Bermudagrass seed

PEST MANAGEMENT GUIDELINES FOR AGRICULTURE

April 2010

Contents (Dates in parenthesis indicate when each topic was updated)

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- Online: http://www.ipm.ucanr.edu
- UC Cooperative Extension: County Offices
- University of California
  ANR Communication Services
  Richmond, CA 94804
  510-665-2195; 800-994-8849

Updates: These guidelines are updated regularly. Check with your University of California Cooperative Extension Office or the UC IPM Web site for information on updates.

Note to readers: These guidelines represent the best information currently available to the authors and are intended to help you in making the best choices for an IPM program. Not all formulations or registered materials are mentioned. Always read the label and check with local authorities for the most up-to-date information regarding registration and restrictions on pesticide use. Check with your agricultural commissioner for latest restricted entry intervals.
### General Information

(Section reviewed 1/07)

**RELATIVE TOXICITIES OF INSECTICIDES and MITICIDES USED IN BERMUDAGRASS TO NATURAL ENEMIES and HONEY BEES**

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Mode of Action^1</th>
<th>Selectivity^2 (affected groups)</th>
<th>Predatory mites^3</th>
<th>General predators^4</th>
<th>Parasites^4</th>
<th>Honey bees^5</th>
<th>Duration of impact to natural enemies^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>acephate (Orthene)</td>
<td>1B</td>
<td>broad (insects, mites)</td>
<td>H</td>
<td>H</td>
<td>M/H</td>
<td>I</td>
<td>intermediate</td>
</tr>
<tr>
<td>Bacillus thuringiensis ssp. kurstaki</td>
<td>11A</td>
<td>narrow (caterpillars)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>III</td>
<td>none</td>
</tr>
<tr>
<td>cyfluthrin (Baythroid)</td>
<td>3A</td>
<td>broad (insects, mites)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>I</td>
<td>moderate</td>
</tr>
<tr>
<td>sulfur</td>
<td>un</td>
<td>narrow (mites and citrus thrips)</td>
<td>L/H</td>
<td>M/L</td>
<td>H</td>
<td>III</td>
<td>short</td>
</tr>
<tr>
<td>zeta-cypermethrin (Mustang)</td>
<td>3A</td>
<td>broad (insects, mites)</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>I</td>
<td>moderate</td>
</tr>
</tbody>
</table>

H = high       M = moderate       L = low      — = no information        un = unknown or uncertain mode of action

1 Rotate chemicals with a different mode-of-action Group number, and do not use products with the same mode-of-action Group number more than twice per season to help prevent development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their Web site at http://www.irac-online.org/.

2 Selectivity: Broad means it affects most groups of insects and mites; narrow means it affects only a few specific groups.

3 Generally, toxicities are to western predatory mite, *Galendromus occidentalis*. Where differences have been measured, these are listed as pesticide-resistant strain/native strain.

4 Toxicities are averages of reported effects and should be used only as a general guide. Actual toxicity of a specific chemical depends on the species of predator or parasite, environmental conditions, and application rate.

5 Ratings are as follows: I—Do not apply or allow to drift to plants that are flowering; II—Do not apply or allow to drift to plants that are flowering, except when the application is made between sunset and midnight if allowed by the pesticide label and regulations; III—No bee precaution, except when required by the pesticide label or regulations. For more information about pesticide synergistic effects, see Bee Precaution Pesticide Ratings (available online at http://ipm.ucanr.edu/beeprecaution/).

6 Duration: Short means hours to days; moderate means days to 2 weeks; and long means many weeks or months.

Acknowledgments: This table was compiled based on research data and experience of University of California scientists who work on a variety of crops and contribute to the Pest Management Guideline database, and from Flint, M. L. and S. H. Dreistadt. 1998. Natural Enemies Handbook: An Illustrated Guide to Biological Pest Control, ANR Publication 3386.
Insects and Mites
(Section reviewed 1/07)

BERMUDAGRASS MIRID (6/09)
Scientific Name: Trigonotylus tenuis

DESCRIPTION OF THE PEST
This plant bug may be abundant on bermudagrass florets and leaves. *Trigonotylus tenuis* is a small, light green, narrow, stilt-legged seed bug. Adults and immatures may be found in bermudagrass at any time from spring through fall.

DAMAGE
*Trigonotylus tenuis* is of greatest concern during spring and fall seed-production seasons from regrowth through bloom. Its feeding can reduce plant vigor, stunting growth and delaying the development of florets. Adult feeding on developing seeds also reduces seed yields.

MANAGEMENT
Monitor seed fields with a sweep net for *Trigonotylus tenuis* from regrowth through bloom. Treat if *Trigonotylus tenuis* counts reach 100 per sweep. When fields are developing seed, monitor for adult bugs only, as nymphal mouthparts do not appear to be large enough to attack developing seed. One adult mirid per 90° sweep 2 weeks before summer harvest can reduce uncleaned seed yields by almost 20 pounds per acre.

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Amount per acre</th>
<th>R.E.I.‡ (hours)</th>
<th>P.H.I.‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. ACEPHATE (Orthene) 75S</td>
<td>1.33 lb</td>
<td>24</td>
<td>0</td>
</tr>
</tbody>
</table>

When choosing a pesticide, consider information relating to the impact on natural enemies and honey bees and the environment. Not all registered pesticides are listed. Always read label of product being used.

A. ACEPHATE (Orthene) 75S
MODE-OF-ACTION GROUP NUMBER: 1B
COMMENTS: Available for use under a 24[c] registration. Do not feed crop residue to livestock or allow animals to graze treated areas. Do not apply this product through any type of irrigation system.

‡ Restricted entry interval (R.E.I.) is the number of hours from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of the two intervals is the minimum time that must elapse before harvest.

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1 Rotate chemicals with a different mode-of-action Group number, and do not use products with the same mode-of-action Group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode-of-action group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For additional information, see their Web site at http://www.irac-online.org/.
CUTWORMS and ARMYWORM (4/10)

Scientific Names:  
- Black cutworm: *Agrotis ipsilon*  
- Granulate cutworm: *Agrotis subterranea*  
- Variegated cutworm: *Peridroma saucia*  
- Armyworm: *Pseudaletia unipuncta*

DESCRIPTION OF THE PESTS
Cutworm larvae can have various colors and patterns, but the heavy-bodied larvae always appear as smooth-skinned caterpillars to the naked eye. They may measure up to 2 inches (5 cm) long. They feed at night and frequently roll into a C-shape when disturbed. Cutworm adults are night-flying moths in the family Noctuidae. The white or greenish eggs of these noctuids are laid in masses, darkening as they approach hatching.

Armyworm larvae are variable in color but are usually dark green or gray with three thick stripes along each side. First instar larvae move by looping their bodies, whereas the older larvae do not.

DAMAGE
Cutworm and armyworm larvae feed mainly on leaves and crowns but may clip off seed heads or may cut off plants near or below the soil surface. Damage is usually limited to certain parts of a field and may reoccur each season in the same place. Cutworms are active year round in the low deserts but are damaging to bermudagrass seed production from mid-March to October. The larvae feed at night and hide in the thatch layer or in a burrow in the soil during the day. Look for close clipping of grass around aeration holes, which are commonly occupied by larvae. Damage appears as circular spots of dead grass or depressed spots.

MANAGEMENT
Cultural practices and biological controls sometimes limit armyworm and cutworm populations. If sprays are necessary, consider spot treatments in areas of localized damage.

Biological Control
Larvae are parasitized by braconid wasps (*Apanteles* spp.) and by tachinid flies. Birds also commonly feed on cutworms, especially during irrigations. *Bacillus thuringiensis* subsp. *kurstaki* is a bacterium commercially formulated for caterpillar control. It is only effective against first- and second-instar cutworm larvae.

Cultural Control
Practice good weed control in and around the field and burn or remove straw and field trash from previous cuttings to reduce egg and worm overwintering sites.

Monitoring and Treatment Decisions
Look for damage symptoms and confirm the presence of cutworms by digging into the soil an inch or so around a damaged spear. Begin applications when insects first appear.
When choosing a pesticide consider information relating to the impact on natural enemies and honey bees and the environment. Not all registered pesticides are listed. Always read label of product being used.

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Amount per acre</th>
<th>R.E.I.‡ (hours)</th>
<th>P.H.I.‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. <strong>BACILLUS THURINGIENSIS</strong> ssp. <strong>KURSTAKI</strong> (various products)</td>
<td>Label rates</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER:</strong> 11</td>
<td>COMMENTS: Apply when cutworms are small, usually in the first or second instar.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. <strong>ZETA-CYPERMETHRIN</strong>* (Mustang)</td>
<td>3–4.3 oz</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>(Mustang Max)</td>
<td>3.2–4 oz</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER:</strong> 3</td>
<td>COMMENTS: Efficacy trials pending, but experience with similar products has shown pyrethrins to be effective.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. <strong>CYFLUTHRIN</strong>* (Baythroid XL)</td>
<td>1.6–1.9 oz</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td><strong>MODE-OF-ACTION GROUP NUMBER:</strong> 3</td>
<td>COMMENTS: Efficacy trials pending, but experience with similar products has shown pyrethrins to be effective.</td>
<td></td>
<td></td>
</tr>
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PLANTHOPPER (4/10)
Scientific Name: Metadelphax propinqua

DESCRIPTION OF THE PEST
The planthopper (often incorrectly referred to as a "fulgorid" but actually a member of the planthopper family Delphacidae, subfamily Delphacinae) may be abundant on bermudagrass florets and leaves from mid-spring through fall. Metadelphax propinqua is a small, tan planthopper, about 0.13 inch (3-4 mm) long. Two distinguishing traits of Delphacid planthoppers are prominent, thickened antennae and a spur at the base of the hind tarsi that points inward. Adult planthoppers can be observed hopping and flying when disturbed. The nymphs resemble adults but are wingless.

In other areas it has been noted that this species has short-winged, intermediate-winged, and long-winged forms. The average lifespan is about 50 days, and depending on location, there are 3 to 10 generations a year.

DAMAGE
Adults and nymphs may be found in bermudagrass at any time during spring and fall seed-production seasons and are of greatest concern when plants are in bloom. Their feeding reduces plant vigor, but more serious is the contamination of seed heads with honeydew deposits that make the seed difficult to harvest and clean.

MANAGEMENT
Monitor seed fields with a sweep net for planthoppers when florets are developing and continue through seed harvest. No threshold is established; however, in a commercial field study, a level of 12 leafhoppers per 90° sweep was not high enough to cause seed harvest problems.

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Amount per acre</th>
<th>R.E.I.‡ (hours)</th>
<th>P.H.I.‡ (days)</th>
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<tbody>
<tr>
<td>ACEPHATE (Orthene) 75S</td>
<td>1.33 lb</td>
<td>24</td>
<td>0</td>
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</tbody>
</table>

When choosing a pesticide, consider information relating to the impact on natural enemies and honey bees and the environment. Not all registered pesticides are listed. Always read label of product being used.

A. ACEPHATE (Orthene) 75S
   MODE-OF-ACTION GROUP NUMBER: 1B
   COMMENTS: Available for use under a 24(c) registration. Do not feed crop residue to livestock or allow animals to graze treated areas. Do not apply this product through any type of irrigation system.

‡ Restricted entry interval (R.E.I.) is the number of hours from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of the two intervals is the minimum time that must elapse before harvest.

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SPIDER MITES (4/10)
Scientific Name:  *Tetranychus* spp.

DESCRIPTION OF THE PESTS
Adult mites are tiny (about 0.06 inch in length), have four pairs of legs, are greenish, pink, or cream colored, and have various-sized black spots on the body. Under warm conditions spider mites move rapidly within the colony area. Spider mites have four stages of development: (1) the egg; (2) a translucent, six-legged immature stage; (3) an eight-legged immature stage; and (4) the eight-legged adult stage. A generation may pass in as few as 5 to 7 days in midsummer or in a month during cool periods. Spider mites produce webbing that is often filled with cast skins, dust, and other debris.

DAMAGE
Mite feeding results in the destruction of chlorophyll; leaves become pale, stippled and, in later stages of infestation, dry up and die. Loss of color is pronounced on the under surface of leaves before it becomes apparent on the upper side. Light infestations can be tolerated, but when heavy, can result in lowered seed yield. Examine leaf blades with a hand lens for spider mites. Frequently infestations include a mixture of spider mite species.

MANAGEMENT
Biological and cultural controls frequently keep spider mites at low levels. Monitor for spider mites and predators before treating.

**Biological Control**
Several predators play an important role in regulating spider mite populations, including the western predatory mite (*Galendromus* [*Metaseiulus* *occidentalis*]), sixspotted thrips (*Scolothrips sexmaculatus*), western flower thrips (*Frankliniella occidentalis*), lady beetles (*Stethorus* sp.), minute pirate bug (*Orius tristicolor*), and lacewing larvae (*Chrysoperla carnea*).

The western predatory mite is the same size as spider mites but lacks spots and ranges in color from cream to amber red. It is available commercially, but research has not been done on the effectiveness of releasing these predators in bermudagrass. Sixspotted thrips and western flower thrips are also effective predators, but naturally occurring populations of these insects generally do not develop to high enough levels to provide significant control before damage has already taken place. Both species are tiny, slender insects about 1 mm or less in length. Sixspotted thrips has three dark spots on each forewing; western flower thrips ranges in color from clear lemon yellow to dark brown. (Pest thrips, *Chirothrips* species, can be distinguished from the beneficial species of thrips by their smaller size and black color.) Monitor western predatory mites and the two species of thrips to determine if they are present in the field and to calculate their relative population density in comparison with pest mites.

**Cultural Control**
Minimize dust and encourage naturally occurring predators and parasites by limiting chemical rates and the number of applications. Control field bindweed growing in or at the edges of a bermudagrass field. Good water management increases plant tolerance to these pests.

**Monitoring and Treatment Decisions**
No threshold is established, but when buildup is observed and no predatory thrips or predaceous mites are present, either spot treat or completely treat the field before webbing occurs.

Online with photos at http://www.ipm.ucanr.edu/PMG/selectnewpest.bermudaseed.html

(4/10) Spider Mites 6
**Common name (example trade name)** | **Amount per acre** | **R.E.I.‡ (hours)** | **P.H.I.‡ (days)**
--- | --- | --- | ---

When choosing a pesticide, consider information relating to the impact on natural enemies and honey bees and the environment. Not all registered pesticides are listed. Always read label of product being used.

A. **SULFUR DUST**
   MODE OF ACTION: Unknown. An inorganic insecticide.
   COMMENTS: Do not apply when temperature exceeds 90°F.
   20–25 lb | 0 | 24

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THRIPS (4/10)
Scientific Names: *Chirothrips falsus* and *C. mexicanus*

DESCRIPTION OF THE PESTS
Thrips may be abundant on bermudagrass florets and leaves. Adult *Chirothrips* are small, black insects about 0.04 inch long with two pairs of narrow wings that are fringed with hairs. Immature thrips are wingless and whitish to yellowish in color. To distinguish these thrips from beneficial thrips species, use a hand lens. Beneficial thrips include the western flower thrips, *Frankliniella occidentalis*, which is a larger insect than the *Chirothrips* spp. and varies in color from clear yellow to a dusky yellowish brown with darker pigmented areas on the segments of the abdomen. Another beneficial thrips, sixspotted thrips, *Scolothrips sexmaculatus*, has dark spots on its light-colored wings.

*Chirothrips* adults emerge continuously throughout the warm months. Adults and immatures may be found in bermudagrass at any time during spring and fall seed-production seasons. Eggs are deposited in plant tissue and hatching occurs in about 5 days; the immature stages take about 5 to 7 days to complete development.

DAMAGE
Thrips are most noticeable and of greatest concern during spring and fall seed-production seasons when plants are in bloom. Their feeding in florets can reduce seed set.

MANAGEMENT
Good weed management in and around bermudagrass fields as well as along ditchbanks and roadways will help to keep thrips populations from building up. Monitor seed fields for thrips when florets are developing and continue through the seed set period. No threshold is established, but treat when thrips buildup is observed.

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Amount per acre</th>
<th>R.E.I.‡ (hours)</th>
<th>P.H.I.‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. ZETA-CYPERMETHRIN* (Mustang)</td>
<td>3–4.3 oz</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Efficacy trials pending, but experience with similar products has shown pyrethrins to be effective.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. CYFLUTHRIN* (Baythroid XL)</td>
<td>2.6–2.8 oz</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NUMBER: 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Efficacy trials pending, but experience with similar products has shown pyrethrins to be effective.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Diseases**

*(Section reviewed 1/07)*

**RUST** *(6/09)*

*Pathogen: Puccinia cynodontis*

**SYMPTOMS**

Rust begins as small, grayish purple pustules on the underside of older leaves. As pustules mature, the leaf tissue ruptures to expose red-brown uredospores. Premature leaf senescence and death occur. If favorable conditions continue, the rust infections progress up the stem of the plant to younger leaves.

**COMMENTS ON THE DISEASE**

Rust in bermudagrass seed fields is often not obvious in the early stages. The first indication of a problem may be red-brown rust spores clinging to the shoes and lower pant legs of scouts walking through the seed field. The causal fungus, *Puccinia cynodontis*, survives on infected bermudagrass and bermudagrass residues in the field as well as in weedy borders and ditches. Humid, moderate temperatures are conducive to rust disease development. Periods of leaf wetness (dew) must occur for infection to take place.

**MANAGEMENT**

**Cultural Control**

Keep plants growing vigorously with adequate, but not excessive, nitrogen fertilization and irrigation. If possible, irrigate during normal dew periods so plant foliage is not wet any longer than normal night and morning leaf wetness periods. Remove straw from the field by burning (preferred) or baling.

**Chemical Control**

Apply fungicides as soon as environmental conditions favor rust development or when rust pustules first appear.

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Amount per acre**</th>
<th>R.E.I.‡ (hours)</th>
<th>P.H.I.‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. TEBUCONAZOLE <em>(Folicur 3.6F)</em></td>
<td>4–8 fl oz</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Demethylation inhibitor (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Read label for restrictions if bermudagrass seed is used for animal feed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. PYRACLOSTROBIN <em>(Headline)</em></td>
<td>6-12 fl oz</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Quinone outside inhibitor (11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Do not graze or feed for age or hay to livestock within 27 days of last application.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. SULFUR <em>(various)</em></td>
<td>3–10 lb (80% sulfur)</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>MODE-OF-ACTION GROUP NAME (NUMBER): Multi-site contact (M2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: Was not effective in 2 replicated trials conducted in Imperial County.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**When choosing a pesticide, consider information relating to environmental impact. Not all registered pesticides are listed. Always read label of product being used.**

**A.** TEBUCONAZOLE *(Folicur 3.6F)*

- **Amount per acre**: 4–8 fl oz
- **R.E.I.**: 12 hours
- **P.H.I.**: 4 days

**MODE-OF-ACTION GROUP NAME (NUMBER):** Demethylation inhibitor (3)

**COMMENTS:** Read label for restrictions if bermudagrass seed is used for animal feed.

**B.** PYRACLOSTROBIN *(Headline)*

- **Amount per acre**: 6-12 fl oz
- **R.E.I.**: 12 hours
- **P.H.I.**: 14 days

**MODE-OF-ACTION GROUP NAME (NUMBER):** Quinone outside inhibitor (11)

**COMMENTS:** Do not graze or feed for age or hay to livestock within 27 days of last application.

**C.** SULFUR *(various)*

- **Amount per acre**: 3–10 lb (80% sulfur)
- **R.E.I.**: 24 hours
- **P.H.I.**: 0 days

**MODE-OF-ACTION GROUP NAME (NUMBER):** Multi-site contact (M2)

**COMMENTS:** Was not effective in 2 replicated trials conducted in Imperial County.

**Notes:**

- **Amount of formulated product**
- **Restricted entry interval (R.E.I.)** is the number of hours from treatment until the treated area can be safely entered without protective clothing. **Preharvest interval (P.H.I.)** is the number of days from treatment to harvest. In some cases the R.E.I. exceeds the P.H.I. The longer of the two intervals is the minimum time that must elapse before harvest.

**Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-action group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode-of-action group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to a fungicide with a different mode-of-action group number.**
INTEGRATED WEED MANAGEMENT (1/07)

Bermudagrass is a very competitive plant species; however, weeds will reduce seed yield if populations are high—especially if the crop is growing poorly. Additionally, weeds make harvesting more difficult because they do not dry as readily as the crop. Succulent weed plants do not pass through harvesting equipment easily and can clog up combines. Another problem with weeds in bermudagrass production is that cleaning undesirable seed out of the crop after harvest can greatly increase processing costs.

MONITORING

Weeds are controlled best in the seedling stage; therefore, it is important to be able to identify them. A good pictorial reference, such as the UC ANR Publication 4030, Grower’s Weed Identification Handbook, or the weed photo gallery on the UC IPM Web site (http://www.ipm.ucanr.edu) will help assist in identifying weeds. It is important to keep a log of summer and winter weeds by field for a comprehensive management system.

Examine the bermudagrass field frequently throughout the year but especially after the first irrigations following harvests. Bermudagrass seed can be harvested twice during the year, once in late spring or early summer and again in late fall. After each harvest, fields are often burned to get rid of thatch, harvest residues, and fungal spores. Following the burn, fields are irrigated to stimulate regrowth of the bermudagrass. Winter annual weeds, both grasses and broadleaves, will germinate after the fall harvest. After the summer harvest, summer grasses and nutsedges are most common. The entire field should be examined to determine which species of weeds are present. Economic thresholds have not been developed for estimating the impact of weed populations on bermudagrass seed yields, but growers report significant yield losses from moderate levels of weeds.

CULTURAL CONTROL

Cultural practices play an important role in bermudagrass weed management because a vigorous crop is very competitive against annual weeds. Bermudagrass is a multi-year crop, so weed problems that occur at the beginning of the production cycle will persist until the field is rotated to another crop. Preplant cultural practices are especially important because bermudagrass is broadcast planted rather than seeded in rows, so mechanical cultivation is not an option for postplant weed control. Bermudagrass is flood irrigated between raised borders. Fields should be precisely leveled before planting the crop to ensure even water distribution. Adequate phosphorus fertilizer should be applied before planting to encourage proper root development. Seed certified by the California Crop Improvement Association is slightly more expensive than common seed, but it is a good investment to ensure potential for higher yield, increased germination, and reduced risk of introducing a new weed species. Monitor nitrogen levels in the crop frequently to plan fertilization schedules that will ensure proper crop growth. On the other hand, excessive nitrogen fertilizer can lead to crop disease problems and increased weed growth. Insect and disease pests should be controlled to maintain crop growth. Thoroughly cleaning harvest equipment before entering or leaving a field is an important practice that prevents spreading weeds within and between fields. Field burning generally does not kill many weed seeds but does make weed monitoring easier.

HERBICIDES

Growers cannot rely on herbicides to solve weed problems in bermudagrass fields, especially when the fields are poorly managed. This is because of very limited herbicide options for this crop and because the thick thatch of stolons and dead plant material prevent herbicides from reaching the soil where they can work properly. Other problems with herbicide use in bermudagrass are that a variety of products (seed, hay, and straw) will be harvested and livestock will occasionally graze in these fields. Growers, PCAs, and pesticide applicators need to be in regular communication to ensure that the specific herbicide used is allowed for the harvested product.
SPECIAL WEED PROBLEMS (6/09)

In bermudagrass production, canarygrass, summer grasses, nutsedge, and wild oats are generally the most common and problematic weeds. Sulfuron herbicide options for these weeds are very limited, so planting bermudagrass in fields infested with any of these weeds is likely to be a poor investment. Paraquat and diquat can provide some control of wild oats and canarygrass, but timing is critical for success. Control is best when weeds are in the seedling stage.
### COMMON and SCIENTIFIC NAMES OF WEEDS (6/09)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canarygrass, Littleseed</td>
<td><em>Phalaris minor</em></td>
</tr>
<tr>
<td>Chamomile, Mayweed</td>
<td><em>Anthemis cotula</em></td>
</tr>
<tr>
<td>Chickweed, Common white</td>
<td><em>Stellaria media</em></td>
</tr>
<tr>
<td>Dandelion</td>
<td><em>Taraxacum officinale</em></td>
</tr>
<tr>
<td>Goosefoot, Nettleleaf</td>
<td><em>Chenopodium murale</em></td>
</tr>
<tr>
<td>Henbit</td>
<td><em>Lamium amplexicaule</em></td>
</tr>
<tr>
<td>Junglerice</td>
<td><em>Echinochloa colona</em></td>
</tr>
<tr>
<td>Knotweed, Silversheath</td>
<td><em>Polygonum argyrocoleon</em></td>
</tr>
<tr>
<td>Mallow, little (Cheeseweed)</td>
<td><em>Malva parviflora</em></td>
</tr>
<tr>
<td>Nutsedge, Yellow</td>
<td><em>Cyperus esculentus</em></td>
</tr>
<tr>
<td>Nutsedge, Purple</td>
<td><em>Cyperus rotundus</em></td>
</tr>
<tr>
<td>Oat, Wild</td>
<td><em>Avena fatua</em></td>
</tr>
<tr>
<td>Shepherd’s-purse</td>
<td><em>Capsella bursa-pastoris</em></td>
</tr>
<tr>
<td>Sowthistles</td>
<td><em>Sonchus spp.</em></td>
</tr>
<tr>
<td>Sprangletop, Bearded</td>
<td><em>Leptochloa uninervia</em></td>
</tr>
</tbody>
</table>
### SUSCEPTIBILITY OF WINTER WEEDS IN BERMUDAGRASS TO HERBICIDE CONTROL (6/09)

<table>
<thead>
<tr>
<th>ANNUAL WEEDS</th>
<th>BRO</th>
<th>CAR</th>
<th>DIC</th>
<th>DIQ</th>
<th>PAR</th>
<th>SUL</th>
<th>TRF</th>
<th>TRI</th>
<th>24D</th>
</tr>
</thead>
<tbody>
<tr>
<td>canarygrass, littleseed</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>P</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>N</td>
</tr>
<tr>
<td>chickweed, common</td>
<td>—</td>
<td>P</td>
<td>—</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>—</td>
</tr>
<tr>
<td>clover, white</td>
<td>N</td>
<td>N</td>
<td>C</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>henbit</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>N</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>—</td>
</tr>
<tr>
<td>goosefoot, nettleleaf</td>
<td>C</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>knotweed, silversheath</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>—</td>
<td>P</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>P</td>
</tr>
<tr>
<td>mallow, little (cheeseweed)</td>
<td>P</td>
<td>C</td>
<td>P</td>
<td>P</td>
<td>—</td>
<td>—</td>
<td>N</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>oat, wild</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>P</td>
<td>—</td>
<td>—</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>shepherd's-purse</td>
<td>—</td>
<td>P</td>
<td>—</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>N</td>
<td>—</td>
</tr>
<tr>
<td>sowthistles</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>P</td>
<td>P</td>
<td>—</td>
<td>—</td>
<td>N</td>
<td>C</td>
</tr>
</tbody>
</table>

C = control  P = partial control  N = no control  — = unknown

**BRO** = bromoxynil (Buctril)  **SUL** = sulfosulfuron (Certainty)
**CAR** = carfentrazone (Shark)  **TRF** = trifloxysulfuron (Monument)
**DIC** = dicamba (Banvel)  **TRI** = trifluralin (Gowan Trifluralin)
**DIQ** = diquat (Reward)  **24D** = 2,4-D* (Amine 4CA)
**PAR** = paraquat* (Gramoxone Inteon)

1 Provides control if applied in seedling stage.

* Permit required from county agricultural commissioner for purchase or use.
### SUSCEPTIBILITY OF SUMMER WEEDS IN BERMUDAGRASS TO HERBICIDE CONTROL (6/09)

<table>
<thead>
<tr>
<th></th>
<th>BRO</th>
<th>CAR</th>
<th>DIC</th>
<th>DIQ</th>
<th>PAR</th>
<th>SUL</th>
<th>TRF</th>
<th>TRI</th>
<th>24D*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANNUAL WEEDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chamomile, mayweed</td>
<td>C</td>
<td>N</td>
<td>C</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>junglerice</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>P</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>N</td>
</tr>
<tr>
<td>sprangletop, bearded</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>N</td>
</tr>
<tr>
<td><strong>PERENNIAL WEEDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dandelion</td>
<td>—</td>
<td>—</td>
<td>C</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>nutsedge, yellow</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>C</td>
<td>C</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

C = control  
P = partial control  
N = no control  
— = unknown

BRO = bromoxynil (Buctril)  
CAR = carfentrazone (Shark)  
DIC = dicamba (Banvel)  
DIM = dimethenamid (Outlook)  
DIQ = diquat (Reward)  
HAL = halosulfuron (Sandea)  
PAR = paraquat* (Gramoxone Inteon)  
TRI = trifluralin (Gowan Trifluralin)  
SUL = sulfosulfuron (Certainty)  
TRF = trifloxysulfuron (Monument)  
TRA = triallate (Avadex MicroActiv)  
PAX = penoxsulam (Sapphire)  
24D* = 2,4-D* (Amine 4CA)

1 Provides control if applied in seedling stage.

* Permit required from county agricultural commissioner for purchase or use.
HERBICIDE TREATMENT TABLE (6/09)

When choosing an herbicide, consider information relating to environmental impact. Not all registered pesticides are listed. Always read label of product being used.

<table>
<thead>
<tr>
<th>Common name (example trade name)</th>
<th>Amount per acre</th>
<th>R.E.I.‡ (hours)</th>
<th>P.H.I.‡ (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 2,4-D AMINE* (Amine 4)</td>
<td>0.5–0.95 lb a.i.</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 4</td>
<td>COMMENTS: Apply to small broadleaf weeds before bermudagrass seed heads start to form. Follow label instructions and local regulations to avoid damage to adjacent crops.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. DICAMBA* (Banvel)</td>
<td>0.25–0.5 lb a.i.</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 4</td>
<td>COMMENTS: Apply to small broadleaf weeds before bermudagrass seed heads start to form. Follow label instructions and local regulations to avoid damage to adjacent crops.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. BROMOXYNIL (Buctril)</td>
<td>0.25–0.5 lb a.i.</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 6</td>
<td>COMMENTS: Effective for control of winter annual broadleaf weeds if applied when weeds are very small (2- to 4-leaf stage of growth).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. TRIFLURALIN (Gowan Trifluralin 10G)</td>
<td>20 lb</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 3</td>
<td>COMMENTS: Use allowed under a Special Local Needs permit. Can be applied after the fields are burned to kill off old growth for control of several annual weeds, but field trials have not demonstrated worthwhile results.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. CARFENTRAZONE-ETHYL (Shark EW)</td>
<td>0.008–0.03 lb a.i.</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 14</td>
<td>COMMENTS: Effective for control of some winter annual broadleaf weeds if applied when weeds are small (up to 4 inches tall). Control is enhanced with the addition of a nonionic surfactant or crop oil concentrate.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. PARAQUAT* (Gramoxone Inteon)</td>
<td>Label rates</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. DIQUAT (Reward)</td>
<td>Label rates</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. SULFOSULFURON (Certainty)</td>
<td>Label rates</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 2</td>
<td>COMMENTS: For postemergent control of certain broadleaf weeds, tall fescue, annual bluegrass, sedges, and green kyllinga. Two applications are often needed; takes about 2 weeks to get good control.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. TRIFLOXYSULFURON (Monument)</td>
<td>Label rates</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 2</td>
<td>COMMENTS: For postemergent control of certain broadleaf weeds, tall fescue, annual bluegrass, sedges, and green kyllinga. Two applications are often needed; takes about 2 weeks to get good control.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. DIMETHENAMID (Outlook)</td>
<td>14–21 fl oz</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>WSSA MODE-OF-ACTION GROUP NUMBER: 15</td>
<td>COMMENTS: Only use on crops that have been established for at least one year. Preemergence control or suppression of both grasses and broadleaves. Do not apply more than 21 fl oz of Outlook / acre per growing season.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common name</td>
<td>Amount per acre</td>
<td>R.E.I.‡ (hours)</td>
<td>P.H.I.‡ (days)</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>HALOSULFURON (Sandea)</td>
<td>0.031–0.062 lb a.i.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>K.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRIALLATE (Avadex MicroActiv)</td>
<td>15 lb</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>L.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PENOXSULAM (Sapphire)</td>
<td>0.06 lb a.i.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>M.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

‡ Restricted entry interval (R.E.I.) is the number of hours from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of the two intervals is the minimum time that must elapse before harvest.

* Permit required from county agricultural commissioner for purchase or use.

1 Group numbers are assigned by the Weed Science Society of America (WSSA) according to different modes of action. Although weeds may exhibit multiple resistance across many groups, mode of action numbers are useful in planning mixtures or rotations of herbicides with different modes of action. For more information, see http://www.hraeglobal.com.
Precautions for Using Pesticides

- Pesticides are poisonous and must be used with caution. **READ THE LABEL BEFORE OPENING A PESTICIDE CONTAINER.** Follow all label precautions and directions, including requirements for protective equipment. Apply pesticides only on the crops or in the situations listed on the label. Apply pesticides at the rates specified on the label or at lower rates if suggested in this publication. In California, all agricultural uses of pesticides must be reported. Contact your county agricultural commissioner for further details. Laws, regulations, and information concerning pesticides change frequently. This publication reflects legal restrictions current on the date next to each pest’s name.

- **Legal responsibility**
  - The user is legally responsible for any damage due to misuse of pesticides. Responsibility extends to effects caused by drift, runoff, or residues.

- **Transportation**
  - Do not ship or carry pesticides together with food or feed in a way that allows contamination of the edible items. Never transport pesticides in a closed passenger vehicle or in a closed cab.

- **Storage**
  - Keep pesticides in original containers until used. Store them in a locked cabinet, building, or fenced area where they are not accessible to children, unauthorized persons, pets, or livestock. **DO NOT** store pesticides with foods, feed, fertilizers, or other materials that may become contaminated by the pesticides.

- **Container disposal**
  - Dispose of empty containers carefully. Never reuse them. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Consult your county agricultural commissioner for correct procedures for handling and disposal of large quantities of empty containers.

- **Protection of nonpest animals and plants**
  - Many pesticides are toxic to useful or desirable animals, including honey bees, natural enemies, fish, domestic animals, and birds. Crops and other plants may also be damaged by misapplied pesticides. Take precautions to protect nonpest species from direct exposure to pesticides and from contamination due to drift, runoff, or residues. Certain rodenticides may pose a special hazard to animals that eat poisoned rodents.

- **Posting treated fields**
  - For some materials, **restricted entry intervals** are established to protect field workers. Keep workers out of the field for the required time after application and, when required by regulations, post the treated areas with signs indicating the safe re-entry date. Check with your county agricultural commissioner for latest restricted entry interval.

- **Preharvest intervals**
  - Some materials or rates cannot be used in certain crops within a specified time before harvest. Follow pesticide label instructions and allow the required time between application and harvest.

- **Permit requirements**
  - Many pesticides require a permit from the county agricultural commissioner before possession or use. When such materials are recommended, they are marked with an asterisk (*) in the treatment tables or chemical sections of this publication.

- **Maximum residue levels**
  - Before applying pesticides to crops destined for export, check maximum residue levels (MRLs) of importing country at [http://www.mrldatabase.com](http://www.mrldatabase.com).

- **Processed crops**
  - Some processors will not accept a crop treated with certain chemicals. If your crop is going to a processor, be sure to check with the processor before applying a pesticide.

- **Crop injury**
  - Certain chemicals may cause injury to crops (phytotoxicity) under certain conditions. Always consult the label for limitations. Before applying any pesticide, take into account the stage of plant development, the soil type and condition, the temperature, moisture, and wind. Injury may also result from the use of incompatible materials.

- **Personal safety**
  - Follow label directions carefully. Avoid splashing, spilling, leaks, spray drift, and contamination of clothing. NEVER eat, smoke, drink, or chew while using pesticides. Provide for emergency medical care **IN ADVANCE** as required by regulation.

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**ANR NONDISCRIMINATION AND AFFIRMATIVE ACTION POLICY STATEMENT FOR UNIVERSITY OF CALIFORNIA PUBLICATIONS REGARDING PROGRAM PRACTICES**

It is the policy of the University of California (UC) and the UC Division of Agriculture & Natural Resources not to engage in discrimination against or harassment of any person in any of its programs or activities on the basis of race, color, national origin, religion, sex, gender, gender expression, gender identity, pregnancy (which includes pregnancy, childbirth, and medical conditions related to pregnancy or childbirth), physical or mental disability, medical condition (cancer-related or genetic characteristics), genetic information (including family medical history), ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services (as defined by the Uniformed Services Employment and Reemployment Rights Act of 1994 (USERRA), as well as state military and naval service. This policy is intended to be consistent with the provisions of applicable state and federal laws and University policies.

University policy also prohibits retaliation against any employee or person in any of its programs or activities for bringing a complaint of discrimination or harassment pursuant to this policy. This policy also prohibits retaliation against a person who assists someone with a complaint of discrimination or harassment, or participates in any manner in an investigation or resolution of a complaint of discrimination or harassment. Retaliation includes threats, intimidation, reprisals, and/or adverse actions related to employment or to any of its programs or activities.

In addition, it is the policy of the University and ANR to undertake affirmative action, consistent with its obligations as a Federal contractor, for minorities and women, for persons with disabilities, and for covered veterans. The University commits itself to apply every good faith effort to achieve prompt and full utilization of minorities and women in all segments of its workforce where deficiencies exist. These efforts conform to all current legal and regulatory requirements, and are consistent with University standards of quality and excellence.

In conformance with Federal regulations, written affirmative action plans shall be prepared and maintained by each campus of the University, including the Division of Agriculture and Natural Resources. Such plans shall be reviewed and approved by the Office of the President and the Office of the General Counsel before they are officially promulgated. Inquiries regarding the University’s equal employment opportunity policies may be directed to Linda Marie Manton, Affirmative Action Contact, University of California, Davis, Agriculture and Natural Resources, One Shields Avenue, Davis, CA 95616, (530) 752-0495.

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Precautions for Using Pesticides

Online at [http://www.ipm.ucanr.edu/GENERAL/precautions.html](http://www.ipm.ucanr.edu/GENERAL/precautions.html)