johnson and Murphy, 1991).

Extremely small particle sizes are not necessary to achieve high levels of control.

However, if tall fescue was seeded in mid-November, most preemergence herbicides applied in early March caused moderate to severe injury expressed as stand reduction.

Reference to the herbicide label will show recommended turfgrass species and time intervals that are required to prevent injury from time of seeding and herbicide application date.

TABLE 2.

Smooth crabgrass control with various formulations of prodiamine. (Yelverton, 1998).

Prodiamine Formulation	Rate	Smooth Crabgrass Control
	(lbs. ai/acre)	(%)
65WDG	0.75	98
0.29GR	0.75	91
0.5GR	0.75	81
LSD (0.05)		**9**

TABLE 3.

Smooth crabgrass and goosegrass control with emulsifiable concentrate (EC) and granular formulations of dithiopyr. (Johnson and Murphy, 1993).

		Control	
Dimension Formulation	Rate	Smooth Crabgrass	Goosegrass
	(lbs. ai/acre)	(%)	
1EC	0.5	64	31
1EC	0.75	91	29
0.25GR	0.25	82	55
0.25GR	0.38	100	78
0.25GR	0.5	100	82
LSD (0.05)		**22**	**15**

Difference in weed species

In general, crabgrass is easier to control with preemergence herbicides than goosegrass. Herbicides that have consistently controlled crabgrass in most university tests include members of the dinitroaniline herbicide family (benefin, oryzalin, benefin + oryzalin, benefin + trifluralin, prodiamine, pendimethalin), dithiopyr, bensulide and oxadiazon. High levels (>80%) of goosegrass control have consistently occurred with oxadiazon, prodiamine, dithiopyr, pendimethalin, oryzalin and benefin + oryzalin. Atrazine and simazine rarely provide acceptable levels of either crabgrass or goosegrass control.

A key factor to effective performance of a fertilizer/herbicide product is the percent load of the herbicide.

HOW TO GET MAXIMUM CONTROL OF SUMMER WEEDS

Maximum control of summer annual weeds with preemergence herbicides can be achieved by following these basic guidelines:

1. **Apply the product at the recommended time and rate.** Weather varies from year to year and it may be necessary to apply earlier than normal. Reference to 30-day weather forecasts can help with this decision.
2. **Apply the product before rain is expected or water it in with two inches of irrigation water.** Numerous instances of poor weed control occur each year because of the lack of rain or an irrigation event within seven days of preemergence application. Additionally, irrigating-in the herbicide is an excellent method to prevent losses due to volatility and lateral herbicide leaching. Turfgrass preemergence herbicides essentially do not leach in downward direction beyond a depth of one to three inches due to binding to soil colloids and organic matter. But they can move laterally, particularly if heavy rainfall occurs shortly after application. Thus, irrigation will usually improve weed control and will help to prevent lateral movement.
3. **Calibrate all application equipment.** Uniform application is critical to achieving good weed control.
4. **If fertilizer/herbicide formulations are to be used, select a product that has uniform particle size.** Be sure the product is applied with a sufficient number of particles to ensure even, uniform application. Also, be sure that the herbicide load is sufficient to apply the recommended rate of the product. Johnson and Murphy (1993) showed that dithiopyr rates can be reduced if applied on a dry granular carrier (Table 3). However, with most other preemergence herbicides the amount of active ingredient applied per acre should be the same either for sprayable or dry formulations.
5. **Delay mowing until after a rainfall or irrigation event.** Studies have shown that mowing and bagging operations can remove significant quantities of a preemergence herbicide if conducted before the herbicide is moved into the soil by rain or irrigation water.
6. **Properly maintain the turfgrass.** Following recommended cultural practices that promote normal turfgrass growth and development will enable the turfgrass to compete with weeds. The first line of defense against weed infestations has been, and probably always will be, a thick, healthy, properly maintained turfgrass. Adherence to recommended soil fertility and pH levels, proper irrigation, controlling other pests, and mowing at the correct height and frequency will improve the effectiveness of most chemical weed control programs.

Role of aerification

Core aeration generally has not been recommended or practiced following a preemergence herbicide application. Core aeration was believed to disrupt the herbicide barrier in the soil and stimulate weed emergence. Research conducted in Georgia (Johnson, 1987) showed that core aeration immediately prior to or one, two, three, or four months after applications of benefin, bensulide, DCPA, and bensulide + oxadiazon to common bermudagrass did not stimulate large crabgrass emergence.

Aeration at one or two months after application increased large crabgrass cover 5% for oxadiazon at 2.0 lbs. ai/acre, but not at 4.0 lbs. ai/acre.

In a related Georgia study (Johnson, 1982), it was shown that core aeration at one, two, or three months after an application of oxadiazon did not decrease goosegrass control on a Tifgreen bermudagrass putting green.

Preemergence herbicides are degraded primarily by soil microorganisms.

In Michigan (Branham and Rieke, 1986), core aeration, or vertical mowing, immediately or one month after an application of benefin, bensulide, or DCPA did not affect large crabgrass control in annual bluegrass.

A study conducted in North Carolina (Monroe et. al., 1990) showed that aeration did not affect the activity of several preemergence herbicides in controlling crabgrass species in either 'Tifgreen' or common bermudagrass.

However, in creeping bentgrass, significantly greater amounts of crabgrass occurred in aerified plots with the cores returned than in plots not aerified, or aerified plots with the cores removed. While most herbicide labels do not recommend aeration after preemergence herbicide application, university conducted research has not shown an adverse effect on crabgrass control.

Results can vary between research plots and commercial turfgrass sites and there may be situations where core aeration after preemergence herbicide application could stimulate crabgrass and goosegrass emergence. But, if the site requires aeration to encourage turfgrass growth and development, then it should be done.

The various species of crabgrass and goosegrass are among the most troublesome annual grass weeds in turf.

If crabgrass or goosegrass emerges, there are excellent postemergence herbicides that can be used.

Formulations matter

Preemergence herbicides are available as a sprayable or dry formulation. Dry formulations consist of the herbicide impregnated on an inert carrier such as clay or various analyses of fertilizer. Herbicide/fertilizer carrier products have become extremely popular in the turfgrass industry. Applying a herbicide/fertilizer product is convenient and enables two operations to be conducted at the same time.

In general, sprayable and granular formulations of preemergence herbicides are equally effective in control susceptible weeds. But keep in mind that regardless of the formulation, herbicides must be uniformly applied to the site for acceptable control.

Uniform coverage is usually easier to achieve with a spray than with a granular application. Several factors impact the results obtained with a herbicide formulated on a fertilizer carrier. Of these, application uniformity and percent load of the herbicide are the most critical.

Application uniformity is determined by particle size, uniformity of particle size, and application equipment. Particle size and uniformity of particle size is determined by the manufacturer or formulator. As particle size decreases, the density of

particles per unit area increases. Uniform particle sizes are equally important to prevent ballistic segregation. Research conducted in Mississippi (Kelly and Coats, 1999) showed that southern crabgrass control increased to a point then leveled off as particle size of a dry fertilizer/herbicide product decreased (Table 1).

Extremely small particle sizes were not necessary to achieve high levels of control. This research concluded that with dithiopyr and oryzalin a particle size 465 particles per gram or greater was necessary to achieve high levels of control. For prodiamine, a particle size of 165 particles per gram or more was sufficient. For oxadiazon, a size fraction of either 58 or 165 particles per gram or greater were equivalent in activity on southern crabgrass.

Another key factor to effective performance of the fertilizer/herbicide product is the percent load of the herbicide. High load products usually are applied at a lower amount of total material per acre than a low load product. Research conducted in North Carolina showed that prodiamine formulated on a 0.29GR (granule) product controlled smooth crabgrass better than when formulated as 0.5GR product (Table 2) (Yelverton, 1998). The increase in smooth crabgrass control was attributable to the better coverage with 0.29GR product.

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