Pre-emergence herbicides differ in their ability to maintain effective soil residual concentrations (i.e., Herbicide A vs. Herbicide B). When values drop below the "threshold" level, effective weed control is lost. In this case, Herbicide B requires a second application to maintain effective weed control.

Turfgrass pre-emergence herbicides differ in soil longevity, weed control efficacy, and potential turfgrass injury. Benefin is generally considered to be shorter-lived in soils than bensulide or pendimethalin; while DCPA is considered to be intermediate. Concentration of the initial application is important in terms of maintaining pre-emergence herbicide soil concentrations.

Pre-emergence herbicides must maintain a critical soil residual level (threshold value) during the growing season that is conducive for germination of the target weed (i.e., annual bluegrass, crabgrass, foxtail, goosegrass or spurge). Applications made too early in the season may break down in the soil to levels below the threshold value. If this occurs and conditions remain favorable for weed germination, less than desirable control will be obtained.

Maintaining levels
To obtain critical threshold values for the pre-emergence herbicide, adequate application rates must be made or repeat applications must be applied to maintain the threshold level. Initial applications will be dictated by label directions, turfgrass safety, efficacy and economics. In cases where potential turfgrass injury is a concern, light, frequent or split applications may be used to obtain control and minimize potential turfgrass injury.

Consult your local turfgrass specialist for specific information regarding the need for split applications of pre-emergence herbicides in your area. This information should increase its effectiveness and safety of your pre-emergence herbicide program.

Most turfgrass pre-emergence herbicides are effective in controlling crabgrass. These herbicides may differ somewhat in percent of control. It is wise to check with turf specialists in your region for the most efficacious materials.

Other annuals
Pre-emergence herbicides differ in their ability to control other annual weed problems. For example, DCPA and pendimethalin effectively control prostrate spurge; while benefin and bensulide are ineffective in controlling this troublesome weed. Bensulide, at concentrations normally applied for crabgrass control, is not as effective in controlling foxtail as is DCPA or pendimethalin. Oxadiazon is more effective for goosegrass control than DCPA. Pendimethalin has good to excellent efficacy for all the annual warm-season species.

It is essential to apply pre-emergence herbicides uniformly to the area. These herbicides are bound in the soil by clay and organic matter and have limited lateral movement. Skips in application allow the target weed to escape, germinate and produce additional seed, thus disrupting turf quality. Careful application is important, making sure to follow label directions and to calibrate application equipment prior to treatment. This will give the safest, most efficacious control from the herbicide selected at the most economic rate.

Turfgrass managers should keep in mind that successful pre-emergence herbicide programs result from selecting the appropriate herbicide, and applying it uniformly at the appropriate rate and time.

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Successful weed control programs in warm-season turf depend on the development of a two-phase control strategy by the professional turf manager.

The first phase involves the use of cultural practices and insect and disease control programs that promote a dense, vigorous turf cover. Adequately maintained turf is less susceptible to a high level of a weed infestation than poorly maintained turf.

Prior to the use of any herbicide, cultural practices—adequate fertilization, irrigation, cultivation and correct mowing height and interval—should be matched to the needs of a particular turfgrass species. Additional-
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The Lawnaire IV is the highest-quality, roll-type aerator on the market today. It combines speed and precision for fast and effective core aeration.

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Increase your customer base with the new Mataway® Overseeder.

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The proven Ryan Ren-O-Thin® power rakes with interchangeable reels; the industry standard Jr. Sod Cutter with Tote Trailer; and the Tow Lawnaire for really large turf areas put you in a position for additional business. Because they’re what you need to provide professional quality turf care.

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The best test of Ryan’s reliability is in your own back yard. So ask the dealer nearest you for a free demonstration today. Or call toll-free: 1-800-228-4444.
ally, insect and disease problems should be eliminated. Strict reliance on herbicides without regard for the contribution of other management practices to the total weed control program does not result in a high-quality, aesthetically appealing turf.

The second phase of a weed control strategy involves the use of pre-emergence and post-emergence herbicides. Pre-emergence herbicides are applied prior to weed seed germination and generally have little, if any, activity on emerged weeds. In contrast, post-emergence herbicides are applied directly to the foliage of emerged weeds and have no or minimal residual activity on non-emerged weeds. Although the majority of herbicides may be classified as either pre-emergence or post-emergence, atrazine and simazine are exceptions. These herbicides have both pre-emergence and post-emergence activity on a wide variety of winter annual weeds.

Pre-emergence herbicides form the base of the chemical weed control program and are used primarily to control annual grasses and certain annual broadleaf weeds. This group of weeds can be controlled with post-emergence herbicides; however, two or more applications are usually necessary and a possibility exists that the turf may be discolored or injured for a short time after application.

Generally, pre-emergence herbicides are safer to apply to warm-season turf, and only one application is necessary. Therefore, pre-emergence herbicides are the preferred method for controlling annual grass and certain annual broadleaf weeds. Post-emergence herbicides should be relied upon to control perennial grass and broadleaf weeds that are not controlled by pre-emergence herbicides.

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

For annual bluegrass, late August to early October applications are used, depending on the geographical location. 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 in the top two inches of the soil profile. Removal of heavy thatch by cultivation (aerification, verticutting, etc.) prior to herbicide application will improve spray penetration through the turf canopy and increase herbicide contact with the soil. Cultivation after a pre-emergence herbicide application is not recommended since it may decrease the effectiveness of the herbicide.

In past years, there were only about four or five pre-emergence her-
There's no better value for crabgrass control than Balan. And none with more experience. It's been used more years by more golf course superintendents than any other granular preemergence herbicide.

Its easy-to-spread clay carrier is one reason why. It makes application more uniform, reduces the dust common in other carriers and also increases your equipment calibration accuracy.

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bicides available for use on warm-season turf. However, 16 are now registered for use on Southern turf (Table 1).

The selection of which to use should be based on (a) turfgrass tolerance and (b) the weed species composition of a particular site. Herbicide selection based solely on cost may result in possible turf injury and/or the additional expense of a follow-up post-emergence herbicide treatment.

**Turfgrass tolerance**

Warm-season turfgrasses and tall fescue vary in their tolerance to pre-emergence herbicides (Table 2). For example, with the exception of spring greenup, centipede and St. Augustine have excellent tolerance to atrazine at all times of the year. Zoysia and bermudagrass are tolerant to atrazine when dormant, but may be discolored or injured if applications are made at other times of the year. Tall fescue is highly susceptible to severe injury from atrazine. Also, bahiagrass will be injured from pre-emergence applications of this herbicide.

**Summer annual weed control**

Crabgrass (large, smooth, Southern) and goosegrass are commonly found in Southern turf. With the exception of atrazine, pre-emergence herbicides applied in the spring months provide good to excellent crabgrass control (Table 3).

Goosegrass tends to sporadically germinate during the long growing season of the South and is more difficult to control than crabgrass. Oxadiazon, napropamide and bensulide + oxadiazon have provided high levels of goosegrass control in tests conducted in Georgia. Benefin + oryzalin, oryzalin and the various formulations of pendimethalin have also provided fair to good control of goosegrass with a single application at recommended rates.

Split applications of oryzalin and pendimethalin are being evaluated in Georgia and usually have provided better goosegrass control than a single application.

Sandbur is an occasional problem in warm-season turf. It can be controlled with spring applications of benefin + oryzalin, bensulide, napropamide, oryzalin, and pendimethalin.

Certain pre-emergence herbicides can also be selected that provide control of prostrate spurge and prostrate knotweed.

**Winter annual weed control**

Similar to summer annual weed control, pre-emergence herbicides vary in their effectiveness on winter annual weeds. Bensulide has generally not provided the high level of annual bluegrass control that has been observed with other pre-emergence herbicides (Table 4).

Common chickweed and henbit are easily controlled by pre-emergence applications of benefin, benefin + oryzalin, oryzalin, or pendimethalin. Additionally, common chickweed can be controlled with DCPA, ethofumesate, napropamide, and pronamid. Herbicides that have effectively controlled parsley-piert are bensulide and oxadiazon. Napropamide is effective for spurweed control. Good to excellent corn speedwell control can be obtained with benefin, DCPA, napropamide, oxadiazon and pronamide. Atrazine and simazine provide effective pre-emergence or post-emergence annual bluegrass and winter annual broadleaf weed control (Table 4).

The wide time period of application for these herbicides offers tremendous scheduling flexibility for the professional warm-season turf manager.

**Overseeded bermudagrass**

On bermudagrass that is overseeded with annual or perennial ryegrass, fenarimol or ethofumesate may be used for annual bluegrass con-

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**Table 3. Summer annual weed control ratings for pre-emergence herbicides.**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Crabgrass spp.</th>
<th>Goosegrass</th>
<th>Sandbur</th>
<th>Prostrate Spurge</th>
<th>Prostrate Knotweed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrazine</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Benefin</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Benefin + Oryzalin</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Benefin + Trifluralin</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Bensulide</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Bensulide + Oxadiazon</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>DCPA</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Napropamide</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Oryzalin</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Oxadiazon</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Pendimethalin</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Siduron</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Simazine</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
</tbody>
</table>

E = Excellent, > 90% control.
G = Good, 80 to 89% control.
F = Fair, 70 to 79% 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.

---

**Table 4. Winter annual weed control ratings for pre-emergence herbicides.**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Annual Bluegrass</th>
<th>Common Chickweed</th>
<th>Henbit</th>
<th>Parsley-Piert</th>
<th>Spurweed</th>
<th>Corn Speedwell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrazine</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Benefin</td>
<td>E</td>
<td>G</td>
<td>P</td>
<td>P</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Benefin + Oryzalin</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Benefin + Trifluralin</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Bensulide</td>
<td>F</td>
<td>P</td>
<td>E</td>
<td>P</td>
<td>P</td>
<td>E</td>
</tr>
<tr>
<td>DCPA</td>
<td>G</td>
<td>G</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Ethofumesate</td>
<td>G</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Fenarimol</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Napropamide</td>
<td>G</td>
<td>E</td>
<td>P</td>
<td>P</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Oryzalin</td>
<td>G</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Oxadiazon</td>
<td>G</td>
<td>P</td>
<td>E</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Pronamide</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>P</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Pentimethalin</td>
<td>G</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Simazine</td>
<td>E</td>
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benefin
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oxadiazon
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pendimethalin

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*leaching
*micrbiolal breakdown
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*dilution
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THE LANDSCAPE EXPO: YEAR TWO

The Landscape Expo has seen exceptional growth in just one year, making it one of the largest industry trade shows.

More than 5,000 people will visit the 1987 edition of the Landscape Exposition, March 3-5 in the O'Hare Exposition Center, Rosemont, Ill.

The 5,000 figure will double the attendees of last year's inaugural Expo, according to Expo administrators. More than 225 exhibiting companies will cover more than 50,000 sq. ft. of exhibit space, a 20 percent increase from the first show.

The Expo has the backing of the PGMS, PLCAA, ALCA and the Illinois Landscape Contractors Association.

Supporting the trade show will be a greatly expanded schedule of educational sessions (see following page) featuring some of the green industry's leading experts.

Fernando Bensuaski, managing partner in Bensuaski, Delana & Luce, kicks off the educational program with a speech about buying and leasing options for new equipment. A second talk by Bensuaski will deal with acquiring and keeping capital.

Consultants Ed Wandtke and Rudd McGary of All-Green Management Associates will discuss the logistics of setting up an employee training program, as well as what the program should include. In other sessions, the two will address business aspects of the industry such as employee relations, marketing and pricing.

Jim Leatzow, president of Leatzow Agency/Financial Guardian, and Richard Lehr, a partner with Sirote, Permutt, et. al., will deliver a pair of two-part programs, one on preventing problems incurred by parks and playgrounds, and another on avoiding lawsuits.

In a related speech, Lawn Care Industry magazine editor Elliot Maras will deliver a talk on avoiding conflict with the media. With recent problems the lawn care market has been facing with the media, this session comes at the perfect time.


Dr. Martin Petrovic of Cornell University will present a session on effective turf management, and how it can help preserve groundwater supplies.