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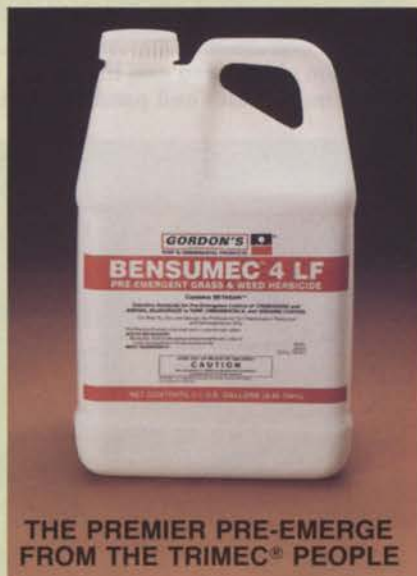
which has been the overwhelming choice of prestigious country clubs and professional landscape managers for over 20 years.

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# BENSUMEC™ 4 LF

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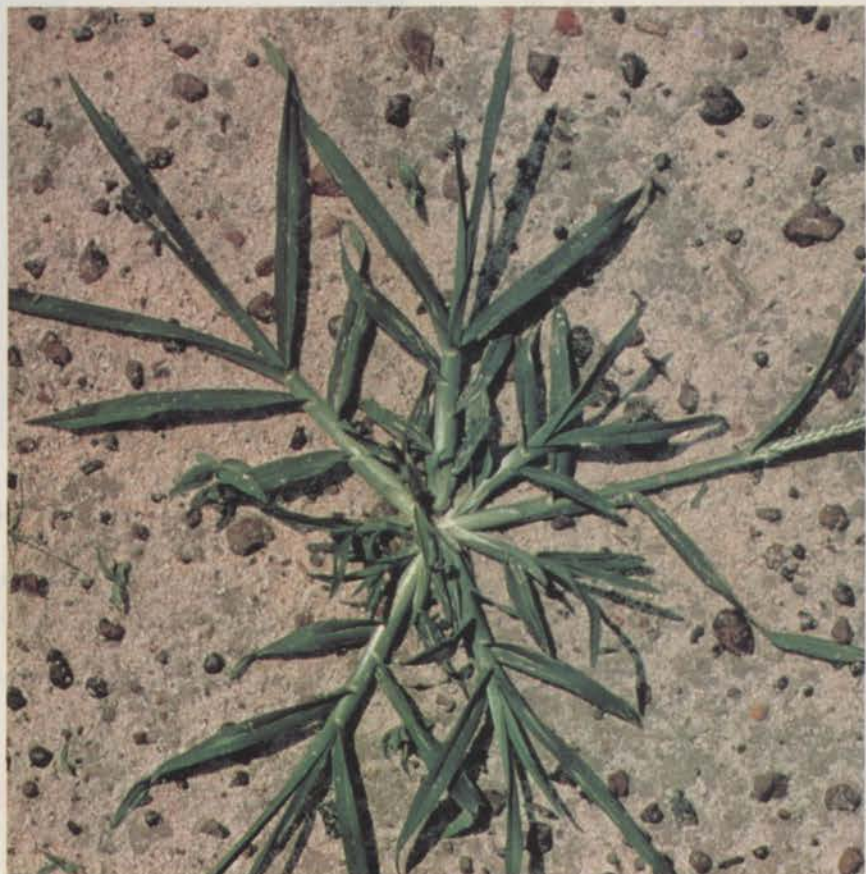
PBI/GORDON'S UNIQUE FORMULATION OF BETASAN HERBICIDE

Circle No. 151 on Reader Inquiry Card

728-190



Common chickweed and henbit are easily controlled with benefin, benefin + oryzalin, oryzalin and pendimethalin. See table 4.



Goosegrass is susceptible to spring-applied, pre-emergence herbicides.

that is obtained from the inherent competitive ability of a properly maintained warm-season turfgrass. Avoid a strict reliance on herbicides without regard for other management practices in the overall weed control program. This will not result in a high quality, aesthetically appealing warm-season turfgrass.

#### Important tools

Pre-emergence herbicides form the foundation of a chemical weed control program. They are primarily used for the control of crabgrass species, goosegrass and winter annual weeds.

Post-emergence herbicides control these weeds, but usually more than one application is required and often the turfgrass is injured for a short period of time after application.

In the past years there were only four to five pre-emergence herbicides available for warm-season turfgrasses. However, there are now 18 herbicides or herbicide combinations registered for pre-emergence use on warm-season turfgrasses (Table 1).

Isoxaben (Gallery) is the newest registration. It was labeled in 1989 for pre-emergence weed control in both cool-season and warm-season turfgrasses. Isoxaben effectively controls a wide range of summer and winter annual broadleaf weeds, but is not effective for the control of crabgrasses and goosegrass. Additionally, dithiopyr (Dimension) and prodiamine (Barricade) are in the final stages of the registration process and may be available for use in 1990.

#### Factors to consider

It is extremely difficult to name one pre-emergence herbicide that would be "best" for all turfgrass weed control situations. Several factors must be considered before selecting a pre-emergence herbicide. Selection should be based on turfgrass tolerance and the weed species composition of the site. Herbicide selection based solely on cost may result in possible turfgrass injury and/or the additional expense of a follow-up post-emergence herbicide application.

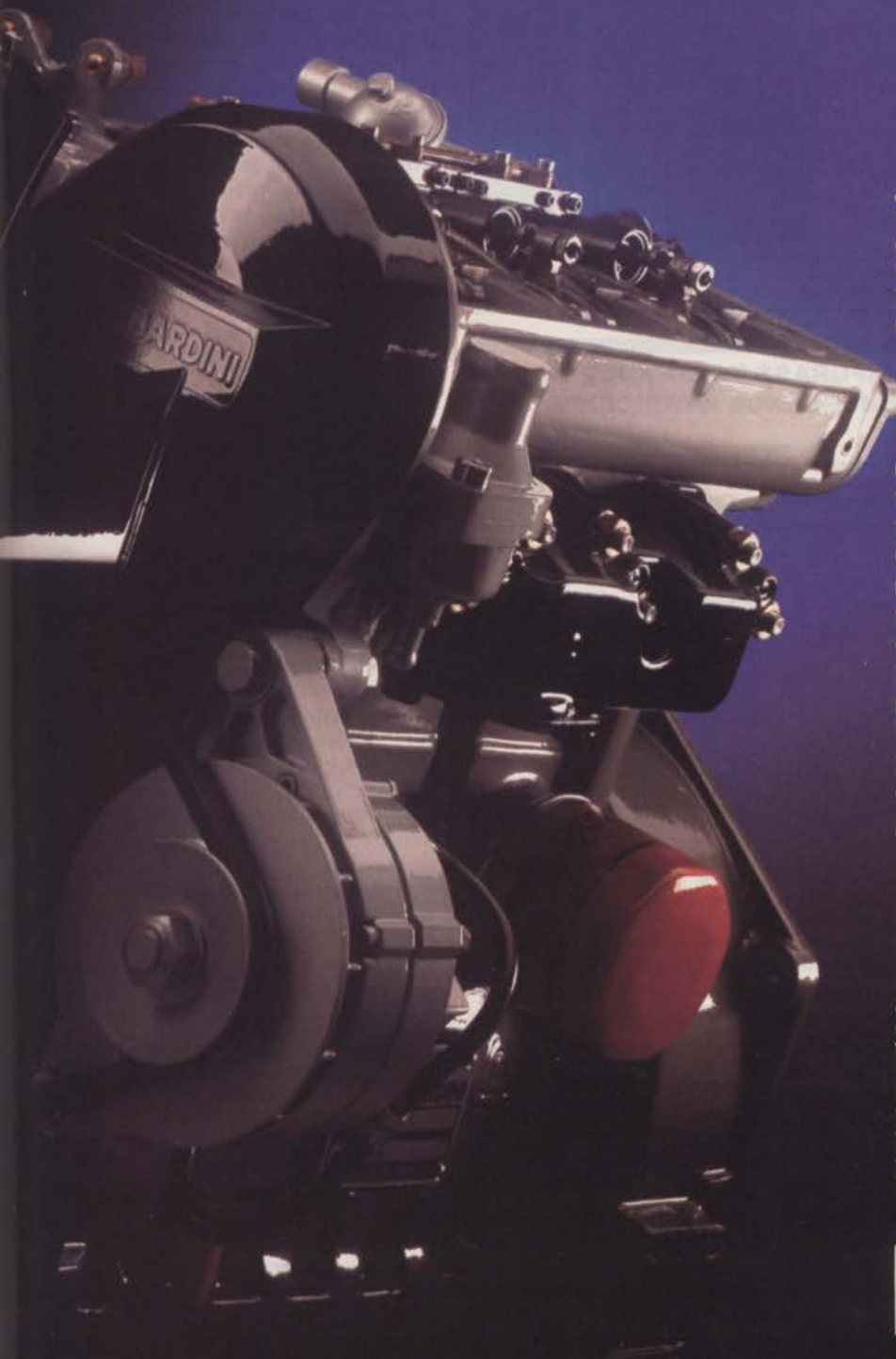
There are significant differences in the tolerance of warm-season turfgrasses to pre-emergence herbicides (Table 2). For example, zoysiagrass and bermudagrass have excellent tolerance to atrazine when dormant, but may be discolored or injured if applications are made during the summer months. In contrast, centipedegrass and St. Augustinegrass have excellent tolerance to atrazine at all times of the year, with the possible exception of

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**TABLE 1. COMMON AND TRADE NAMES OF WARM-SEASON TURFGRASS PREEMERGENCE HERBICIDES.**

| Common Name             | Company       | Trade Name and Formulation <sup>1</sup> |
|-------------------------|---------------|---|
| atrazine                | Royalgard     | Purge 4 lbs./gal.                       |
| benefin                 | Ciba-Geigy    | Aatrex 4L, 90DG, 80W                    |
| benefin + oryzalin      | Elanco        | Balan 2.5G, 85DF                        |
| benefin + trifluralin   | Lesco         | 2.5 Benefin Granular (2.5G)             |
| bensulide               | Elanco        | XL 2G                                   |
| bensulide + oxadiazon   | ICI           | ElancoTeam 2G                           |
| DCPA                    | Royalgard     | Betasan 2.9E, 4E, 3.6G, 7G, 12.5G       |
| dithiopyr <sup>2</sup>  | PBI/Gordon    | Roysan 4E, 12.5G                        |
| ethofumesate            | Lesco         | Betamec 4LF                             |
| fenarimol               | Lesco         | Lescosan 4E, 7G                         |
| isoxaben                | Fermenta      | ScottsGoosegrass/Crabgrass Control 6.5G |
| napropamide             | Monsanto      | Dacthal 75W                             |
| oryzalin                | Nor-Am        | Dimension 1EC                           |
| oxadiazon               | Elanco        | Prograss 1.5EC                          |
| pendimethalin           | Elanco        | Rubigan 1AS                             |
| prodiamine <sup>2</sup> | Elanco        | Gallery 75DF                            |
| pronamide               | Lesco         | Devrinol 5-G Ornamental                 |
| simazine                | ICI           | Devrinol 50WP, 5G                       |
|                         | Elanco        | Surflan 4AS                             |
|                         | Rhone-Poulenc | Ronstar 2G, 50W                         |
|                         | Lesco         | PRE-M 60DG                              |
|                         | Scotts        | Southern Weedgrass Control 2.45G        |
|                         |               | Turf Weedgrass Control 1.71G            |
|                         |               | Weedgrass Control 60DG                  |
|                         | Sandoz        | Barricade                               |
|                         | Rohm-Haas     | Kerb 50W                                |
|                         | Ciba-Geigy    | Princep 80W, 4L, 90DG, 4G               |

<sup>1</sup>Numeral refers to percent or pounds of active ingredient.  
<sup>2</sup>Registration pending Environmental Protection Agency approval.

controlling weeds. However, establishment problems can occur if seeding, sprigging or sodding operations are planned for a particular site. Always consult the herbicide label to determine the length of time required before renovation operations can be safely conducted.

**Timing applications**

Pre-emergence herbicides are applied to the turfgrass site prior to weed seed germination. This group of herbicides controls susceptible weeds during the weed seed germination process. Pre-emergence herbicides do not affect the viability of dormant weed seeds.

Pre-emergence herbicides are applied in the spring for crabgrass and goosegrass control and in the fall months for winter annual weed control. Since most pre-emergence herbicides are not effective on emerged weeds, applications must be made prior to weed emergence.

Late February to early March applications generally provide better crabgrass control than later applications. However, in the cooler, mountainous regions of the South, the spring application may be delayed until late March or early April. For winter annual weed control, late August to early October applications are used depending upon the geographical location.

**Cultural practices**

Pre-emergence herbicides require rainfall or irrigation water to move them into the zone of maximum weed seed germination (e.g. the upper one to two inches of the soil profile). Recommendations vary slightly among the different pre-emergence herbicides, but unless one-fourth to one-half inch of rainfall occurs within seven days, the herbicide should be irrigated into the top two inches of the soil profile.

Spring scalping and subsequent mowings of warm-season turfgrasses should be delayed until after either rainfall or irrigation has removed the pre-emergence herbicide from the turfgrass foliage. Unless the herbicide has been washed from the foliage, mowing can remove significant quantities of the herbicide from the site.

**Reducing thatch**

A thick thatch layer has been shown to decrease the persistence of pre-emergence herbicides. Eliminating heavy thatch by cultivation (core aeration, verticutting, topdressing) increases herbicide contact with the soil and helps to prevent the accelerated breakdown of the herbicide in the thatch layer.

*continued on page 46*

**TABLE 2. WARM-SEASON TURFGRASS TOLERANCE TO REGISTERED PREEMERGENCE HERBICIDES.**

| Herbicide                 | Turfgrasses |               |                 |                     |             |
|---------------------------|-------------|---------------|-----------------|---------------------|-------------|
|                           | Bahia-grass | Bermuda-grass | Centipede-grass | St. Augustine-grass | Zoysiagrass |
| atrazine <sup>1</sup>     | NR          | T(D)          | T               | T                   | T(D)        |
| 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           |
| ethofumesate <sup>2</sup> | NR          | T(D)          | NR              | NR                  | NR          |
| fenarimol                 | —           | T             | —               | —                   | —           |
| isoxaben                  | 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           |
| pronamide                 | NR          | T             | NR              | NR                  | NR          |
| simazine                  | NR          | T             | T               | T                   | T           |

<sup>1</sup>When dormant, bermudagrass and zoysiagrass have good tolerance to atrazine.  
<sup>2</sup>Ethofumesate is labeled for use on dormant bermudagrass that is overseeded with perennial ryegrass.  
 T = Tolerant at labeled rates; NR = Not registered for use on this turfgrass.

spring green-up.

Centipedegrass has not exhibited acceptable tolerance to the wettable powder formulation of oxadiazon (Ronstar 60W) in experiments conducted by the University of Georgia. Without a doubt, the herbicide label is the best reference to determine if a pre-emergence herbicide may be used on a particular warm-season turfgrass.

Pre-emergence herbicides should be used only on established warm-season turfgrasses. Newly-seeded and sprigged turfgrasses have a low level of tolerance and can be severely injured by most pre-emergence her-

bicides. Therefore, pre-emergence herbicide applications should be delayed until complete soil coverage has been achieved.

**Post-alternative**

An alternative to using pre-emergence herbicides during the "grow-in" of a warm-season turfgrass is to use post-emergence herbicides. Naturally there are exceptions, but many can be used during warm-season turfgrass establishment.

Pre-emergence herbicides persist in the soil for two to four months. The soil persistence characteristics of these herbicides are advantageous in



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**TABLE 3. SUMMER ANNUAL GRASS CONTROL RATINGS FOR PREEMERGENCE HERBICIDES.**

| Herbicides            | Crabgrass spp. | Goosegrass |
|-----------------------|----------------|------------|
| atrazine              | P              | P          |
| benefin               | E              | F          |
| benefin + oryzalin    | E              | F-G        |
| benefin + trifluralin | E              | F          |
| bensulide             | E              | P          |
| bensulide + oxadiazon | E              | G          |
| DCPA                  | E              | F          |
| napropamide           | E              | G          |
| oryzalin              | E              | F-G        |
| oxadiazon             | G              | E          |
| pendimethalin         | E              | F-G        |
| pronamide             | F              | P          |
| simazine              | F              | P          |

E = Excellent, ≥ 90% control. F = Fair, 70 to 79% control.  
G = Good, 80 to 89% control. P = Poor, < 70% control.

Bensulide has not generally provided the high level of annual bluegrass control that has been achieved with other pre-emergence herbicides (Table 4).

Common chickweed and henbit are easily controlled with benefin, benefin + oryzalin, oryzalin and pendimethalin. Additionally, DCPA (Dacthal), napropamide, ethofumesate (Prograss) and pronamide will control common chickweed.

Herbicides that have effectively controlled parsley-piert are bensulide and oxadiazon. Napropamide is effective for lawn burweed (spurweed) control. Good to excellent corn speedwell control has been obtained with benefin, DCPA, napropamide, oxadiazon, pendimethalin and pronamide.

Atrazine and simazine effectively control all the winter annual weeds shown in Table 4, either as a pre-emergence or post-emergence application.

**Overseeded turfgrasses**

On bermudagrass that is overseeded in the fall with perennial ryegrass, fenarimol (Rubigan) and ethofumesate may be used for pre-emergence control of annual bluegrass.

Ethofumesate should only be applied to bermudagrass that is completely dormant, since it can delay the spring green-up of bermudagrass when applications are made to bermudagrass that is not totally dormant. Spring applications of oryzalin, benefin + oryzalin and pendimethalin have been shown to decrease the stand of fall overseeded ryegrass.

These herbicides should not be applied to fall overseeded warm-season turfgrasses unless the goal is to hasten the spring transition by eliminating the perennial ryegrass.

Numerous pre-emergence herbicides are available to control summer and winter annual weeds in warm-season turfgrasses. Choosing the appropriate herbicide requires a knowledge of the tolerance of the various warm-season turfgrass species to the different pre-emergence herbicides and familiarity with the weed species found on a particular site.

Additionally, future renovation plans for the site must be known before a pre-emergence herbicide is used. Attention to the cultural needs of the specific warm-season turfgrass species and the timely use of both pre-emergence and post-emergence herbicides will enable the turfgrass manager to achieve the goal of growing a high quality, weed-free, attractive warm-season turfgrass. **LM**

**TABLE 4. WINTER ANNUAL WEED CONTROL RATINGS FOR PREEMERGENCE HERBICIDES.**

| Herbicide             | Annual Bluegrass | Common Chickweed | Henbit | Parsley-Piert | Lawn Burweed | Corn Speedwell |
|-----------------------|------------------|------------------|--------|---------------|--------------|----------------|
| atrazine              | E                | E                | E      | E             | E            | E              |
| benefin               | E                | G                | G      | P             | P            | E              |
| benefin + oryzalin    | E                | L                | L      | —             | —            | —              |
| benefin + trifluralin | L                | —                | —      | —             | —            | —              |
| bensulide             | F                | P                | P      | E             | P            | P              |
| DCPA                  | G                | G                | F      | P             | P            | G              |
| ethofumesate          | G-E              | L                | —      | —             | —            | —              |
| fenarimol             | G                | —                | —      | —             | —            | —              |
| napropamide           | G                | E                | P      | P             | E            | E              |
| oryzalin              | G                | G                | G      | —             | —            | —              |
| oxadiazon             | G                | P                | P      | G             | P            | G              |
| pendimethalin         | G                | G                | G      | —             | —            | E              |
| pronamide             | E                | E                | P      | P             | P            | E              |
| simazine              | E                | E                | E      | G             | E            | E              |

E = Excellent, ≥ 90% control. F = Fair, 70 to 79% control.  
G = Good, 80 to 89% control. P = Poor, < 70% control.  
L = Weed species is listed on the herbicide label, but has not been evaluated by The University of Georgia.  
— = Weed response is not known.

**Source:** Dr. Murphy

Cultivation has not been generally practiced or recommended after a pre-emergence herbicide application. Cultivation was believed to physically disrupt the herbicide barrier in the soil and stimulate weed emergence. Recent studies conducted in Georgia have shown that core aeration at various time intervals after a pre-emergence herbicide application did not stimulate large crabgrass and goosegrass emergence in bermudagrass. Data are not available for other weed species but it appears that core aeration does not influence the level of weed control that is normally achieved with a pre-emergence herbicide.

**Summer control**

Crabgrass (large, smooth, Southern) and goosegrass are commonly found in Southern turfgrasses. With the exception of atrazine, simazine and pro-

namide (Kerb), spring applications of pre-emergence herbicides will provide good to excellent control of crabgrasses (Table 3).

Goosegrass tends to germinate later in the spring than crabgrass and is more difficult to control. Single applications of oxadiazon (Ronstar) and bensulide + oxadiazon (goosegrass/crabgrass control) have provided high levels of goosegrass control in experiments conducted in Georgia.

Split applications, each at an interval of 8 to 10 weeks, of benefin + oryzalin (XL), benefin + trifluralin (Team), oryzalin (Surflan), pendimethalin (various trade names) and napropamide (Devrinol) will also give acceptable control of goosegrass.

**Winter control**

Similar to summer annual weeds, pre-emergence herbicides vary in their effectiveness on winter annual weeds.

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
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## ...ON COOL-SEASON TURFGRASSES

Identification, proper cultural practices and efficient herbicide applications are essential in order to control unwanted plants.

by Tom Fermanian, Ph.D., University of Illinois

**O**h the lowly crabgrass plant: there's never enough of it in an area to make a decent turf, but it is the one grass that can be found just about everywhere.

Crabgrass and other annual grass species often represent a major headache to turf managers in cool, humid regions. This group of species, once germinated, seems to out-compete desirable turfgrasses.

Annual grasses generally become a persistent problem only in sparse turfs with open enough cover to allow young seedlings to germinate and

grow. The best management of annual grasses is the proper management of desired turf species. Using cultural practices to promote healthy, dense turf minimizes the need for active annual grass controls.

### Annual grass control

The first step to select an appropriate control strategy for any weed is identifying the weed. Once the troublesome pests have been identified as an annual grass, a corrective strategy can be developed.

The primary causes of open, sparse

turf are a limiting nutrient(s) (generally nitrogen) or injury due to stress or pest invasion. Therefore, the first strategy in annual grass management is to increase density by proper fertilization.

Other soil properties, such as pH level, soil compaction, and salt and moisture levels, should also be checked. Soil pH can be corrected by adding sulphur or lime; soil compaction may be alleviated with aeration; and soil moisture can be controlled with proper irrigation and/or drainage.

*continued on page 52*

**Figure 1.**

