Turf: Diseases

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Fungicides play an important role in the successful management of turfgrasses, especially throughout the transition zone where no grasses experience ideal growing conditions. However, the use of fungicides is only one part of successful management of diseases. Practicing sound cultural techniques, such as proper fertilization, irrigation, and mowing strategies, provides a stand of turf with a greater ability to withstand attack by pathogens. Additional information on proper cultural practices is available in the following links:

Spring and Summer Lawn Management Considerations for Cool-Season Turfgrasses: (http://pubs.ext.vt.edu/430/430-532/430-532.html)

Spring and Summer Lawn Management Considerations for Warm-Season Turfgrasses (http://pubs.ext.vt.edu/430/430-533/430-533.html)

Winter Management and Recovery Tips to Optimize Athletic Field Safety and Performance for Spring Sports (http://pubs.ext.vt.edu/430/430-408/430-408.html)

Below are the most common fungicide active ingredients that are used for turfgrass management, along with diseases that they control.

Table 7.1- Fungicides Labeled for Control of Various Turfgrass Diseases

Active Ingredient	Algae	Anthracnose	Brown Patch	Copper spot	Dead Spot	Dollar Spot	Fairy Ring	Gray Leaf Spot	Large Patch	Leaf Spot/Melting Out	Microdochium Patch (Pink Snow Mold)	Powdery Mildew	Pythium Blight	Red Thread	Rusts	Spring Dead Spot	Summer Patch	Take-all Patch	Typhula Blight (Gray Snow Mold)	Yellow Patch
azoxystrobin		*	*				*	*	*	*	*	*	*	*	*	*	*	*	*	*
boscalid					*	*														
chloroneb													*						*	
chlorothalonil	*	*	*	*		*		*		*	*			*	*				*	
cyazofamid													*							
difenoconazole		*	*			*	*	*	*	*	*	*		*	*		*	*		*
etridiazole													*							
fenarimol		*	*	*		*					*	*		*		*	*	*	*	
fludioxonil		*			*	*		*		*	*						*		*	*
fluopicolide + propamocarb													*							
fluazinam	*	*	*			*			*	*	*			*					*	
fluoxastrobin		*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
flutolanil			*				*							*					*	*
flutriafol		*	*	*		*		*	*			*			*	*	*			
fluxapyroxad	*		*			*			*		*						*		*	
fosetyl-Al													*							
iprodione			*			*			*	*	*			*					*	
isofetamid						*										*				
mancozeb	*		*	*		*		*		*			*	*	*					
mefenoxam													*							
mefentrifluconazole		*				*	*									*	*	*		
metconazole		*	*			*	*	*	*		*			*		*	*		*	*
myclobutanil		*	*	*		*		*	*	*	*	*		*	*	*	*	*		
PCNB		*	*	*	*			*		*			*	*	*	*	*	*		
penthiopyrad		*	*			*			*	*		*		*					*	
phosphonates													*							
picarbutrazox													*							
polyoxin-D zinc salt		*	*				*	*	*	*	*			*					*	*
propamocarb													*							
propiconazole		*	*		*			*		*	*	*		*	*	*	*	*	*	*
prothioconazole		*	*			*	*	*	*		*					*	*	*		
pydiflumetofen						*	*				*					*				
pyraclostrobin		*	*		*	*	*	*	*	*	*	*	*	*	*		*	*	*	
tebuconazole		*	*	*		*		*	*		*	*		*	*	*	*	*	*	*
thiophanate-methyl		*	*	*	*	*		*	*	*				*		*	*	*		*
thiram			*	*		*				*	*			*	*				*	
triadimefon			*	*		*					*	*		*	*		*	*	*	
trifloxystrobin		*	*					*		*	*			*	*		*			
triticonazole	*	*	*			*		*	*	*	*			*	*		*	*	*	
vinclozolin			*			*				*	*			*					*	

These recomendations are not a substitute for pesticide labeling. **Always Read and Follow the Label**

Table 7.2 - Registered Trade Names of Common Active Ingredients Used for Control of Turfgrass Diseases by Professionals	
active ingredient	**Trade name(s)**
azoxystrobin	**Heritage*** (50WG, G, SC, TL, Action), Headway*, Headway G, Renown*, Briskway*, Posterity Forte*, Posterity XT*, QualiPro Strobe (2L, Pro, T, TM), Endow, Contend*, Union*
benzovindiflupyr	**Ascernity***, Contend*
boscalid	**Emerald**, Honor*, Encartis*
chloroneb	Andersons Fungicide V, Fungicide IX*
chlorothalonil	**Daconil** (Action*, Ultrex, WeatherStik, ZN), QualiPro Chlorothalonil, Docket, Echo Chlorothalonil, Enclave*, Pegasus, Primera One Chlorothalonil, Pro Solutions Thalonil, Concert II*, Instrata*, Legend, Renown*, Reserve*, Spectro 90*, Disarm C*, Vitalonil*, TM/C*, Encartis*
cyazofamid	**Segway,** Union*
difenoconazole	**Briskway***, Ascernity*, Contend*
etridiazole	**Terrazole 35WP,** Terrazole L
fenarimol	**Rubigan**
fluazinam	**Secure, Secure Action***
fludioxonil	**Medallion SC,** Medallion WDG, Instrata*
fluindapyr	**Kalida***
fluopicolide + propamocarb	**Stellar**
fluoxastrobin	**Fame** SC, Fame + C and Fame + T*, Fame G, Disarm 480SC, Disarm C*, Disarm G, Disarm M*
flutriafol	**Rayora**, Kalida*
fluxapyroxad	**Xzemplar** and Lexicon*
flutolanil	**Prostar,** Pedigree
fosetyl-Al	**Signature Xtra Stressgard,** Chipco Signature, QualiPro Fosetyl-Al
iprodione	**26GT,** 26019 Flo, Iprodione Pro 2SE, Enclave*, Nufarm Iprodione, Primera One Iprodione, QualiPro Ipro 2SE, Raven, Interface*, 26/36*, Dovetail*, Nufarm TM+IP*
isofetamid	**Kabuto** and Tekken
mancozeb	**Fore** (Rainshield), Dithane, Junction*, Protect, Wingman
mefenoxam	**Subdue** MAXX, Subdue G, QualiPro Mefonoxam 2AQ
mefentrifluconazole	**Maxtima** and Navicon*
metconazole	**Tourney**
myclobutanil	**Eagle 20EW,** QualiPro Myclobutanil, Disarm M*, Lebanon Eagle G, Howard Johnson's Eagle G
PCNB	**Turfcide10G,** Turfcide 400, Andersons FFII
penthiopyrad	**Velista**
phosphonates	**Appear II,** Alude, AgriFos, Exel LG, Fiata, Fosphite, Fungi-Phite, K-Phite, Phorcephite, Phostrol, Primera Magellan, Quanta, Rampart, ReSyst
picarbutrazox	**Serata**
polyoxin-D zinc salt	**Affirm,** Endorse
propamocarb	**Banol,** Stellar*
propiconazole	**Banner MAXX,** Andersons Prophesy, Kestrel, Lesco Spectator, Nufarm Propiconazole, PrimeraOne Propiconazole, ProPensity, Propiconazole Select, Strider, Propimax, QualiPro Propiconazole, Savvi, Headway*, Headway G, Instrata*, Concert*, Posterity Forte*, Posterity XT*, Contend*, Headway G
prothioconazole	**Densicor**
pydiflumetofen	**Posterity,** Posterity Forte*, Posterity XT*

pyraclostrobin	**Insignia** (SC and WG formulations), Honor*, PillarG*, Lexicon*, Navicon*
tebuconazole	**Torque,** Enclave*, QualiPro Tebuconazole, Mirage, Fame + T*, Clearscape, E-Scape, Strobe T*, Tekken*
thiophanate-methyl	**3336** (WSP, FLO, Plus, G, DG Lite), 26/36*, Allban, Andersons Fluid Fungicide, Andersons Fungicide VII, Cavalier, Consyst*, Dovetail*, Fungicide IX*, Fungo, Lesco T-Storm, Lesco Twosome*, Nufarm TM+CTN*, Nufarm TM+IP*, Nufarm T-Methyl, Peregrine, PrimeraOne TM, QualiPro TM, QualiPro TM/C*, Spectro 90*, Systec, T-Bird, TM Select, Tee-1-Up*, Tee-Off, Topsin
thiram	**Spotrete,** Thiram Granuflo
triadimefon	**Bayleton** (Flo, 50DG, 50WSP, G), Andersons Bayleton G, Andersons Fungicide VII, Armada*, Tartan*
trifloxystrobin	**Compass,** Armada*, Tartan*, Interface*
triticonazole	**Trinity,** Triton WG, Triton FLO, Reserve*, PillarG*
vinclozolin	**Curalan,** Touche

*Product is a preformulation of at least two active ingredients. **BOLD** products are generally considered to be the most common trade name. It is possible that not all products labeled for use in turf are listed in this table. Products listed in this table are included in the Virginia Department of Agriculture and Consumer Services Approved Pesticide Database (http://www.kellysolutions.com/va/pesticideindex.htm). Always Read and Follow the Label. Many products have restrictions on site usage, yearly maximum use, application frequency, and/or personal protection equipment requirements. These recommendations are not a substitute for pesticide labeling.

Turf: Insects

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The remarks column on this section contains information on suggested timing, pest thresholds, detection and monitoring techniques, and cultural and biological control recommendations for turfgrass professionals to maximize control effectiveness. Information on the Insecticide column proposes both the active ingredient and commercial insecticide, inside parenthesis, suggested to target the selected pest.

Caution: Be sure to consider drainage, slope, type of soil, weather, and general area use when spraying insecticides to avoid contamination of water sources and reduce exposure to non-target organisms. Avoid using treated areas immediately after application.

Note: Unless indicated otherwise, the following recommendations for amount of product are given for 1,000 sq ft of area and in per acre amounts as well. Formulations other than those indicated may have different rates. **Always follow directions on product labels, and make sure to follow the respective re-entry intervals for each applied insecticide.** To ensure even distribution of soil insecticides apply at least one half inch of water immediately after application in order to move the material through the thatch layer.

■ White Grubs

White grubs include larvae of Japanese beetle, May and June beetle, masked and European chafers, oriental beetle, green June beetle, and black turfgrass ataenius. White grubs can be managed by some entomopathogenic nematodes. Not all nematode species (named on the product label under the "Active Ingredients" section) available commercially will provide adequate control. Products with *Steinernema riobrave* should not be used for grub control. Products with *Heterohabditis bacteriophora* are more effective. Entomopathogenic (insect killing) nematode products should be applied only when the pest is present. Apply nematodes late in the day to avoid exposure to UV light damage. Irrigate the day before and immediately after application. Early spring treatments are usually not effective because soil temperatures should be at least 60°F or higher.

Beauvaria bassiana (white muscardine entomopathogenic fungus) products also provide effective control. Follow label instructions and water 0.5 inch immediately after application. Avoid fungicide applications for at least 4 days when using these products.

Insecticides available for grub management should be applied at the labeled rate and watered in with 0.25 to 0.5 inch of water. Most insecticides provide the best control when used against early instar (smaller) grubs present from early to mid August. Populations high enough to warrant treatment are ≥8 grubs/sq ft on well-maintained turf, and 4 to 6 grubs per square foot or higher on unthrifty turf. White grubs stop feeding in September or October, so control during fall may not prove successful. Spring treatments generally are not effective either.

Cultural management: Reducing the thatch layer to <0.5 inch will help increase the penetration of any treatment applied to turfgrass. Also, avoid applying grubicides when soil is saturated or waterlogged.

■ Green June Beetle Grub

The green June beetle grub comes up through the thatch layer at night to feed on the surface. Monitor in late July the same way as for other white grubs. To monitor for grubs, use a cup cutter and carefully check the thatch and area beneath it. As few as 3 to 5 grubs per square foot can cause significant damage to golf fairways and greens. Treatments applied in the late afternoon or early evening are better at targeting the nighttime surface-feeding grubs. Irrigate before application to attract the grubs to the surface.

■ Black Turfgrass Ataenius

Black turfgrass ataenius is the smallest white grub that attacks turfgrass in Virginia. This pest has two generations per year in Virginia. Adult beetles overwinter in the thatch layer of the rough next to fairways or in wooded lots. The overwintering adults become active from mid-April to early May about the time when spring crocus and red bud are in bloom. Applications targeting adults should not be watered in because the adults are in the thatch layer. First generation adults are actively laying eggs in July. Second generation adults begin emerging from late August through September. Spring applications targeting the early instar grubs of the first generation could be timed to when the black locust begins to bloom (May). Insecticides targeting second generation grubs could be applied from mid-July to early August before the grubs have matured to the third (and final) instar to avoid serious damage to the turfgrass. A degree day program (Wegner and Niemczyk 1981 in Haruo Tashiro, Turfgrass Insects of the United States and Canada) targets treatments to control the newly hatching first instar grubs. Based on a 55°F flight threshold, the program predicts that first generation eggs should begin to appear when 180-270 DD (degree days) have accumulated. Second generation eggs are expected to appear when 1,170-1,278 DD have accumulated, which coincides with the July blooming stage of Rose of Sharon. There are about 60-70 days between generations. Thresholds for black turfgrass ataenius are not firm but turf often shows damage at populations of 20 to 30 grubs per square foot, and populations of 50 per square foot can result in serious damage. However, damage often goes unnoticed in grass that is longer than 2.0 inches, properly fertilized, and not water-stressed. To monitor for grubs, use a cup cutter and carefully check the thatch and area beneath it.

Table 7.3 - Insecticides for White Grubs (larval stage)			
Insecticide	**Amount product per 1,000 sq ft**	**Amount product per acre**	**Remarks**
Bacillus thuringiensis var. galleriaei (grubGone! G)	37-55 oz	100-150 lb	Check label for details
Beauvaria bassiana	See label		Use 100 gal water/A. Multiple products. Check label for details.
chlorantraniliprole (Acelepryn 1.67SC)	0.184-0.367 oz	8.0-16.0 oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses and sod farms. Has moderate systemic activity. Acelepryn may be applied from early April to early September for preventative and early curative control of all major white grub species. Use higher rate for late August or early September applications due to fewer mid-instar grubs present at the time of application. Optimal results can be achieved if product is watered in (≥0.5 inch) immediately after application.
clothianidin (Arena 0.25G) (Arena 50WDG)	1.84-3.67 lb 0.147-0.294 oz	80.0-160.0 lb 6.4-12.8 oz	Arena 0.25G: Residential and nonresidential sites. Treatment should be followed by sufficient water to move active ingredient (AI) into soil.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	1.8-3.6 lb 0.27- 0.44 fl. oz	80.0-160.0 lb 11.65-19.0 fl. oz	Aloft GC G and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control for turf on residential and nonresidential sites including lawns, commercial, public, parks, recreational areas, athletic fields, golf courses and sod farms. For the granular formulation, apply enough water (≥0.5 inch) to release AI from carrier.
cyantraniliprole (Ference)	0.184 to 0.367 fl. oz	8 to 16 fl. oz	
deltamethrin (Deltagard G)	2.0-3.0 lb	87.0-131.0 lb	
dinotefuran (Zylam 20SG)	1.0 oz	2.7 lb	Zylam 20SG: Residential and nonresidential sites, including sod farms. Optimum control can be achieved when applications are made prior to or at egg hatch of the target pests followed by sufficient irrigation or rainfall to move AI through the thatch layer. The AI in Zylam is highly systemic and has a high water solubility. It is highly mobile and resistant to biodegradation. These physical traits make the AI a good candidate for leaching into the ground water, particularly where the water table is shallow and roots are permeable. Do not graze treated areas or use clippings from treated areas for feed or forage. Keep children and pets off areas until spray has dried. Do not apply to areas that are water logged or saturated or frozen.
entomopathogenic nematodes	See label		Various commercial products
imidacloprid (Merit 2F) (Merit 75WSP) (Merit 0.5G)	0.46–0.6 fl. oz 1.6 oz (1 packet)/ 8,250-11,000 sq ft 1.4-1.8 lb	1.25-1.6 pt 60.0-80.0 lb	Merit 2F, 75WSP and 0.5G: Residential and nonresidential sites. Merit 2F and 75WSP can be used on sod farms, **but not the 0.5G formulation**. Treatment should be followed by sufficient water to move AI into soil.

Table 7.3 - Insecticides for White Grubs (larval stage) (continued)

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC)	 2.3-2.9 lb 2.3-2.9 lb	 100.0-125.0 lb 100.0-125.0 lb	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms**. Allectus GC and GC SC: **RESTRICTED USE**. Golf courses and sod farms only. For best results for all products, water within 24 hours of treating to move AI through the thatch layer.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	 1.32-1.65 fl. oz	 3.6-4.5 pt	
tetraniliprole (Tetrino)	0.367-0.735 fl. oz	16-32 fl. oz	
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Meridian 25WG: Residential and nonresidential sites. Treatment should be followed by sufficient water to move AI into soil.
trichlorfon (Dylox 6.2G) (Dylox 420SL)	 3.0 lb 6.9 fl. oz	 130.0 lb 300.0 fl. oz	Dylox 6.2G, and 420SL: Residential, parks and golf course sites. For best results, thatch layer must be <0.5 inch at time of treatment. Apply immediately after mixing with water. AI breaks down within 9-15 minutes in high pH water (i.e. pH ≥9). Do not use treated area or clippings from treated areas for feed or forage.

Table 7.4 - Insecticides for Adults of Black Turfgrass Ataenius

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
Adult stage			
bifenthrin (Talstar EZ) (Talstar GC) (Talstar PL)	 1.15-2.3 lb 1.15-2.3 lb 1.15-2.3 lb	 50.0-100.0 lb 50.0-100.0 lb 50.0-100.0 lb	Residential and nonresidential sites.
lambda-cyhalothrin (Scimitar GC)	0.24 fl. oz (7.0 mL) (use 2-10 gal water)	10.0 fl. oz	**RESTRICTED USE**. Residential and nonresidential sites. For best results, water lightly after treating (≤0.5 inch) to move AI into thatch layer.
spinosad (Conserve SC Turf)	 1.2 fl. oz	 52.0 fl. oz	Residential and nonresidential sites.

■ Annual Bluegrass Weevil

Golf course greens and fairways planted in creeping bentgrass, *Agrostis stolonifera,* often become infested with annual bluegrass, *Poa annua.* These two grass species are the main hosts on which annual bluegrass weevil (ABW) adults and larvae feed.

In early spring around the time when *Forsythia* is in full bloom, ABW adults leave their overwintering sites in pine duff or other types of leaf litter and walk to annual bluegrass-infested bentgrass greens and fairways. The full bloom stage of the flowering dogwood typically marks the end of adult migration. The adults feed in the grass foliage above the thatch and can be easily detected upon close inspection. Two or three eggs are laid within leaf sheaths just above the crown. Newly hatched larvae feed within the leaf sheath and then move into the crown and roots where the most serious damage occurs. If unchecked, high populations of larger larvae (fourth and fifth instars) can kill the bentgrass, turning greens and fairways light brown despite adequate moisture and nutrients. The life cycle from egg to adult takes about 50-60 days in New England states, but may require fewer days in warmer southern states, including Virginia. Depending on location, ABW is capable of completing up to four generations per year. In the fall, ABW adults move from golf greens and fairways to overwinter sites.

The ABW egg is pale yellow to white and oblong in shape. It is about 0.03 in long by 0.01 in wide. The larva is legless, has a brown head and creamy white body, and is rounded at both ends. The larva passes through five instars (sheds its skin four times) before pupating. The first instar is about 0.03 in long, whereas the fifth instar is about 0.20 in. The newly emerged ABW adult is light tan; it then turns brown with small areas of yellow scales and hairs mottled throughout. The body eventually turns dark charcoal gray after the brown and yellow scales wear off. The length of the adult varies from 1/8 in – 5/32 in, and the antennae are elbowed and attached near the tip of the snout where the chewing mouthparts are located.

Adulticide products used widely are pyrethroids such as Scimitar and Talstar. Larvicide products such as Dylox, Conserve, Provaunt and Acelepryn have become popular ABW management tools. However, years of repeated exposure to pyrethroids in some New England states has caused some ABW populations to become resistant. Fortunately, ABW resistance to insecticides is not widespread yet here in Virginia.

Be on the alert from March through April to identify if ABW adults are on your course. Soap flushes on turf could be done to monitor for the presence of ABW adults. There is evidence that the soap will not damage the greens. It is recommended to mix one fluid ounce of any lemon-scent dishwasher soap for each gallon of water. Ideally, the flush will cover at least one-foot square area on the green. Doing soap flushes really early in the morning might underestimate the adult numbers. Target to do these soap flushes during the warmer time of the day. The ultimate goal is to detect the peak of adult activity on the greens; therefore weekly monitoring soap flushes may be necessary to properly time an insecticide application.

Immature ABW larvae could be detected in the field by conducting the salt float method from a turf soil core. It is recommended to mix one pound of common salt for each gallon of water. Once the turf soil plug is extracted, any green turf leaves should be removed to facilitate the inspection of the mixture. Using a container with a sealing lid, submerge the turf plug into the salt solution. Soil plug can be cut in multiple piece to increase surface area. To dislodge any immatures from the plug, the mixture should be shaken vigorously and let sit for at least a couple of minutes. The salt will aid to make any ABW immature present to float and easy to count. Counting first instar ABW immatures with this methods could be challenging due to how small those larvae are. The idea is to detect the presence of immatures to trigger the respective control strategy.

Table 7.5 - Insecticides for Annual Bluegrass Weevil

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
Larva stage			
chlorantraniliprole (Acelepryn 1.67SC)	0.275-0.46 fl. oz	12.0-20.0 fl. oz	Acelepryn 1.67SC: Residential, commercial, recreational turf, including golf courses and sod farms. Has moderate systemic activity. Apply ≥0.5 inch water immediately after application.
cyantraniliprole (Ference)	0.275 to 0.459 fl. oz	12 to 20 fl. oz	
dinotefuran (Zylam 20SG)	1.0 oz	2.7 lb	Zylam 20SG: Residential and nonresidential sites, including sod farms. Optimum control can be achieved when followed by sufficient irrigation or rainfall to move AI through the turf thatch layer. The AI in Zylam is highly systemic and has a high water solubility. It is highly mobile and resistant to biodegradation. These physical traits make the AI a good candidate for leaching into the ground water, particularly where the water table is shallow and roots are permeable. Caution must be taken when using this product. Do not graze treated areas or use clippings from treated areas for feed or forage. Keep children and pets off areas until spray has dried. Do not apply to areas that are water logged or saturated or frozen.
imidacloprid (Merit 2F) (Merit 75WSP) (Merit 0.5G)	0.46-0.6 fl. oz 1.6 oz (1 packet) /8,250-11,000 sq ft 1.4-1.8 lb	1.25-1.6 pt 60.0-80.0 lb	Merit 2F, 75WSP, 0.5G: Residential and nonresidential sites (check labels for details). Merit 2F and 75WSP can be used on sod farms, **but not the 0.5G formulation**. Treatment should be followed by sufficient water to move AI into soil.
indoxacarb (Provaunt)	0.275 oz	12.0 oz	Provaunt: Residential and nonresidential sites. Label specifies lawn, golf courses, and other recreational turfgrass areas. For best results, do not water or mow for 24 hours after treating. If grass is maintained at a mowing height >1.0 inch, then consider using the higher application rate if pest pressure is high.
tetraniliprole (Tetrino)	0.367-0.735 fl. oz	16-32 fl. oz	

Table 7.5 - Insecticides for Annual Bluegrass Weevil (continued)			
Insecticide	**Amount product per 1,000 sq ft**	**Amount product per acre**	**Remarks**
Larva stage			
spinosad (Conserve SC)	1.2 fl. oz	52.0 fl. oz	Conserve SC: Residential and nonresidential sites
Larva and Adult stage			
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G)	1.8-3.6 lb	80.0-160.0 lb	Aloft GC G and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control on residential and nonresidential sites. For the granular formulation, apply enough water (≥0.5 inch) to release AI from carrier.
clothianidin (24.70%) and bifenthrin (12.3%) (Aloft GC SC)	0.27-0.44 fl. oz	11.65-19.0 fl. oz	
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus GC)	1.7-2.9 lb	75.0-125.0 lb	Allectus GC and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control for golf courses and sod farms only. For the granular formulation, apply enough water (≥0.5 inch) to release AI from carrier.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	0.9-1.65 fl. oz	2.3-4.5 pt	
trichlorfon (Dylox 420SL [larvae]) (Dylox 420SL [adults])	5.2-6.9 fl. oz 6.9 fl. oz	225.0-300.0 fl. oz 300.0 fl. oz	Dylox 420SL: Residential and nonresidential sites (check label for details). Apply immediately after mixing with water. AI breaks down within 9-15 minutes in high pH water (i.e., pH ≥9). Do not use treated area or clippings from treated areas for feed or forage.
Adult stage			
bifenthrin (Check other labels of Talstar products for annual bluegrass weevil)	0.25-5.0 oz	10.9-21.8 oz	Residential and nonresidential sites (check label for details).
lambda-cyhalothrin (Scimitar GC)	0.24 fl. oz (7.0 mL)	10.0 fl. oz	**RESTRICTED USE.** Residential and nonresidential sites (check label for details). For best results, apply at recommended rates in 2-10 gals water/1,000 sq. ft. A nonionic wetting agent, penetrant, or similar adjuvant is recommended at label rates. Lightly irrigate after application with ≤0.5 inch water to move Scimitar GC into thatch layer.

■ Sod Webworm

Sod webworm damage is most severe during hot droughty conditions in mid- to late summer. Other contributing factors on turf are most noticeable in high-maintenance conditions and where grass is kept short. Two generations per year occur in Virginia. Initial damage symptoms are brown patches of turfgrass about 5-6 inches in diameter. Upon close inspection the leaves have been chewed back. If unchecked, these brown patches will increase in size and eventually kill the turf. For flushing larvae from thatch, mix 3-4 tablespoons of dishwashing liquid in 2 gallons of water. Pour evenly over 1 square yard of turf. Watch the area for 10 minutes, counting the sod webworm caterpillars as they rise to the surface. Sod webworm densities of 15 per square yard warrant treatment. Young larvae, which are most susceptible to treatment, can be expected in turf about 2 weeks after adults are present, usually late June and again in early September. Unfortunately, by the time damage is noticeable, the larvae are not susceptible to Bt products because they are getting ready to pupate. Spring and early summer treatments may be effective against the larvae that have overwintered. Do not mow for 1 to 3 days after treatment.

Cultural management: Plant endophyte enhanced fescue and ryegrass. Damage is seldom noticeable in turf more than 2.5 inches in height.

Table 7.6 - Insecticides for Sod Webworm			
Insecticide	**Amount product per 1,000 sq ft**	**Amount product per acre**	**Remarks**
acephate (Orthene Turf, Tree, and Ornamental 97 Spray)	0.4-0.8 oz (use minimum 1-15 gal water)	1.0-2.0 lb	**Golf courses and sod farms only**. For best results, treat when insects appear. Repeat application may be necessary, but do not treat at more than 1-week intervals. Do not graze or provide livestock treated grass.

Table 7.6 - Insecticides for Sod Webworm (continued)

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
azadirachtin (Azatrol EC)	≤1.3 fl. oz (use 1-2 gal water)	≤57.0 oz (use 40-100 gal water)	Residential and nonresidential sites (check label for details). The most vulnerable pest stages are the early larval stages when populations are established, but before damage is noticeable. Avoid watering and mowing for 12 to 24 hours after treating, and repeat as needed every 7 days.
Bacillus thuringiensis var. kurstaki (Dipel Pro DF)	See label		Check label for details.
beta-cyfluthrin (Tempo Ultra GC)	0.13-0.27 fl. oz (4.0-8.0 mL)	6.0-12.0 fl. oz	Residential and nonresidential sites, **but not for use on golf courses, sod farms, and sod grown for seed** (check label for details). Do not water or mow for 24 hours after treating.
bifenthrin (Talstar EZ) (Talstar GC) (Talstar PL)	 1.15 lb 1.15 lb 1.15 lb	 50.0 lb 50.0 lb 50.0 lb	Residential and nonresidential sites (check labels for details). For all granular treatments, water ≤0.1 inch immediately after treatment to release/activate AI from granule.
chlorantraniliprole (Acelepryn 1.67SC)	0.046-0.092 fl. oz	2.0-4.0 fl. oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses and sod farms. Has moderate systemic activity. Provides excellent curative control of caterpillars (larvae) in turf. For optimal control, delay watering or mowing for 24 hours after application. If turf is maintained at >1 inch in height, higher rates may be required during periods of high pest pressure.
clothianidin (Arena 0.25G) (Arena 50WDG)	 0.3-0.4 lb 0.3-0.4 lb	 120-160 lb 9.6-12.8 oz	Residential and nonresidential sites (check labels for details). For best results, treat just prior to egg laying or to early instar larvae of target pests. Treatment should be followed by sufficient water to move AI into soil.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	 0.3-0.4 lb 0.27- 0.44 fl. oz	 80.0-160.0 lb 11.65-19.0 fl. oz	Aloft GC G and GC SC: **RESTRICTED USE**. Contact and systemic insect pest control for turf on residential and nonresidential sites, including lawns, commercial public, parks, recreational areas, athletic fields, golf courses, and sod farms. For the granular formuation, apply enough water (≥0.5 inch), to release AI from the carrier.
cyantraniliprole (Ference)	0.046 to 0.367 fl. oz	2-16 fl. oz	
deltamethrin (Deltagard G)	2.0-3.0 lb	87.0-131.0 lb	Check label for details.
dinotefuran (Zylam 20SG)	1.0 oz	2.7 lb	Zylam 20SG: Residential and nonresidential sites, including sod farms. Optimum control can be achieved when followed by sufficient irrigation or rainfall to move AI through the turf thatch layer. The AI in Zylam is highly systemic and has a high water solubility. It is highly mobile and resistant to biodegradation. These physical traits make the AI a good candidate for leaching into the ground water, particularly where the water table is shallow and roots are permeable. Caution must be taken when using this product. Do not graze treated areas or use clippings from treated areas for feed or forage. Keep children and pets off areas until spray has dried. Do not apply to areas that are water logged or saturated or frozen.
entomopathogenic nematodes		100 million-1 billion	Check label for details.

Table 7.6 - Insecticides for Sod Webworm (continued)

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC) imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	 1.2-2.9 lb 1.2-2.9 lb 0.67-1.65 fl. oz	 50.0-125.0 lb 50.0-125.0 lb 1.8-4.5 pt	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms**. Allectus GC and GC SC: **RESTRICTED USE**. Golf courses and sod farms only. For all products, water within 24 hours of application to move the AI through the thatch layer. Avoid mowing after treating until irrigation or rainfall has occurred.
indoxacarb (Provaunt)	0.046-0.092 oz	2.0-4.0 oz	Residential and nonresidential sites. Label specifies lawns, golf courses, and other recreational turfgrass areas. For best results, do not water or mow for 24 hours after treating. If grass is maintained at a mowing height >1.0 inch, then consider using the higher application rate if pest pressure is high.
lambda-cyhalothrin (Scimitar GC)	0.24 fl. oz (7.0 mL) (use 2-10 gal water)	5.0-10.0 fl. oz	Scimitar GC: **RESTRICTED USE**. Residential and nonresidential sites. Water lightly after treating (≤0.5 inch) to move AI into thatch layer.
spinosad (Conserve SC)	0.25 fl. oz	10.0 fl. oz	Residential and nonresidential sites. For best results, treat during the late afternoon or early evening, and do not water or mow for 12 to 24 hours after treating.
tetraniliprole (Tetrino)	0.367-0.735 fl. oz	16-32 fl. oz	
trichlorfon (Dylox 6.2G) (Dylox 420SL)	2.0 lb 4.6-6.9 fl. oz	87.0 lb 200.0-300.0 fl. oz	Dylox 6.2G, and 420SL: Residential, parks, and golf course sites. Water lightly after treating to move AI into thatch layer. For best results using Dylox 420SL, do not water after treating. Apply immediately after mixing with water. AI breaks down within 9-15 minutes in high pH water (i.e. pH ≥9). Do not use treated area or clippings from treated areas for feed or forage.

■ Chinch Bug

Chinch bugs are piercing-sucking insects that have two generations per year in Virginia. Chinch bugs can cause significant damage to turf when found in densities of 15 to 20 immature bugs (nymphs) per square foot. Damage usually occurs to turf in sunny areas with a heavy thatch layer that is somewhat droughty. Initial damage symptoms are small patches of turf that are yellow. As patches increase in size, the center turns brown with the expanding border of dead and dying grass with new grass turning from yellowish green to green, respectively. Areas planted with fine (red) fescue are especially at risk to chinch bugs. Chinch bugs may be sampled by floatation. Drive a 4-inch diameter cylinder with open ends on both sides into the turf. Then pour in water at a rate that maintains the water level in the cylinder about 1 inch above the turfgass for 5 to 10 minutes. Chinch bugs will float to the surface where they can be easily counted. Another scouting method is to use the soapy flush (previously described under the ABW section), aiming to disturb chinch bugs, forcing them to move to the surface of the turf. Insecticide treatment is often effective, but because chinch bugs are highly mobile, the area may be quickly recolonized. Do not mow or water the turf for 2 to 3 days after treatment. If the entomopathogenic fungus *Beauvaria bassiana* is used as a control measure, do not apply fungicides immediately before or after application (see product label).

Cultural management: Plant endophyte enhanced fescue and ryegrass. Reduce the use of fine (red) fescue in sunny areas, reduce thatch, and avoid spring fertilization with high nitrogen content.

Table 7.7 - Insecticides for Chinch Bug

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
acephate (Orthene Turf, Tree, and Ornamental 97 Spray)	0.9-1.5 oz (use 1-15 gal water to obtain good coverage).	2.5-4.0 lb	**Golf courses and sod farms only**. Water lightly (≤0.5 inch) after treating. Do not graze or provide livestock treated grass.
Beauvaria bassiana	See label		Use 100 gal water/A. Check label for details.
beta-cyfluthrin (Tempo Ultra GC)	0.27 fl. oz (8.0 mL)	12.0 fl. oz	Residential and nonresidential sites, **but not for use on golf courses, sod farms, and sod grown for seed** (check label for details). For best results, water turf immediately after treating to move AI into thatch layer.

Table 7.7 - Insecticides for Chinch Bug (continued)

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
bifenthrin (Talstar EZ) (Talstar GC) (Talstar PL)	 2.3-4.6 lb 2.3-4.6 lb 2.3-4.6 lb	 100.0-200.0 lb 100.0-200.0 lb 100.0-200.0 lb	Residential and nonresidential sites. For all granular treatments, water ≤0.25 inch immediately after treating to release/activate AI from granule.
chlorantraniliprole (Acelepryn 1.67SC)	0.184-0.46 fl. oz	8.0-20.0 fl. oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses, and sod farms. Has moderate systemic activity. For suppression of chinch bugs.
clothianidin (Arena 0.25G) (Arena 50WDG)	 0.3-0.4 lb 0.3-0.4 lb	 120.0-160.0 lb 9.6-12.8 oz	Residential and nonresidential sites. For best results, apply enough water to move AI to where target insects are active.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	 1.8-3.6 lb 0.27-0.44 fl. oz	 80.0-160.0 lb 11.65-19.0 fl. oz	Aloft GC G and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control for turf on residential and nonresidential sites, including lawns, commercial public, parks, recreational areas, athletic fields, golf courses, and sod farms. For the granular formulation, apply enough water (≥0.5 inch), to release AI from the carrier.
cyantraniliprole (Ference)	0.184 to 0.459 fl. oz	8-20 fl. oz	
deltamethrin (Deltagard G)	 2.0-3.0 lb	 87.0-131.0 lb	Residential and nonresidential sites. Use higher rates for subsurface pests and/or for extended residual control.
imidacloprid Merit 2F	0.6 fl. oz	1.6 pt	
Merit 0.5 G	1.8 lb	80 lb	
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC) imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	 1.7-2.9 lb 1.7-2.9 lb 0.9-1.65 fl. oz	 75.0-125.0 lb 75.0-125.0 lb 2.3-4.5 pt	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms.** Allectus GC and GC SC: **RESTRICTED USE.** Golf courses and sod farms only.
permethrin (Astro)	0.4 to 0.8 fl. oz	17 to 35 fl oz	
lambda-cyhalothrin (Scimitar GC)	 0.47 fl. oz (14.0 mL) (use 2-10 gal water)	 20.0 oz	**RESTRICTED USE.** Residential and nonresidential sites. For best results, water lightly after treating (≤0.5 inch) to move AI into thatch layer.
tetraniliprole (Tetrino)	0.367-0.735 fl. oz	16-32 fl. oz	
thiamethoxam (Meridian 25WG)	 1.5-1.95 oz/5,000 sq ft	 12.7-17.0 oz	Residential and nonresidential sites. For suppression of chinch bugs.
trichlorfon (Dylox 420SL)	6.9 fl. oz	300.0 fl. oz	Residential, parks, and golf course sites. Check label for details. Apply immediately after mixing with water. AI breaks down within 9-15 minutes in high pH water (i.e. pH ≥9). Do not use treated area or clippings from treated areas for feed or forage.

■ Billbugs

Billbugs have one generation per year here in Virginia. Effective control can be obtained by a single early-season treatment for adults in early April. Visually monitor for active adults during early April to predict when and where to treat; and where problems might arise later in the season (billbug adults can often be seen crossing paved areas adjacent to turf). Damage from billbug larvae is often misdiagnosed as drought stress, white grub or chinch bug damage, or late spring greening. To recognize billbug damage, pull on the grass stems. They will break off near the crown and emit a fine sawdust-like frass (insect excrement) that has been packed inside the stems from larval feeding. If damage is severe, pull back the sod from the soil and you should find distinct patches of yellowish sawdust-like frass. Larval treatments should be applied if there are 6 to 8 larvae per square foot. Billbug adults can be detecting by mixing 3-4 tablespoons of dishwashing liquid in 2 gallons of water, and pouring this mixture evenly over 1 square yard of turf (soapy flush method). Watch the area for 10-15 minutes, observing the billbugs as they rise to the surface.

Cultural management: Plant endophyte enhanced fescue and ryegrass in addition to other turf varieties (ryegrass and bluegrass) that are resistant to billbug feeding.

Table 7.8 - Insecticides for Billbugs (e.g., bluegrass billbug, hunting billbug)

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
Grub/larval stage			
chlorantraniliprole (Acelepryn 1.67SC)	0.184-0.46 fl. oz	8.0-20.0 fl. oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses, and sod farms. Has moderate systemic activity.
clothianidin (Arena 0.25G) (Arena 50WDG)	0.2-0.4 lb 0.2-0.4 lb	80.0-160.0 lb 6.4-12.8 oz	Residential and nonresidential sites. For best results, apply enough water to move AI to where target insects are active.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	1.8-3.6 lb 0.27-0.44 fl. oz	80.0-160.0 lb 11.65-19.0 fl. oz	Aloft GC G and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control for turf on residential and nonresidential sites, including lawns, commercial public, parks, recreational areas, athletic fields, golf courses, and sod farms. For the granular formuation, apply enough water (≥0.5 inch), to release AI from the carrier.
cyantraniliprole (Ference)	0.184 to 0.367 fl. oz	8 to 16 fl. oz	
dinotefuran (Zylam 20SG)	1.0 oz	2.7 lb	Zylam 20SG: Residential and nonresidential sites, including sod farms. Optimum control can be achieved when applications are made prior to or at egg hatch of the target pests followed by sufficient irrigation or rainfall to move AI through the turf thatch layer. The AI in Zylam is highly systemic and has a high water solubility. It is highly mobile and resistant to biodegradation. These physical traits make the AI a good candidate for leaching into the ground water, particularly where the water table is shallow and roots are permeable. Caution must be taken when using this product. Do not graze treated areas or use clippings from treated areas for feed or forage. Keep children and pets off areas until spray has dried. Do not apply to areas that are water logged or saturated or frozen.
imidacloprid (Merit 2F) (Merit 75WSP) (Merit 0.5G)	0.46-0.6 oz 1.6 oz (1 packet) /8,250-11,000 sq ft 1.4-1.8 lb	1.25-1.6 pt 60.0-80.0 lb	Merit 2F, 75WSP, and 0.5G: Residential and nonresidential sites (check label for details). Merit 2F and 75WSP can be used on sod farms, **but not the 0.5G formulation**. Treatment should be followed by sufficient water to move AI into soil.

Table 7.8 - Insecticides for Billbugs (e.g., bluegrass billbug, hunting billbug) (continued)			
Insecticide	**Amount product per 1,000 sq ft**	**Amount product per acre**	**Remarks**
Grub/larval stage			
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC)	 1.7-2.9 lb 1.7-2.9 lb	 75.0-125.0 lb 75.0-125.0 lb	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms**. Allectus GC: **RESTRICTED USE**. Golf courses and sod farms only.
tetraniliprole (Tetrino)	0.367-0.735 fl. oz	16-32 fl. oz	
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Residential and nonresidential sites.
Adult stage			
beta-cyfluthrin (Tempo Ultra GC)	0.27 fl. oz (8.0 mL)	12.0 fl. oz	Residential and nonresidential sites, but not for use on golf courses, sod farms, and sod grown for seed.
bifenthrin (Talstar EZ) (Talstar GC) (Talstar PL)	 1.15-2.3 lb 1.15-2.3 lb 1.15-2.3 lb	 50.0-100.0 lb 50.0-100.0 lb 50.0-100.0 lb	Residential and nonresidential sites.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	 1.8-3.6 lb 0.27-0.44 fl. oz	 80.0-160.0 lb 11.65-19.0 fl. oz	Aloft GC G and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control for turf on residential and nonresidential sites, including lawns, commercial public, parks, recreational areas, athletic fields, golf courses, and sod farms. For the granular formuation, apply enough water (≥0.5 inch), to release AI from the carrier.
deltamethrin (Deltagard G)	2.0-3.0 lb	87.0-131.0 lb	Residential and nonresidential sites.
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC) imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	 1.7-2.9 lb 1.7-2.9 lb 0.9-1.65 fl. oz	 75.0-125.0 lb 75.0-125.0 lb 2.3-4.5 pt	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms.** Allectus GC; Allectus GC SC: **RESTRICTED USE.** Golf courses and sod farms only.
lambda-cyhalothrin (Scimitar GC)	0.24 fl. oz (7.0 mL)(use 2-10 gal water)	10.0 fl. oz	**RESTRICTED USE.** Residential and nonresidential sites. For best results, water lightly after treating (<0.5 inch) to move AI into thatch layer.

■ Fall Armyworm, Cutworms, and Armyworms

Monitoring and treatment strategies are similar for fall armyworm, cutworms, and other armyworms. A detergent drench flushing technique (or the soapy flush method) is useful to determine if these caterpillars are present in turf. Mix 3-4 tablespoons of dishwashing liquid in 2 gallons of water. Pour evenly over 1 square yard of turf. Watch the area for 10 minutes, observing the caterpillars as they rise to the surface.

Fall Armyworm has two to three generations per year in Virginia. Fall armyworm populations of 9 or more caterpillars per square yard may warrant treatment. Populations can reach damaging levels late in the season. Unlike other armyworms, the fall armyworm is a major pest of turfgrass. Damage appears as thinning of turf over a widespread area. Preferred hosts are bermudagrass, ryegrass, fescue, and bluegrass. All plant parts above ground are consumed.

Cutworms have from two to four generations per year in Virginia. Cutworm populations of 3 to 8 caterpillars per square yard may warrant treatment. Damage appears as small patches and sunken areas, especially on golf greens.

Most insecticides used for cutworms are stomach poisons because the larvae feed at night. Apply insecticides in the early evening for the best results. Unless specified on the label, do not water or mow for 24 hours after treating. Cutworms are highly mobile, so treated areas are likely to become re-infested from surrounding areas. Cultural management: Plant endophyte enhanced fescue and ryegrass. Turf more than 2.5 inches in height requires less treatment for cutworms. Cutworm populations can be reduced if grass clippings are removed during mowing because cutworm moths lay their eggs at the tip of grass blades. If using entomopathogenic nematodes, apply late in the day and water before and after application.

Armyworm: Up to three generations of armyworms occur per year in Virginia.

Larvae appear in April, late June, and August-September. Armyworms feed in groups on grass blades, causing skeletonizing by early instars and consumption of the whole leaf by later instars, resulting in circular patches of bare ground. Armyworms prefer cereal crops, so turf areas near farmland growing these crops are at higher risk; however, they typically are not a major pest of turfgrass.

Treat when armyworms are first detected. If using entomopathogenic nematodes, apply late in the day and water before and after application.

Table 7.9 - Insecticides for Fall Armyworm, Cutworms, and Armyworms

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
acephate (Orthene Turf, Tree, and Ornamental 97 Spray)	0.4-0.9 oz (use minimum 5 gal water)	1.0-2.5 lb	**Golf courses and sod farms only**. Do not graze or provide livestock treated grass.
azadirachtin (Azatrol EC)	≤1.3 fl. oz (use 1-2 gal water)	≤57.0 fl. oz (use 40-100 gal water)	Residential and nonresidential sites. The most vulnerable pest stages to azadirachtin are the early larval stages when populations are established, but before damage is noticeable. Avoid watering and mowing for 12 to 24 hours after treating, and repeat as needed every 7 days.
beta-cyfluthrin (Tempo Ultra GC)	0.14-0.27 fl. oz (4.0-8.0 mL)	6.0-12.0 fl. oz	Residential and nonresidential sites, **but not for use on golf courses, sod farms, and sod grown for seed**. Do not water or mow for 24 hours after treating.
bifenthrin (Talstar EZ) (Talstar GC) (Talstar PL)	 1.15 lb 1.15 lb 1.15 lb	 50.0 lb 50.0 lb 50.0 lb	Residential and nonresidential sites. For all granular treatments, water ≤0.1 inch immediately after treatment to release/activate AI from granule.
chlorantraniliprole (Acelepryn 1.67SC)	0.046-0.092 fl. oz	2.0-4.0 fl. oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses, and sod farms. Has moderate systemic activity. Provides excellent curative control of caterpillars (larvae) in turf. For optimal control, delay watering or mowing for 24 hours after application. If turf is maintained at >1 inch in height, higher rates may be required during periods of high pest pressure.

Table 7.9 - Insecticides for Fall Armyworm, Cutworms, and Armyworms (continued)

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
clothianidin (Arena 0.25G)	0.3-0.4 lb	120.0-160.0 lb	Residential and nonresidential sites. Apply enough water to move AI to where target insects are active.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	1.8-3.6 lb 0.27-0.44 fl. oz	80.0-160.0 lb 11.65-19.0 fl. oz	Aloft GC G and GC SC: **RESTRICTED USE**. Contact and systemic insect pest control for turf on residential and nonresidential sites, including lawns, commercial public, parks, recreational areas, athletic fields, golf courses, and sod farms. For the granular formulation, apply enough water (≥0.5 inch), to release AI from the carrier.
Cyantraniliprole (Ference)	0.046 to 0.367 fl. oz	2.0-16.0 fl. oz	
deltamethrin (Deltagard G)	2.0-3.0 lb	87.0-131.0 lb	Check label for details.
dinotefuran (Zylam 20SG)	1.0 oz	2.7 lb	**For use on cutworm only.**
Entomopathogenic nematodes	See label		Check label for details.
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	1.2-2.9 lb 1.2-2.9 lb 0.67-1.65 fl. oz	50.0-125.0 lb 50.0-125.0 lb 1.8-4.5 pt	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms**. Allectus GC and GC SC: **RESTRICTED USE**. Golf courses and sod farms only For all products, water within 24 hours of application to move the AI through the thatch layer. Avoid mowing after treating until irrigation or rainfall has occurred.
indoxacarb (Provaunt)	0.046-0.092 oz	2.0-4.0 oz	Residential and nonresidential sites. Label specifies lawns, golf courses, and other recreational turfgrass areas. For best results, do not water or mow for 24 hours after treating. If grass is maintained at a mowing height >1 inch, then consider using the higher application rate if pest pressure is high.
lambda-cyhalothrin (Scimitar GC)	0.11-0.24 fl. oz (3.4-7.0 mL)(use 2-5 gal water)	5.0-10.0 fl. oz	Scimitar GC: **RESTRICTED USE**. Residential and nonresidential sites. For best results, do not water or mow for 12 to 24 hours after treating.
spinosad (Conserve SC)	0.25-1.2 fl. oz	10.0-52.0 fl. oz	Residential and nonresidential sites. For best results, do not water or mow for 12 to 24 hours after treating. Low and high rates are based on whether larvae are small or large, respectively.
tetraniliprole (Tetrino)	0.367-0.735 fl. oz	16-32 fl. oz	
trichlorfon (Dylox 420SL)	4.6-6.9 fl. oz	200.0-300.0 fl. oz	Residential, park, and golf course sites. For best results, do not water after treating. Apply immediately after mixing with water. AI breaks down within 9-15 minutes in high pH water (i.e. pH ≥9). Do not use treated area or clippings from treated areas for feed or forage.

■ Ants

Several ant species, including field ants, can become problematic in turfgrass. Ant will tunnel under the turf roots, and deposit the excavated soil at the entrance of each mound, disrupting root growth and influencing playability of the affected area. High infestations of ants might result in having several mounds, where the free movement of the golf ball will be impeded. Additionally, ants and their mounds will become nuisance once established in turfgrass nearby other structures, like buildings and cement paths and driveways.

Table 7.10 - Insecticides for Ants

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
bifenthrin (Talstar S)	1 fl. oz	40 fl. oz	For golf courses and sod farms. Use 10 gal for 1,000 sq. ft. For low volume of application, water down the product with at leas 0.25 inches of water after application.
dinotefuran (Zylam 20SG)	1 oz	2.7 lb	Apply when seeing foraging activity from ants.
indoxacarb (Advion Insect Granular)	1.15-4.6 lb	50.0-200.0 lb	Turfgrasses grown for golf courses (tee box areas, roughs, fairways, greens, and collars), residential complexes and other similar landscape turf areas. Not for use on turfgrass that is being grown for seed or on commercial sod farms.
lambda-cyhalothrin (Scimitar GC)	0.11-0.24 fl. oz (3.4-7.0 mL)(use 2-5 gal water)	5.0-10.0 fl. oz	Scimitar GC: **RESTRICTED USE**. Residential and nonresidential sites. For best results, do not water or mow for 12 to 24 hours after treating.
Thiamethoxam (Meridian 25WG)	3-4 oz	12.7-17 oz	Turfgrass on golf courses, residential lawns, commercial grounds and sod farms. Do not use for seed production.

■ Mole Crickets

Mole crickets generally are not major pests of turf. However, they can cause serious damage in turf from tunneling in and beneath the thatch layer of sandy soils. Adult control is difficult to achieve in the early spring because the adults are actively seeking mates and continually invading preferred grassy areas. Areas that experience heavy adult pressure in the spring may warrant treating with maximum labeled rates and additional applications immediately prior to peak egg hatch.

Summer treatments targeting the young mole cricket nymphs are usually more effective in knocking down populations. The smaller size of the young nymphs (relative to the adults) makes them much more susceptible to insecticides. In addition, given that the nymphs must actively feed close to the surface to grow and develop, their exposure to insecticides is greatly increased. Treatments applied later in the summer may warrant higher rates and additional applications to control larger nymphs and young adults.

It is important to realize that as soils dry out, mole cricket nymphs and adults will burrow down substantially into the soil profile to remain in contact with moist soil. This is why most insecticide labels for mole crickets stress the point that if the soil is dry at the time of application, sufficient irrigation (but well short of waterlogging the turf) must be done before treating to provide favorable conditions that will drive the nymphs and adults up to the surface. The efficacy of most treatments will be greatly improved if pretreatment watering is done.

Table 7.11 - Insecticides for Mole Crickets

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
acephate (Orthene Turf, Tree, and Ornamental 97 Spray)	0.8-1.4 oz (use 1-15 gal water)	2.0-3.9 lb	**Golf courses and sod farms only**. Treat when mole crickets or their damage first appear. For best results, water before treating to drive the adults and nymphs to the surface, especially if soil is dry, but do not water after treating. If possible, treat in the late afternoon or early evening. More than one treatment at higher rates may be required during the growing season to knock down existing populations. Do not graze or provide livestock treated grass.
beta-cyfluthrin (Tempo Ultra GC)	0.27 fl. oz (8.0 mL)	12.0 fl. oz	Residential and nonresidential sites, **but not for use on golf courses, sod farms, and sod grown for seed**. For best results, water before treating to drive the adults and nymphs to the surface, especially if soil is dry.
bifenthrin (Talstar EZ) (Talstar GC) (Talstar PL)	 2.3-4.6 lb 2.3-4.6 lb 2.3-4.6 lb	 100.0-200.0 lb 100.0-200.0 lb 100.0-200.0 lb	Residential and nonresidential sites. For best results, water before treating to drive the adults and nymphs to the surface, especially if soil is dry. Treat in late afternoon or early evening, and then water in ≤0.5 inch immediately after treating.
clothianidin (Arena 0.25G) (Arena 50WDG)	 0.4 lb 0.294 fl. oz	 160.0 lb 12.8 fl. oz	Arena 0.25G and 50WDP: Residential and nonresidential sites. Arena 0.25G: For suppression of mole crickets. Highest rate suggested. Arena 50WDG: For suppression of mole crickets. Use high rate. For best results water before treating to drive the adults and nymphs to the surface, especially if the soil is dry. Apply enough water to move AI to where target insects are active.
clothianidin (0.025%) and bifenthrin (0.125%) (Aloft GC G) clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	 1.8-3.6 lb 0.27-0.44 oz	 80.0-160.0 lb 11.65-19.0 oz	Aloft GC G and GC SC: **RESTRICTED USE.** Contact and systemic insect pest control for turf on residential and nonresidential sites, including lawns, commercial public, parks, recreational areas, athletic fields, golf courses, and sod farms. For the granular formulation, apply enough water (≥0.5 inch), to release AI from the carrier.
dinotefuran (Zylam 20SG)	1.0 oz	2.7 lb	Zylam 20SG: Residential and nonresidential sites, including sod farms. Optimum control can be achieved when applications are made prior to or at egg hatch of the target pests followed by sufficient irrigation or rainfall to move AI through the turf thatch layer. The AI in Zylam is highly systemic and has a high water solubility. It is highly mobile and resistant to biodegradation. These physical traits make the AI a good candidate for leaching into the ground water, particularly where the water table is shallow and roots are permeable. Caution must be taken when using this product. Do not graze treated areas or use clippings from treated areas for feed or forage. Keep children and pets off areas until spray has dried. Do not apply to areas that are water logged or saturated or frozen.

Table 7.11 - Insecticides for Mole Crickets

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC) imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	2.9 lb 2.9 lb (for Allectus G and GC, a single annual application may be made using 4.6-5.7 lb) 1.32-1.65 fl. oz (for Allectus GC SC, a single annual application may be made using 2.64-3.3 oz)	125.0 lb 125.0 lb (for Allectus G and GC, a single annual application may be made using 200.0-250.0 lb) 3.6-4.5 pt (for Allectus GC SC, a single annual application may be made using 7.2-9.0 pt)	Allectus G: Residential and nonresidential sites, **but not for use on golf courses or sod farms**. Allectus GC SC: **RESTRICTED USE.** Golf courses and sod farms only. For best results for all Allectus formulations, water before treating to drive the adults and nymphs to the surface, especially if soil is dry. Treat in late afternoon or early evening, and then water in ≤ 0.5 inch immediately after treating.
indoxacarb (Advion Mole Cricket Bait)	1.15-4.6 lb	50.0-200.0 lb	Residential and nonresidential sites, **but not for use on sod farms and sod grown for seed**. Do not allow livestock or domestic animals to consume the bait or graze in treated areas. Water soil before treating to bring mole crickets to surface, and treat infested areas in late afternoon. Rainfall or irrigation within 2-3 days after treating may reduce bait effectiveness.
lambda-cyhalothrin (Scimitar GC)	0.24 fl. oz (7.0 mL) (nymphs and young adults) (use 4-10 gal water) 0.47 fl. oz (14 mL) (adults) (use 4-10 gal water)	10.0 fl. oz (nymphs and young adults) 20.0 fl. oz (adults)	**RESTRICTED USE.** Residential and nonresidential sites. For best results, water before treating to drive nymphs and adults to the surface, especially if soil is dry. Also, use a nonionic wetting agent, penetrant, or similar adjuvant. Use highest water application rates possible when treating. Immediately after treating, apply 0.25 to 0.5 inch of water.
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Residential and nonresidential sites. For suppression of mole crickets.
trichlorfon (Dylox 6.2G) (Dylox 420SL)	3.0 lb 6.9 fl. oz	130.0 lb 300.0 fl. oz	Dylox 6.2G, and 420SL: Residential, park, and golf course sites. For best results, thatch layer must be <0.5 inch at time of treatment. Apply Dylox 420SL immediately after mixing with water. AI breaks down within 9-15 minutes in high pH water (i.e. pH ≥9). Do not use treated area or clippings from treated areas for feed or forage.

Turf: Weeds

Shawn D. Askew, Professor, Virginia Tech

■ Weedy Grasses

There are several preemergence crabgrass killers available which will do an excellent job of controlling crabgrass and other annual grasses. Goosegrass is more difficult to control than most of the other annual grasses. Higher rates are suggested for goosegrass control and repeating herbicide application in May or June is suggested for best results.

Preemergence crabgrass killers kill seedlings as they germinate. Thus, it is necessary that they are applied in advance of crabgrass germination. Crabgrass usually germinates after April 15 in the mountains and March 15 in the Piedmont areas.

Midseason to late postemergent applications for annual grasses are considered to be less desirable than preemergent or early postemergent control. Late postemergent treatments will usually result in turfgrass discoloration and browning of crabgrass foliage, and later bare areas in a lawn. However, early postemergent treatments will provide excellent crabgrass control and allow turfgrass to begin to cover during the summer and fall. Goosegrass is very difficult to control with postemergent herbicides. It is possible to control crabgrass and allow a more difficult problem with goosegrass to develop without competition for the space left by the dying crabgrass. Arsenical herbicides may still be used on a restricted basis in golf and sod turf but are banned from residential and athletic turf. Fenoxaprop, mesotrione, quinclorac, topramezone, and metribuzin are used to control annual grasses in certain turfgrasses during late spring and summer.

Most perennial grasses are controlled by physical removal or by non-selective chemicals. Bermudagrass (aka wiregrass) can be controlled with multiple treatments of mesotrione, topramezone, fenoxaprop, or fluazifop each mixed with triclopyr and applied at 3-week intervals. Dallisgrass may be selectively controlled in warm-season turf with arsenical herbicides in golf or sod turf or with various sulfonylurea products applied repeatedly in the fall. Dallisgrass and other Paspalum sp. may be suppressed in cool-season golf or sod turf, with pinoxaden, or with various turf with topramezone or mesotrione.

Table 7.12 - Annual Grass Control[1]
In Bluegrass, Tall Fescue, Perennial Ryegrass, and Common Bermudagrass

Herbicide	Crabgrass	Goosegrass	Annual Bluegrass	Foxtail	Sandbur	Annual treatments[2]
Preemergent						
Benefin	S	I	I	S	I	2
Bensulide	S	R	S	S	—	1-2
Bensulide + Oxadiazon	S	S	S	S	I	2
DCPA	S	I	I	S	I	2
Dithiopyr	S	I	I	S	—	1
Ethofumesate	—	—	S	—	—	2-3
Oryzalin	S	I	S-I	S	S-I	2
Oxadiazon	S	S	I	S	I	1
Pendimethalin	S	I	I	S	I	2
Prodiamine	S	I	I	S	—	1
Pinoxaden	S-I	R	R	S	S-I	1
Siduron	S	R	R	S	—	2
Benefin + Oryzalin	S	S-I	S-I	S	S-I	1
Benefin + Trifluralin	S	I	S-I	S	S-I	2
Postemergent						
Dithiopyr	S	I	I-R	S	—	1
DSMA, MSMA	S	I-R	R	S	S-I	2-6
Dithiopyr + MSMA[3]	S	I	I-R	S	S-I	1
Dithiopyr + fenoxaprop	S	S-I	I-R	S	—	1
Fenoxaprop	S	I	I-R	S	—	2
Flazasulfuron[4]	I-R	I-R	S-I	I-R	I-R	2
Foramsulfuron[4]	I-R	S-I	S	I-R	I-R	2
Mesotrione	S	S-I	I-R	S	—	2-4
Metsulfuron	I-R	R	S-I	I-R	I-R	2
Quinclorac	S	I-R	R	S	—	1-2
Trifloxysulfuron[4]	I-R	I-R	S	I-R	I-R	2
Topramezone	S	S	R	S	—	1-3

[1]The relative effectiveness of commonly used herbicides for selected weeds is using S = weed susceptible; I = intermediate, good control at times with high rates, sometimes poor, may require more than one treatment; R = resistant weeds in most instances.
[2]Lower label rates may require additional applications.
[3]Not for use in residential or athletic turf.
[4]For use on warm-season grasses only.

Table 7.13 - Preemergent

Application	Weed Problems	Chemical Rate/ 1000 sq ft	Remarks
New seeding bluegrass, tall fescue, perennial ryegrass, creeping bentgrass	Annual grasses: barnyardgrass, crabgrass, foxtails	siduron (Tupersan 3.7oz of 50% WP) mesotrione (Tenacity 0.12 oz of 4FL)	Apply at time of seeding. Kills annual weedy grasses, but not annual bluegrass. For use on bluegrass, tall fescue, or perennial ryegrass. Do not use on bermudagrass. Apply at time of seeding. Kills annual weedy grasses including goosegrass and suppresses annual bluegrass. Also kills many broadleaves. For best results, repeat application at first mowing (usually 6 weeks after seeding). For use on bluegrass, tall fescue, and centipedegrass. Consult label regarding perennial ryegrass and fine fescue as some seeding restrictions may apply.
New seeding tall fescue, perennial ryegrass, bluegrass, bentgrass	Annual grasses: crabgrass, foxtails, barnyardgrass	quinclorac (Drive 0.28 oz of 75% DF)	Apply at time of seeding for fescue and ryegrass. Must use 7 days before or 28 days after bentgrass and bluegrass seeding. Controls annual grasses and some broadleaf weeds, but not goosegrass or annual bluegrass.
Preemergent bermudagrass (during establishment from sprigs)	Annual grasses: crabgrass, goosegrass, foxtails	oxadiazon (Ronstar G 3.4 lb of 2% gran or Ronstar 2.2 oz of 50WP)	Apply at the time of sprigging and do not disturb soil surface after application. Provides preemergence control of the annual grasses and allows good establishment of bermudagrass sprigs. For use by commercial and landscape personnel only. Ronstar is not for home lawns.
Preemergent bermudagrass, zoysiagrass (during establishment from seed)	Annual grasses: crabgrass, foxtails, barnyardgrass	quinclorac (Drive 0.19 oz of 75% DF)	Apply at time of seeding. Controls annual grasses and some broadleaf weeds, but not goosegrass or annual bluegrass.
Established turf bluegrass, tall fescue, perennial ryegrass, bermudagrass	Annual grasses: barnyardgrass, crabgrass, foxtails	benefin (Balan 3.0 lb of 2.5% gran or 1.8 oz of 60DF)	Apply uniformly in late winter or early spring before crabgrass emergence. May be reapplied after 2 months for continued crabgrass control. Reseeding should not be attempted for 6 weeks after application.
		bensulide (Betasan 7.5- 9.4 oz of 4EC or 1.9- 2.3 lb of 12.5% gran or 3.3 lb of 7% gran)	Same. Do not reseed within 4 months of application. If for some reason turfgrass must be reseeded, charcoal will inactivate this herbicide. Application may be repeated after 3 to 4 months for continued crabgrass control.
		DCPA (Dacthal 1/3 lb of 75% WP or 5.0 lb of 5% gran or 5.1 oz of 6FL)	Apply in the early spring before crabgrass emergence. Flowering of forsythia can be used as a guide for proper timing of application. In areas where late-germinating crabgrass is experienced, a second application of half the regular rate is necessary after 8 weeks. In addition to crabgrass control, the DCPA treatments will provide some preemergence control of sandbur and postemergence control of corn speedwell.
		dithiopyr (Dimension 1.5 oz of 1EC)	Apply prior to or at crabgrass emergence. On fall seeded turfgrasses, delay application to early Postemergence for improved tolerance.
		oxadiazon (Ronstar 3.4 lbs of 2% gran or Ronstar 2.2 oz of 50WP)	Apply in the early spring before crabgrass emergence. Oxadiazon is used on bluegrass, bermudagrass, tall fescue, and perennial ryegrass. Ronstar is not for use on home lawns.
		pendimethalin (Pendulum 2G 1.75 to 2.25 lbs or Pendulum Aqua cap 1.6 oz of 3.8 ME)	Apply in the early spring before crabgrass emergence. Professional applicators may also use PreM 60WDG. Must be reapplied after 6-8 weeks for continued crabgrass control.
		prodiamine (Barricade 0.40 oz of 65WG)	Apply in spring before crabgrass germination. Irrigation or rain is desirable within a week to 10 days after application. Wait 6 mo to overseed by broadcasting over the surface. This waiting period may be reduced to 4 mo by drilling seed directly into the soil.
		benefin + trifluralin (Team 2G 3.5 lb of 1.3 + 0.7 gran)	Apply in spring before crabgrass germination and repeat application to maintain late season control.
		bensulide + oxadiazon (Goosegrass/Crabgrass Control 2.6 lb of 5.25 + 1.31 gran)	Apply in spring before crabgrass germination.

Table 7.13 - Preemergent (continued)

Application	Weed Problems	Chemical Rate/ 1000 sq ft	Remarks
Established turf bluegrass, tall fescue, perennial ryegrass, bermudagrass	Goosegrass	oxadiazon (Ronstar 3.4 lb of 2% gran or Ronstar 2.2 oz of 50WP)	Apply uniformly in early spring before goosegrass germination. This treatment will also give crabgrass control. Oxadiazon provides a high level of goosegrass control from early spring application. Ronstar is not for use on home lawns.
		pendimethalin (Pendulum Aqua cap 1.1 oz of 3.8 ME)	Apply in early spring and repeat after 6 weeks to improve late season goosegrass and crabgrass control.
		prodiamine (Barricade 0.40 oz of 65WG)	Apply in spring before goosegrass germination. Irrigation or rain is desirable within a week to 10 days after application. Wait 6 mo to overseed by broadcasting over the surface. This waiting period may be reduced to 4 mo by drilling seed directly into the soil. Repeat application according to label directions for goosegrass control.
		oxadiazon + bensulide (Goosegrass/Crabgrass Control 2.6 lb of 1.31 + 5.25 gran)	Apply in early spring before goosegrass germination. This treatment also controls crabgrass when applied as a preemergence. This product may be allowed on golf greens for goosegrass control; however injury must be acceptable.
Established bermudagrass	Goosegrass, crabgrass	benefin + oryzalin (XL Herbicide 3.0 lb of 1% + 1% gran and repeat after 8 weeks)	Apply in spring before annual grass germination. Reseeding turfgrass areas should be delayed at least 6 weeks after application.
		oxadiazon (Ronstar 1.8 to 2.2 oz of 50WP or 3.4 lb of 2% gran)	Apply in early spring to dormant bermudagrass and irrigate to wash into soil surface. It is suggested for fairways, parks, golf courses and lawns. Ronstar is not for use on home lawns, putting greens or tees.
Established turf, bluegrass, tall fescue, bermudagrass, perennial ryegrass	Annual bluegrass	bensulide (Betasan 0.6 pt of 4EC or 2.25 lb of 12.5% gran or 4.1 lb of 7% gran)	Apply in late August before annual bluegrass germination. Do not overseed or reseed for 4 or more months. Application of activated charcoal will inactivate bensulide and allow reseeding of desirable grass. Spring treatments for crabgrass control do not provide sufficient residual activity for any appreciable annual bluegrass control in the Fall.
		bensulide (Betasan 9.6 fl oz of 4EC) dithiopyr (Dimension 1.84 fl oz of 1EC) prodiamine (Barricade 0.5-1.0 fl oz of 4EC)	Apply in late August before annual bluegrass germination. Do not overseed or reseed for 4 months or as specified on label. Application of activated charcoal will inactivate herbicide and allow for reseeding of desirable grasses.
		ethofumesate (Prograss 1.5-2.0 oz of 1.5EC and repeat after 30 to 60 days)	Preemergence and early postemergence annual bluegrass control is obtained with this treatment. Apply to dormant bermudagrass and bluegrass in the fall and repeat the treatment at 30 to 60 days. First application may be made at 15 to 30 days after overseeding bermudagrass with perennial ryegrass. Do not apply after January 1 on bluegrass and bermudagrass turf. Initial treatments before bermudagrass goes dormant or treatments made after February 1 are likely to cause bermudagrass injury. These treatments may be made for annual bluegrass control during establishment and on established perennial ryegrass. With perennial ryegrass, application can be made in spring if annual bluegrass is emerging.
Established bermudagrass	Annual bluegrass	simazine (Princep DF 0.4 oz of 90DF or 0.75 oz of 4L)	Apply before annual bluegrass germinates. Do not overseed or seed for 4 months before or 6 months after treatment. May be used only in coastal plain area of Virginia. For control of a few broadleaf weeds, read label. Hybrid bermudagrasses are slightly more sensitive to simazine.

Table 7.14 - Postemergent

Application	Weed Problems	Chemical Rate/ 1000 sq ft	Remarks
Established turf, bluegrass, bermudagrass, tall fescue, perennial ryegrass	Annual grasses: crabgrass, foxtails, goosegrass	DSMA (Many formulations available. Must follow directions on label of container.) OR MSMA	Various formulations are available. Start in June when annual grass is in the 1 to 3 leaf stage and less than 1 inch tall. At least 3 applications at 7-day intervals are necessary for goosegrass control. Timing of application is critical. Apply when soil moisture is adequate for rapid growth of crabgrass and turf. Some discoloration of turfgrass is to be expected. Follow label instructions for use of individual formulations. Use lower rate when mid-day temperatures are 80°F or higher. Not for use in lawns or athletic fields.
Established turf, bluegrass, tall fescue, perennial ryegrass, fine fescue	Annual grasses: crabgrass, foxtail, goosegrass	fenoxaprop (Acclaim 1EC at 0.345 to 0.73 oz)	Turfgrasses should be more than one year old. The low rate is used early in year (about June 15) when crabgrass is in seedling stage (not tillered). As tillering becomes evident (1 to 3/ plant), the high rate is used for adequate control. The turfgrasses also become more tolerant in July as growth pattern begins to slow. Tank mixing with broadleaf herbicides tends to reduce effectiveness on crabgrass.
		dithiopyr (Dimension at 1.5 oz of 1EC)	Apply at emergence and up until tillering of crabgrass. Excellent control of crabgrass but only suppression of goosegrass is expected.
		mesotrione (0.09-0.18 oz of 4SC)	Apply at emergence through tillering. Tillering plants require two applications at 3-week intervals. Plants exceeding 10 tillers often require 3 applications at 3-week intervals, especially if the lower rate must be used. Also controls goosegrass, nimblewill, creeping bentgrass, foxtail, barnyardgrass, and several other grass and broadleaf species. Suppresses bermudagrass. Do not use more than 0.5 lb ai/A in a single season.
		quinclorac (Drive 0.37 oz of 75DF)	Apply at emergence through tillering. Two applications may be needed on tillering crabgrass but do not exceed 2 lb ai/A during a season. Also controls several broadleaf weeds, especially clover. Does not control goosegrass. Read and follow label instructions. Avoid drift to desirable ornamental plants.
		topramezone (Pylex 0.023 oz of 2.8SC)	Apply at emergence through tillering. Two applications may be needed on mature crabgrass of over 10 tillers or when lower rates are used. Add methylated seed oil adjuvant at 0.5% by volume. Controls goosegrass at any growth stage. Also controls foxtails and some other grasses and broadleaf weeds but does not control sedges.
		fenoxaprop or DSMA, MSMA + Preemergence	Use label rates of pendimethalin, dithiopyr, bensulide, DCPA, or siduron.
Established bermudagrass only	Goosegrass	metribuzin (0.125-0.25 oz of Sencor 75TH)	Metribuzin should be tank-mixed with DSMA or MSMA where labels do not prohibit this treatment, at the user's discretion. Apply to actively growing bermudagrass and goosegrass in 40 gallons of water/A (1 gal/1000 sq ft). Repeat in 2 to 3 weeks - 2 applications maximum/year. Do not use on golf greens. Expect some discoloration of the bermudagrass. Do not use on bluegrass, fescues, or perennial ryegrasses.
Established bermudagrass, zoysiagrass	Goosegrass	foramsulfuron (Revolver 0.6 fl oz of 0.19 EC)	Apply 2 to 3 times. May mix or apply in sequence with MSMA or metribuzin.
Established dormant bermudagrass	Annual bluegrass, other winter annual weeds	glyphosate (Roundup 0.28 oz of 4.0 lb/gal LC); add 0.5% nonionic surfactant	Apply with 1/2 gal of water/1000 sq ft to actively growing annual bluegrass and other winter annual weeds in late winter on dormant bermudagrass (must be applied before any bermudagrass greenup.)
Established bermudagrass, zoysiagrass only	Annual bluegrass, roughstalk bluegrass, perennial ryegrass	foramsulfuron (Revolver 0.4 fl oz of 0.19EC) trifloxysulfuron (Monument 0.007-0.011 oz of 75WG) rimsulfuron (Tranxit 0.046 oz of 25DF)	Apply any time after 50 percent bermudagrass greenup or during dormancy, but not within 1 month of greenup. Products may move in watershed or track onto surrounding cool-season grasses. Do not apply to saturated soils and irrigate 4 to 12 hours after treatment with 0.1 inch water.

Table 7.14 - Postemergent (continued)

Application	Weed Problems	Chemical Rate/ 1000 sq ft	Remarks
Established turf	Dallisgrass (Paspalum dilatatum)	MSMA (Follow directions on container label) Pinoxaden (Manuscript 19.2 oz of 0.42 EC)	Apply June through September when mid-day temperatures do not exceed 90°F. June to early July is best timing and has a better enviromental condition for control. Two or three applications at 7- to 10-day intervals will be required for control. Not for use in lawns or athletic fields. Apply in fall when Paspalum weeds are actively growing. For spot treatments, apply 9.6 fl oz per 10,000 sq ft. Do not apply more than 19.2 fl oz/A per year.
Established turf bluegrass, tall fescue, perennial ryegrass, bermudagrass	Yellow and purple nutsedge as well as other sedges.	halosulfuron (Sedgehammer 0.023 oz of 75WDG) sulfentrazone (Dismiss 0.35 oz of 4L)	Apply when actively growing. Avoid applications when turf and nutsedge are under stress. A nonionic surfactant should be added at a rate of 0.25-0.50% V/V. Halosulfuron is not labeled for use on golf greens. Apply when sedges are actively growing. Ensure uniform coverage. Works quickly compared to other sedge herbicides. Weeds begin to brown within 3 days. Excessive rates or certain tank mixtures, especially fertilizers, may lead to temporary turf discoloration.
	Yellow nutsedge	bentazon (Basagran T/O 1.0 oz of a 4 lb/gal LC) MSMA (MSMA6 1.0 oz of 6 lb/gal LC)	Apply when actively growing. At least 2 applications at 10-day intervals will be required for control. A third application may be made if needed (no more than three/year). A crop oil should be added at 0.25% V/V. Not effective for purple nutsedge control. Bentazon is not labeled for use on golf greens. Perennial ryegrass has shown considerable injury in some cases.
Established turf bermudagrass	Purple nutsedge, wild onion, wild garlic	imazaquin (Image 0.5-1.0 oz of 1.5 lb/gal)	Apply when actively growing. Imazaquin may be tank-mixed with MSMA for control of yellow nutsedge. A nonionic surfactant should be added at 0.25% V/V.
Renovation of established turf	Tall fescue, quackgrass, bermudagrass, orchardgrass, nimblewill	glyphosate (Roundup 2.5 oz 4.0 lb/gal LC)	Allow 2 to 4 weeks without mowing before chemical treatment. See label for desirable plant size to treat. Allow 7 days before clipping the dead sod and vertical mowing to 1/4 inch deep into soil. Seed the desired turfgrass and irrigate as needed. Early fall applications coincide with seeding dates, but application can also be made at other times when undesirable grass is actively growing.
Established turf bluegrass, tall fescue, perennial ryegrass	Bermudagrass, quackgrass, orchardgrass, nimblewill	mesotrione (Tenacity 0.12 to 0.18 oz of 4SC)	Mix with triclopyr (Turflon Ester 0.5-0.75 oz of 4EC) for best results. Apply twice in spring after weeds are green and twice in early fall before frost. Repeat treatments at a 3-week interval. Do not apply triclopyr to bluegrass during mid summer. Mesotrione treatments may continue during midsummer at 3-week intervals if weeds persist. Rates may be lowered as the number of treatments is increased. Frequent applications at low rates control weeds far better than few applications at high rates.
		topramezone (Pylex 0.023 oz of 2.8SC)	Mix with triclopyr (Turflon Ester 0.5-0.75 oz of 4EC) for best results. Also, include 0.5% methylated seed oil adjuvant. Apply three times in fall at 3-week intervals not to exceed 4 fl oz Pylex per acre per year.

■ Moss Control

Moss gradually invades lawns in areas where the turfgrasses are growing poorly. The infested site may be described as wet, shady, highly acidic, and under low fertility. A program to control moss involves correcting the turfgrass growing conditions as much as possible. Remove as much moss as possible by raking, vertical mowing and aerifying to prepare a seed bed to reseed thin turfgrass areas. Select a species/cultivar adapted to the area conditions. Maintain optimum growing conditions for the turfgrass as fertility, pH, moisture (not excessive) and mowing height/frequency. The turfgrass density is very important to prevent further moss encroachment. Sometimes a shade tree may be removed to allow enough light for good turfgrass growth.

Chemical formulations for moss control usually contain iron, copper, or potassium salts of fatty acids as active ingrediants. Ferrous sulfates and chelated iron products applied as liquid sprays are generally rapid and effective on moss. Dry formulations of ferrous sulfate monohydrate are available such as Moss Control Granules for Lawns containing 5% iron (follow label directions). Carfentrazone (Quicksilver T&O) is an herbicide for broadleaf control that can be used in lawns or putting greens for moss control. Apply 6.7 ounces Quicksilver T&O per acre or 0.15 ounce per 1,000 square feet twice at 3-week intervals. Moss discoloration is a sign of successful treatment and takes longer under cool conditions. Moss control is temporary and treatment may be required annually. Managers should improve conditions for turfgrass growth while minimizing the favorable environment for the moss. Read and follow label directions carefully.

■ Broadleaf Weeds

The herbicide response table that follows compares the susceptibility of common lawn weeds to weed killers. Annual weeds live only one year and should be treated in the seedling stage. Winter annuals germinate in the fall and should be controlled at that time. Spring germinating annuals, likewise, need to be treated in the spring. Biennial plants live 2 years and perennials live for 3 years or more. In

general, broadleaf weeds respond best to weed killers when they are most actively growing and in the seedling stage. This is usually in the spring or fall. When equally effective, we prefer the fall application because of less likelihood of damage to ornamental and garden plants. Application of high rates of weed killer during hot dry conditions may brown desirable grasses. Effectiveness of postemergence broadleaf herbicides is better when rainfall or irrigation does not occur for 24 hours after application.

Most lawns that need treatment contain a variety of weeds which can best be controlled by a combination of ingredients. Many formulations are sold that contain more than one ingredient. It is necessary that label direction on the container be followed to get the proper application rate. When combinations are used, the results are additive and the individual rates are reduced, slightly. A combination of 2,4-D and dicamba (1.0 lb + 0.25 lb) or 2,4-D and mecoprop (1.0 lb + 1.0 lb) is very effective on a wide range of broadleaf weeds. We would consider this to be the best treatment for an average lawn with a variety of weeds. Knotweed, dock, and red sorrel are susceptible to dicamba. Dicamba is soil-mobile and should not be used in the root area of shallow-rooted trees or shrubs. The specific herbicide(s) should be selected according to the kinds of weeds present in the turf and the appropriate herbicides may be tank-mixed or purchased as a pre-mixed formulation.

Combinations of 2,4-D + mecoprop + dicamba and other three-way mixtures are on the market. Follow label directions on the containers for proper application rates and directions. The low rate of dicamba in these three-way mixtures reduces the possibility of dicamba injury.

Triclopyr may be purchased as a formulation mixture with 2,4-D (Turflon D, Chaser) or clopyralid (Confront) or may be used as a tank-mixture with these herbicides. Some formulation mixtures are suggested for use by professional personnel in charge of weed control applications. Read the label for rates to use for specific weeds and turfgrass tolerances. Triclopyr should not be used on bermudagrass unless some injury can be tolerated and then lower label rates are suggested.

Newly seeded turf areas should not be treated with broadleaf weed killers until enough growth has occurred to allow two mowings. The broadleaf weed killers recommended for lawns are not particularly toxic to humans, pets, birds, or wildlife. They would create a problem only if ingested in large quantities. They are biodegraded by soil micro-organisms and their persistence in the soil would range from 2 to 4 weeks for 2,4-D, and possibly 6 months for dicamba.

The chemicals noted can be used safely at recommended rates on bluegrass, fescue, or common bermudagrass. The bentgrasses are susceptible to injury from 2,4-D; however, there are formulations containing low rates of 2,4-D in combination with other materials that may be safely used. Avoid application on bentgrasses when temperatures exceed 85°F.

The availability of many formulations of the various broadleaf herbicides which vary in amount of active ingredient makes it difficult to establish a general rate to apply to 1000 sq ft or to add to 1 gal of water. Directions on the container label should be used as a guide to determine the proper amount of formulation to use. With a 4.0 lbs/gal formulation, 1.0 qt contains 1.0 lb of active ingredient and a rate given in lb/A is equal to qt/A. To convert to small areas, 1.0 qt/A = 1-1/2 tbsp/1000 sq ft.

Table 7.15 - Conversion for Small Area Application

	Formulation available					
Rate Desired	**1 lb/gal.**	**2 lb/gal.**	**4 lb/gal.**	**1 lb/gal.**	**2 lb/gal.**	**4 lb/gal.**
	Quarts/Acre[1]			**Tablespoons/1000 sp ft**		
1/3 lb/A	1-1/2	3/4	3/8	2-1/4	1-1/8	9/16
1/2 lb/A	2	1	1/2	3	1-1/2	3/4
1 lb/A	4	2	1[1]	6	3	1-1/2[1]
1-1/2 lb/A	6	3	1-1/2	9	4-1/2	2-1/4
2 lb/A	8	4	2	12	6	3

[1]One quart/A is equal to 1-1/2 tablespoons/1000 sq ft.
Two tablespoons are equal to 1.0 fluid ounce or 29.6 cc.

Table 7.16 - Preemergent Broadleaf Weed Control

Application	Weed Problem	Chemical	Remarks
Preemergent (Established turf)	Annual broadleaf weeds	DCPA (Dacthal 1/3 lb of 75% WP or 5.1 oz of 6FL or 5.0 lb of 5% gran)	DCPA will provide some preemergent control of prostrate and spotted spurge, common chickweed, carpetweed, purslane, and sandbur. Creeping speedwell may be controlled with high rates as a postemergence application in May or June.
		isoxaben (Gallery 3/8-1/2 oz of 75DF)	Apply uniformly in early spring prior to germination of target weeds such as: white clover, spotted spurge, yellow woodsorrel, or prostrate knotweed. Fall germinating weeds may require applications in late summer (common chickweed, henbit, dandelion, corn speedwell, shepherdspurse, broadleaf and buckhorn plantains). Is safe in and around various trees, shrubs, and groundcovers in May or June.

Table 7.17 - Broadleaf Weed Control in Bluegrass, Tall Fescue, Perennial Ryegrass, and Common Bermudagrass
The relative effectiveness of commonly used herbicides for selected weeds is listed in this table. See (1) for key.

Weeds which are intermediate in response should be given repeat treatment rather than increasing the rate of a single application. It may sometimes be desirable to treat at times other than those listed. When this is necessary, make sure that good growing conditions prevail and contact with desirable plants is prevented. Combination products may be more effective than individual chemicals on a particular weed. The herbicides listed may be purchased as a pre-mixed formulation or separately and tank-mixed as labels allow. **Use caution when applying triclopyr or clopyralid to bermudagrass-see label restrictions.**

Weed	Response to Herbicides (lb/A)1									Preferred Time to Treat
	Classification	2, 4-D 1.5-2.0	Dicamba 0.33-0.5	2,4-D + Mecoprop 1+1	2, 4-D + Mecoprop + Dicamba	2, 4-D + Dicamba 1.0+0.33	2, 4-D + Dichlorprop + Mecoprop	2, 4-D+ Triclopyr 1.0+0.5	Triclopyr + Clopyralid 0.56+0.19	
Bedstraw	A	I-R	S	I	I-R	S	—	—	—	April & May
Bindweed	P	S	S	S-I	S	S	S	S	—	May & June
Bittercress	WA or B	S	S	S	S	S	S	S	—	Oct & Nov
Blackmedic	A, B, & P	R	S	I	S	S	S	S	S	April & May
Buttercup	WA, B, & P	S-I	I	S	S	S	S	I	S	Oct & Nov
Buttonweed, Virginia	P	R	R	R	I-R	I	I	I	I	May & repeat
Carpetweed	SA	S	S	S	S	S	S	S	—	May & June
Catsear, Dandelion	P	S-I	S	S	S	S	S	S	S	Oct & Nov
Chickweed, Common	WA	R	S	S	S	S	S	S	S	Oct & Nov
Mouseear	P	I-R	S	S-I	S	S	S	S	S-I	Oct & Nov
Chicory	P	S	S	S	S	S	S	S	—	Oct & Nov
Cinquefoil, Common	A	S	S	S	S	S	S	S	—	May & June
Clover, Crimson	SA	S	S	S	S	S	S	S	S	May & June
Hop	SA	I	S	S	S	S	S	S	S	April & May
White	P	I	S	S	S	S	S	S	S	Oct & Nov
Daisy, Oxeye	P	I	I	I	I	I	I	I	—	Oct & Nov or May
Dandelion	P	S	S	S	S	S	S	S	S-I	Oct & Nov
Dock	P	I	S	I	I	S	I	I	I	Feb - April
Dogfennel	P	R	S	I-R	I-R	S	I	I	S-I	Oct & Nov or April
Garlic, Wild	P	I	I	I	I	S-I	I	—	—	Oct - Nov. & Feb - March
Geranium, Carolina	WA	S	S	S	S	S	S	S	—	April - May
Ground Ivy	P	I-R	S-I	I	I	S-I	I	S- I	S-I	April - May
Hawkweed	P	S-I	S-I	S-I	S-I	S	S-I	S-I	I	Aug & Sept
Healall	P	S	S-I	S-I	S-I	S	S	—	—	Oct & Nov
Henbit	WA	I	S	I	S-I	S	S	S	S	Oct & Nov
Honeysuckle	P	S-I	S	S-I	S	S	S	S	—	May & June
Horsenettle	P	I-R	I	I-R	I-R	I	I	I	—	May & June
Horseweed	WA, SA	I	S	S-I	S-I	S	—	—	S	Oct or May
Knapweed, Spotted	B	I	S	I	I	S	I	S	—	Oct & Nov
Knawel (German Moss)	WA	R	S	I	I	S	S	S-I	—	Oct & Nov
Knotweed	SA	R	S	I	I	S	I	—	—	March - April
Lambsquarters	SA	S	S	S	S	S	S	S	S	April & May
Lespedeza	SA	I-R	S	S-I	S	S	S	S	I	April & May
Mallow, Common	SA	I-R	S-I	I	I	S-I	S-I	—	S-I	April & May

Table 7.17 - Broadleaf Weed Control in Bluegrass, Tall Fescue, Perennial Ryegrass, and Common Bermudagrass (continued)
The relative effectiveness of commonly used herbicides for selected weeds is listed in this table. See (1) for key.

Weeds which are intermediate in response should be given repeat treatment rather than increasing the rate of a single application. It may sometimes be desirable to treat at times other than those listed. When this is necessary, make sure that good growing conditions prevail and contact with desirable plants is prevented. Combination products may be more effective than individual chemicals on a particular weed. The herbicides listed may be purchased as a pre-mixed formulation or separately and tank-mixed as labels allow. **Use caution when applying triclopyr or clopyralid to bermudagrass-see label restrictions.**

Weed	Response to Herbicides (lb/A)1									Preferred Time to Treat
	Classification	2, 4-D 1.5-2.0	Dicamba 0.33-0.5	2,4-D + Mecoprop 1+1	2, 4-D + Mecoprop + Dicamba	2, 4-D + Dicamba 1.0+0.33	2, 4-D + Dichlorprop + Mecoprop	2, 4-D+ Triclopyr 1.0+0.5	Triclopyr + Clopyralid 0.56+0.19	
Mugwort	P	I-R	S-I	I-R	I-R	S-I	I	—	—	March
Mustards	WA & B	S	S	I	S-I	S	S	—	—	Oct & Nov
Onion, Wild	P	I	I	I	I	S-I	I	—	—	Oct - Nov & Feb - March
Ornamental Plants	P	S-I	S	S-I	S-I	S	S	S	—	Most likely to injure April to June
Oxalis	A,P	I-R	R	I-R	I-R	I	S	I	I -R	April - May
Pennycress	A	S	S	S	S	S	—	—	—	Oct & Nov
Pepperweed	WA or B	S	S	S	S	S	S	—	S- I	Oct & Nov
Pigweed	SA	S	S	S	S	S	S	S	—	April & May
Plantains	P	S	I-R	S	S	S	S	S	S- I	Oct & Nov
Poison Ivy	P	I	S-I	I	I	S-I	I	S-I	I	June
Pony Foot	P	S	S-I	S-I	S-I	S	—	—	—	Oct & Nov
Poorjoe (Diodia)	A	S-I	—	S-I	S-I	S	—	—	—	May & June
Prostrate Spurge	SA	I	S	I	S-I	S	S-I	S-I	I	April - May
Purslane	SA	I	S	I	I	S	I	S-I	—	May & June
Red Sorrel Shepherds'	P	R	S	I	I	S	I	S-I	S-I	Oct & Nov
Purse	WA	S	S	S	S	S	S	S	S- I	Oct & Nov
Smartweed	SA	I-R	S	I-R	I	S	I	I	I	April & May
Sowthistle	WA	S	S	S	S	S	S	S	—	Oct & Nov
Speedwell, Corn	SA or WA	R	R	R	R	I-R	I	I	I	April
Spotted Spurge	SA	I-R	S-I	S-I	S-I	S-I	S-I	S-I	I	May & June
Star-of-bethlehem	P	R	I-R	R	R	I-R	R	—	—	April
Teasel (Common)	B	S	S	S	S	S	S	S	-	April & May
Thistle, Bull	B	S-I	S	S-I	S-I	S	S-I	S-I	—	Oct & Nov
Canada	P	I	I	I-R	I	I	I	I	S-I	Oct & Nov
Curl	B or P	S	S	S	S	S	S	S	—	April
Musk	B	S	S	S	S	S	S	S	I	April
Vegetables	A	S	S	S	S	S	S	S	S	Most likely to injure April to June
Violet	P	I-R	I	I-R	I-R	I	I	I	I	April
Wild Carrot	B	S	S	S	S	S	S	S	I	Oct & Nov
Wild Strawberry	P	R	S-I	R	I-R	S-I	I	I	—	Oct & Nov
Yarrow	P	I	S	I	I	S	I	I	—	Oct & Nov
Yellow Rocket	B or P	S-I	S-I	S-I	S-I	S	S	S	—	Oct & Nov
Yellow Woodsorrel	A	R	R	I-R	I	I	S	I	1-R	April & May

[1]S = weed susceptible; I = intermediate, good control at times with high rates, sometimes poor, may require more than one treatment; R = resistant weeds in most instances; A = annual; SA = summer annual; WA = winter annual; B = biennial; and P = perennial.

Table 7.18 - Golf Course Putting Greens (Bentgrass or Bermudagrass)		
Weed Problem	**Chemical Rate/1000 sq ft**	**Remarks**
Preemergent control of annual grasses	bensulide 7.0-9.4 oz (4.0 lb/gal formulation) or (6.0-8.0 lb of 3.6% gran) or (1.9-2.4 lb of 12.5% gran or 2.4-4.1 lb of 7% gran)	Apply uniformly in the late winter or early spring before crabgrass emergence. August or September application is used for annual bluegrass control. The higher rate is needed for annual bluegrass. For crabgrass, the lower rate is effective and may be repeated after 4 months for better continuous crabgrass control. Goosegrass control is generally poor with bensulide.
	bensulide + oxadiazon (Goosegrass/Crabgrass Control® 2.6 lb of a 5.25% + 1.31% gran)	For use on bermudagrass and bentgrass putting greens, apply with a properly calibrated drop spreader. Use only where goosegrass is heavy on the green during a prior year and the herbicidal side effects are tolerable. Irrigate the green immediately after application. Do not treat greens with less than desirable turf cover and root system.
Postemergent control of annual grasses	DSMA (Follow directions on container label).	Follow label directions. Discoloration of grass should be expected. Use only when mid-day temperatures are below 90°F. Goosegrass control will require 2 to 3 applications at 4- to 7-day intervals and is seldom 100% effective. Goosegrass will also require the higher rates. Other label formulations may be equally effective. Follow label directions for rates.
Postemergent control of broadleaf weeds	dicamba 1.0-2.0 tsp (4.0 lb/gal formulation)	Margin to tolerance is narrow. Excessive rates will kill grass. A teaspoon is 1/6 fluid ounce. Do not try to spot-treat on green or excessive rates will occur. Start spraying on apron and move across the green. Best to put on 1/2 rate in one direction and retreat with remaining 1/2 at right angles.
	mecoprop (MCPP) 1.5-2.0 oz of 2.0 lb/gal formulation	Seaside, Arlington, and Congressional bents may be injured.
	2,4-D + MCPP + dicamba 1.0 oz of Trex-San Bent OR 1.0 oz of Trimec Broadleaf Herbicide (Bent Formula)	A commercial mixture with a reduced rate of 2, 4-D which gives a good spectrum of weed control and increased margin of safety over dicamba alone. Do not over-apply. Slight yellowing may occur temporarily. Do not irrigate within 24 hours after application.
Postemergent control of moss	carfentrazone (QuickSilver 0.15 oz of 1.9EC)	Apply at 2-week intervals for at least 3 treatments. Moss will return unless suitable changes in greens management such as increased mowing heights, proper fertility, etc. are met.

■ Golf Course Fairways

Fairway weed control can be accomplished with the same weed killers listed in the first part of the turf section. The same rates and remarks will apply. See Growth Regulation section in this publication for suppression of annual bluegrass in fairway bluegrasses and perennial ryegrasses.

■ Golf Course Sand Traps

Weeds in sand traps present considerable problems in golf course management. EPTC (Eptam 5G) is used in sand traps. All weed growth must be removed before application. Eptam must be raked into the sand to a 2- to 3-inch depth immediately after application. It will not injure greens when blasted or tracked on the turf by players. Follow directions on the container label for correct rate and method of application.

■ Nonselective Control of Perennial Grasses

(Bermudagrass, Fescue, Nimblewill, Orchardgrass, Quackgrass)

Undesirable patches or clumps of perennial grasses can be treated with glyphosate (Roundup, Kleenup). Lightly wet the foliage of the undesirable grass in the spring or summer when it is actively growing. Follow label directions for rates of application and proper timing. Glyphosate has no soil residual and reseeding can occur as soon as the foliage has turned brown (7-10 days).

■ Weed Control in Driveways, Fence Lines, and Parking Areas

There are many good soil sterilants on the market that will give long-term control of weeds. These are discussed in the non-selective section of this guide. These materials are very powerful weed killers and not designed for homegrounds situations. Many trees and shrubs have been killed when application of soil sterilants was made within their root feeding areas. See glyphosate for nonselective weed control above.

Table 7.19 - Woody Plant Control Around Homes, Cabins, Buildings, Fence Lines, Trails, and Vacant Lots		
Problem and Application Technique	**Chemical and Application Rate**	**Remarks**
Foliage Spray		
Honeysuckle	2, 4-D amine 1.5 oz of 3.8 lb/ gal/1.0 gal water	Wet thoroughly all foliage and stems to runoff. Apply during active growth periods after full leaf stage in spring. Turfgrasses will survive some drippage.
Honeysuckle, blackberry, poison ivy, Virginia creeper, wild rose, willow, many other shrubs and trees.	triclopyr (Brush-B-Gon 5.7%, mix 4.0 oz with 1.0 gal water)	Same as above.
Blackberry, poison ivy, Virginia creeper, and other woody plants. Also bermudagrass, quackgrass, nimblewill, other grasses.	glyphosate (Roundup 41%, mix 1.0-6.0 oz with 1.0 gal water)	Several formulations are available. Use according to label directions (Kleenup, Roundup, Blot-out, and others).

Turf: Growth Regulators

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Growth regulators are utilized to reduce the amount of mowing and trimming needed for maintaining turfgrass. The suggested growth regulator, applied before seedhead formation, will also inhibit the development of seedheads of cool-season turfgrasses for one season. Bermudagrass seedheads are inhibited for about 4 weeks.

Growth regulators are suggested for use on areas such as highways and other rights-of-way, industrial parks, schools, cemeteries, airports, and golf course roughs. They are particularly useful along fence lines, sloping areas, guard rails, and other areas difficult to mow and trim. A few growth regulators are available for well-maintained and extensively managed turfgrasses. These growth regulators are used for turfgrass growth suppression and/or annual bluegrass suppression.

Spring growth regulator application should be delayed until turfgrass reaches a desirable density. In many cases where mowing can be utilized, the regulator may be best applied after the first time the grass is clipped. This clipping will achieve a more neatly trimmed appearance for a longer period. Caution: the turfgrass stand does not become more dense after treatment; therefore, the turfgrass may remain at the density you see at the time of treatment. If thatch is showing through when the regulator is applied, it may continue to show for 6 to 8 weeks. Generally, after the period of turfgrass growth suppression, the foliage may even take on a darker green appearance.

The turfgrass should have a good appearance and be actively growing at the time of treatment with growth regulator. Any debris or clippings should be removed. For seedhead control, apply at least 2 weeks prior to seedhead emergence. Apply when rain is not expected for 24 hours.

Table 7.20 - Use of Growth Regulators

Application	Turfgrass Shoot Regulation	Chemical Rate/1000 sq ft	Remarks
Established rough turf (Highway rights-of-way, airports, cemetaries, parks and other cool season rough turfgrasses)	Tall Fescue and Bluegrass	imazethapyr + imazapyr (Event at 0.18 to 0.22 oz) OR imazethapyr + imazapyr (Event at 0.09 oz)	The introductory comments above provide useful information on where and when to apply PGRs. They are best utilized on medium- to low-managed turf but where frequent mowing has been necessary. Not used on residential turf around homes and apartments. The PGRs are most useful during the spring to reduce growth for 6 to 8 weeks. This period usually accounts for 60% of the year's total growth of fescue.
Established rough turf (Warm season turfgrass)	Bermudagrass (Common)	flurprimidol (Cutless 50w rate varies with cultivar, see label)	Same as above. Time of application is usually later in spring after green-up and before peak period of vegetative growth.
Established well-maintained turf	Bluegrass and Perennial Ryegrass in fairways and well maintained turfgrass areas	flurprimidol (Cutless at 0.18 oz of 50 WP)	Apply in spring before major flush of growth but after greenup requiring mowing once or twice. This will also suppress annual bluegrass growth but allows seedhead development or flowering of the annual bluegrass.
Established well-maintained turf	Bluegrass and Perennial Ryegrass in fairways and well maintained turfgrass areas	trinexapac (Primo at 0.75 oz of 1 lb/gal)	Apply in spring after greenup requiring mowing but before major flush of turfgrass growth. Reduce rate by 50% or more if mowing height is less than 0.5 inches (see label). Sequential applications are suggested at monthly intervals. Apply after turfgrass has been mowed. Do not apply in hot, dry weather or when turfgrass is under stress. Application rate varies with turfgrass species. Read label for further specifics. Annual bluegrass will be suppressed to a much greater extent than perennial bluegrass. Overseed this area if needed. Trinexapac is also suggested for edging along sidewalks, curbs, driveways, flower beds, fences, and parking areas. Make application at monthly intervals during active growth periods. Follow label directions.
		paclobutrazol (Fertilizer with TGR poa annua control at 2.9 lb of 0.42% or TGR turf Enhancer at 0.33 oz of 50WP)	Apply in spring after greenup occurs and mowing is required. Annual bluegrass is suppressed. Do not apply where area contains as much as 70% annual bluegrass.