

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	Anthracoze	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	*	*	*			*			*	*	*			*					*	*
fluxastrobin		*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
flutolanil			*				*							*					*	*
fluxapyroxad	*		*			*			*		*						*		*	*
fosetyl-Al													*							
iprodione			*			*		*	*	*	*			*					*	*
isofetamid						*										*				
mancozeb	*		*	*		*		*		*				*	*	*				
mefenoxam													*							
mefentrifluconazole		*				*	*									*	*	*		
metconazole		*	*			*	*	*	*		*			*		*	*		*	*
myclobutanil	*	*	*	*		*		*	*	*	*	*		*	*	*	*	*	*	*
PCNB	*	*	*	*				*		*			*	*	*	*	*	*	*	*
penthiopyrad		*	*			*			*	*		*		*					*	*
phosphonates													*							
polyoxin-D zinc salt		*	*				*	*	*	*	*			*					*	*
propamocarb													*							
propiconazole		*	*		*			*		*	*	*		*	*	*	*	*	*	*
pydiflumetofen						*	*				*					*				
pyraclostrobin		*	*		*	*	*	*	*	*	*	*	*	*	*		*	*	*	*
tebuconazole		*	*	*		*		*	*	*	*	*		*	*	*	*	*	*	*
thiophanate-methyl		*	*	*	*	*		*	*	*				*		*	*	*	*	*
thiram			*	*		*				*	*			*	*				*	*
triadimefon			*	*		*					*	*		*	*		*	*	*	*
trifloxystrobin		*	*				*			*	*			*	*		*		*	*
triticonazole	*	*	*			*		*	*	*	*			*	*		*	*	*	*
vinclozolin			*			*				*	*			*					*	*

These recommendations 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, TL, Action), Headway*, Renown*, Briskway*, Posterity Forte*, Posterity XT*, QualiPro Strobe (2L, Pro, T, TM) and Endow
boscalid	Emerald , Honor*, Union*
chloroneb	Andersons Fungicide V, Fungicide IX*
chlorothalonil	Daconil (Action*, Ultrex, WeatherStik, ZN), QualiPro Chlorothalonil, Docket, Echo Chlorothalonil, Enclave*, Pegasus, Primera One Chlorothalonil, Pro Solutions Thaloniil, Concert*, Instrata*, Legend, Renown*, Reserve*, Spectro 90*, Disarm C*, Vitaloniil*, TM/C*
cyazofamid	Segway , Union*
difenoconazole	Briskway* , Ascernity*
etridiazole	Terrazole 35WP , Terrazole L
fenarimol	Rubigan
fluazinam	Secure, Secure Action*
fludioxonil	Medallion SC , Medallion WDG, Instrata*
fluopicolide + propamocarb	Stellar
fluoxastrobin	Fame SC , Fame + C and Fame + T*, Fame G, Disarm 480SC, Disarm C*, Disarm G, Disarm M*
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
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*
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 timing, pest thresholds, suggested detection and monitoring techniques, and cultural and biological control recommendations to aid turfgrass professionals to maximize control effectiveness. This is an excellent opportunity for turfgrass professionals to utilize the IPM approach and reduce any potential impact on the environment.

Many insecticides are currently under examination due to the Food Quality Protection Act (FQPA). Users of organophosphates and carbamate pesticides should keep up to date with ongoing label cancellations.

Caution: Be sure to consider drainage, slope, type of soil, weather, and general area use to avoid contamination of water sources. 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. 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 ataeenius. More details regarding Green June beetle and black turfgrass ataeenius grubs are given below. 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 exhibits behavior different than the other white grub species. Unlike the other species that crawl on their front side and use their 3 pairs of legs in the process, the green June beetle grub moves on its back with its three pairs of legs pointing up. Also, 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. As few as 3 to 5 grubs per square foot can cause significant damage to golf fairways and greens. Treatment should be applied in late August to avoid damage from mounding caused by grub tunneling. 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 Aetaenius

Black turfgrass ataeenius is the smallest white grub that attacks turfgrass in Virginia. The fully-grown grub reaches 0.31 inch (8 mm) in length. The size of the adult beetle varies from 1/8” to 1/4” (3.6-5.5 mm) in length. 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. A springtime pyrethroid application targeting the overwintering adults after they become active (typically the last week of April), but before peak egg laying has occurred, can provide effective control adults and the first generation of new grubs. 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. Insecticides targeting second generation adults are not recommended. Spring applications targeting the early instar grubs of the first generation should be timed to when the black locust begins to bloom (May). Insecticides targeting second generation grubs should 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 ataeenius 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.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
<i>Bacillus thuringiensis</i> var. <i>galleriae</i> (grubGone! G)	37-55 oz	100-150 lb	Check label for details
<i>Beauveria bassiana</i>		16.0-32.0 oz	Use 100 gal water/A. Check label for details.
carbaryl (Sevin SL)	2.0 gal.	0.5 to 1.0 gal	All grubs except Green June Beetle
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 Sept. for preventative and early curative control of all major white grub species infesting turfgrass. Use higher rate for late August or early Sept. 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.
chlorpyrifos (Dursban 50W)	1.46-2.93 oz	4.0-8.0 lb	RESTRICTED USE. Dursban 50W can only be used on sod farms and turfgrass grown for seed to control white grubs. For best results, treat from late July through early August to reach the newly hatched grubs that are actively feeding near the soil-thatch interface. Soil should be moist before treating. Water 0.5 to 1.0 inch immediately after treating to move AI into soil.
	0.73 oz	2.0 lb	Green June beetle grubs
clothianidin (Arena 0.25G)	1.84-3.67 lb	80.0-160.0 lb	Arena 0.25G: Residential and nonresidential sites (check labels for details). For best results, treat just prior to egg laying or to early instar grubs of target pests. Treatment should be followed by sufficient water to move AI into soil. Arena 50WDG: Use high rate for control of Asiatic garden beetle grub.
	(Arena 50WDG) 0.147-0.294 oz	6.4-12.8 oz	
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 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. Check labels for details.
	clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	0.27- 0.44 oz	
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	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 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.
entomopathogenic nematodes		100 million-1 billion	
imidacloprid (Merit 2F) (Merit 75WSP) (Merit 0.5G)	0.46–0.6 oz	1.25-1.6 pt	Merit 2F, 75WSP and 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. For best results, treat from early July to early August. Can also treat up to 45 days before the historical peak of adult flight to 2nd instar grub being targeted. Treatment should be followed by sufficient water to move AI into soil.
	1.6 oz (1 packet)/ 8,250-11,000 sq ft		
	1.4-1.8 lb	60.0-80.0 lb	

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.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	1.32-1.65 oz	3.6-4.5 pt	For best results for all products, water within 24 hours of treating to move AI through the thatch layer.
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Meridian 25WG: Residential and nonresidential sites (check label for details). For best results, treat from peak flight to peak egg hatch. Can also treat up to 45 days before historical peak of adult flight to 2nd instar grub being targeted. Treatment should be followed by sufficient water to move AI into soil.
trichlorfon (Dylox 6.2G) (Dylox 420SL)	3.0 lb 6.9 oz	130.0 lb 300.0 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. Treat from mid July to early August when grubs are young and actively feeding near soil surface. Treatment should be followed by sufficient water to move AI into soil. Dylox and 420SL: 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.

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 (check labels for details). For best results to control overwintering adults, treat from mid-April to early May (usually bracketed by when spring crocus and redbud are in bloom). To control first generation adults, treatments should be timed to coincide with the blooming stage of Rose of Sharon in July.
chlorpyrifos (Dursban 50W)	1.46 oz	4.0 lb	RESTRICTED USE . Dursban 50W can only be used on sod farms and turfgrass grown for seed for black turfgrass ataenius control. For best results, treat overwintering adult stage from mid-April to early May (usually bracketed by when spring crocus and redbud are in bloom). Repeat application may be needed within 1 to 2 weeks. Check label for details.
lambda-cyhalothrin (Scimitar GC)	7.0 ml (use 2-10 gal water)	10.0 oz	RESTRICTED USE . Residential and nonresidential sites. For best results, water lightly after treating (≤0.5 inch) to move AI into thatch layer. Check label for details.
spinosad (Conserve SC Turf and Ornamental AI/gal)	1.2 oz	52.0 oz	Residential and nonresidential sites. Check label for details.

■ 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 ABW adults and larvae feed. A brief overview follows on ABW life history and description of important life stages. Knowing the seasonal development and identity of important life stages is critical to making one or two well-timed applications early rather than six or eight from May through August to control overlapping populations of ABW life stages.

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, and depending on location, ABW is capable of completing three or four generations per year. In the fall, ABW adults fly from golf greens and fairways to overwinter.

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 (i.e., 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.

To avoid multiple insecticide applications, properly time the first application to when the adults begin to move from their overwintering sites onto golf greens to feed and lay eggs. Research has shown that the post-bloom stage of *Forsythia* species (referred to as the “1/2 green and 1/2 gold” stage) can be used on site as a phenological indicator for timing the adulticide application.

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.

Be on the alert from late March through April (season and location dependent) to identify if ABW adults are on your course. Probably the least expensive but still most effective approach for Virginia is to time one pyrethroid application at the 1/2 green and 1/2 gold stage. Experts caution that a second pyrethroid application three-four weeks later is often necessary for late arriving adults. In addition, neonicotinoids applied alone should not be relied on to control ABW adults. They need to be either followed up with or tank-mixed with a contact insecticide, such as a pyrethroid. Allectus and Aloft are recent introductions of products labeled for ABW that combine a neonicotinoid with a pyrethroid.

No matter what approach you take for combating ABW adults and larvae this year, it bears repeating that a well-timed adulticide early, and perhaps a second curative larvicide application two-three weeks later, will go a long way towards mitigating the need for additional insecticide applications, as well as furthering the delay in ABW resistance buildup to these products.

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 oz	12.0-20.0 oz	Acelepryn 1.67SC: Residential, commercial, recreational turf, including golf courses and sod farms. Has moderate systemic activity. Apply Acelepryn at the “adult timing” stage, i.e., the post-bloom stage when Forsythia is 1/2 green and 1/2 gold, to kill the early larval instars in the spring. Apply ≥0.5 inch water immediately after application. Refer to introductory text and label for more details
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 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, 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. Refer to introductory text and label for more details.
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. Refer to introductory text and label for more details.

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 Turf and Ornamental)	1.2 oz	52.0 oz	Conserve SC: Residential and nonresidential sites (check label for details). Refer to introductory text and label for more details.
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. Refer to introductory text and labels for more details.
clothianidin (24.70%) and bifenthrin (12.3%) (Aloft GC SC)	0.27-0.44 oz	11.65-19.0 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. Refer to introductory text and labels for more details.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	0.9-1.65 oz	2.3-4.5 pt	
trichlorfon (Dylox 420SL [larvae]) (Dylox 420SL [adults])	5.2-6.9 oz 6.9 oz	225.0-300.0 oz 300.0 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. Refer to introductory text and label for more details.
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). Refer to introductory text and label for more details.
lambda-cyhalothrin (Scimitar GC)	7.0 ml	10.0 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. Refer to introductory text and label for more details.

■ 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 Spray 97)	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 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.
<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> (Dipel 150D)	See label		Check label for details.
beta-cyfluthrin (Tempo Ultra GC)	4.0-8.0 ml	6.0-12.0 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.
carbaryl (Sevin SL)	4.5-6.0 oz	1.5-2.0 gal	Sevin SL: Residential and nonresidential sites (check labels for details). Do not water for 24 hours after treating.
chlorantraniliprole (Acelepryn 1.67SC)	0.046-0.092 oz	2.0-4.0 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.
chlorpyrifos (Dursban 50W)	0.75 oz	2.0 lb	Dursban 50W: RESTRICTED USE . Golf courses, road medians, and industrial plant sites. Dursban 50W: Can also be used on sod farms and turfgrass grown for seed. For best results for both products, turf should be moist at time of treatment; however, for sod webworm control, do not water or mow for 12 to 24 hours after treating.
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)	0.3-0.4 lb	80.0-160.0 lb	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. Check labels for details.
clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	0.3-0.4 lb	11.65-19.0 oz	
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 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.
entomopathogenic nematodes		100 million-1 billion	Check label for details.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G) (Allectus GC)	1.2-2.9 lb 1.2-2.9 lb	50.0-125.0 lb 50.0-125.0 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 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.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	0.67-1.65 oz	1.8-4.5 pt	
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)	3.4-7.0 ml (use 2-10 gal water)	5.0-10.0 oz	Scimitar GC: RESTRICTED USE. Residential and nonresidential sites (check label for details). Water lightly after treating (≤ 0.5 inch) to move AI into thatch layer.
spinosad (Conserve SC Turf and Ornamental)	0.25 oz	10.0 oz	Residential and nonresidential sites (check label for details). For best results, treat during the late afternoon or early evening, and do not water or mow for 12 to 24 hours after treating.
trichlorfon (Dylox 6.2G) (Dylox 420SL)	2.0 lb 4.6-6.9 oz	87.0 lb 200.0-300.0 oz	Dylox 6.2G, and 420SL: Residential, parks, and golf course sites. For best results to control sod webworm larvae with Dylox 6.2G, treat in spring (May) to kill first generation larvae. 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. Insecticide treatment is often effective, but because chinch bugs are highly mobile, the area may be quickly recolonized. Therefore, an application in April to May followed by 1 to 2 additional applications at 2- to 3-week intervals are recommended for the first generation. Early treatment may provide season-long control (June-September). To spray, mix the suggested amount of insecticide in 15 to 30 gallons of water per 1,000 square feet. Do not mow or water the turf for 2 to 3 days after treatment. If the entomopathogenic fungus *Beauveria 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.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
acephate (Orthene Turf, Tree, and Ornamental Spray 97)	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. Apply as needed for adult population knockdown at 10- to 14-day intervals. Water lightly (≤ 0.5 inch) after treating. Do not graze or provide livestock treated grass.
<i>Beauveria bassiana</i>	16.0-32.0 oz		Use 100 gal water/A. Check label for details.
beta-cyfluthrin (Tempo Ultra GC)	8.0 ml	12.0 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 (check labels for details). For all granular treatments, water ≤ 0.25 inch immediately after treating to release/activate AI from granule.
carbaryl (Sevin SL)	4.5-6.0 oz	1.5-2.0 gal	Sevin SL: Residential and nonresidential sites (check labels for details). For best results, water before treatment to move AI into thatch layer. Do not water for 24 hours after treatment.
chlorantraniliprole (Acelepryn 1.67SC)	0.184-0.46 oz	8.0-20.0 oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses, and sod farms. Has moderate systemic activity. For suppression of chinch bugs. Apply prior to egg hatch. Check label for details.
chlorpyrifos (Dursban 50W)	0.75 oz	2.0 lb	Dursban 50W : RESTRICTED USE . Golf courses, road medians, and industrial plant sites. Dursban 50W: Can also be used on sod farms and turfgrass grown for seed. Check labels for details.
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 (check labels for details). 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)	1.8-3.6 lb	80.0-160.0 lb	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. Check labels for details.
clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	0.27-0.44 oz	11.65-19.0 oz	
cyantraniliprole (Ference)	0.184 to 0.459 fl. oz	8-20 fl. oz	Apply before chinch bug eggs hatch
deltamethrin (Deltagard G)	2.0-3.0 lb	87.0-131.0 lb	Residential and nonresidential sites (check label for details). For best results, treat when insects first appear. Use higher rates for subsurface pests and/or for extended residual control.
imidacloprid Merit 2F	0.6 fl. oz.	1.6 pt	Apply before chinch bug eggs hatch
Merit 0.5 G	1.8 lb	80 lb	
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 and GC SC: RESTRICTED USE . Golf courses and sod farms only.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	0.9-1.65 oz	2.3-4.5 pt	
permethrin (Astro)	0.4 to 0.8 fl. oz.	17 to 35 fl. oz.	
lambda-cyhalothrin (Scimitar GC)	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.
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Residential and nonresidential sites (check label for details). For suppression of chinch bugs, treat when young nymphs are first observed.
trichlorfon (Dylox 420SL)	3.75 oz 6.9 oz	10.2 lb 300.0 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. Effective control can be obtained by a single early-season treatment for adults in early April. Visually monitor for active adults during this period to predict 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 in early June if there are 6 to 8 larvae per square foot. Billbug adults can be detected by mixing 3-4 tablespoons of dishwashing liquid in 2 gallons of water, and pouring this mixture evenly over 1 square yard of turf. 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.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
Grub/larval stage			
carbaryl (Sevin SL)	6.0 oz	2.0 gal	Sevin SL: Residential and nonresidential sites (check labels for details). For best results, treat when larvae are actively feeding near soil surface. Water soon after treatment.
chlorantraniliprole (Acelepryn 1.67SC)	0.184-0.46 oz	8.0-20.0 oz	Acelepryn 1.67SC: For residential, commercial, recreational turf, including golf courses, and sod farms. Has moderate systemic activity. Product should be applied when the overwintering stage adults are first observed. This usually occurs in late April or early May in regions with cool-season turf. Best control of the larval stage can be achieved by targeting the overwintering adult stage as it becomes active in the spring but before egg laying has occurred. An application at this time will also aid in control of white grubs. Check label for details.
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 (check labels for details). 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 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. Check labels for details. A spring application will control billbug larvae. Check labels for details.
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. For best results, treat from early July to early August. Also treat up to 45 days before the historical peak of adult flight to the 2nd larval instar being targeted. 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.
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Residential and nonresidential sites (check label for details). For best results, treat from peak flight to peak egg hatch. Can also treat up to 45 days before historical peak of adult flight to 2nd larval instar being targeted.
Adult stage			
beta-cyfluthrin (Tempo Ultra GC)	8.0 ml	12.0 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, treat when billbug adults first appear in the spring. This application will also aid in control of overwintering chinch bug adults.
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 (check labels for details). For best results using Talstar products, treat when adult billbugs are first observed in April and May. Degree-day models have been developed to optimize application timing. This application will also aid in control of overwintering chinch bug adults.
chlorpyrifos (Dursban 50W)	0.75-1.46 oz	2.0-4.0 lb	Dursban 50W: RESTRICTED USE . Dursban 50W: Can only be used on sod farms and turfgrass grown for seed for billbug control. Treat early in the season just prior to or coinciding with first appearance of adults (check label for details).
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. A spring application will control billbug larvae. Apply when overwintering adult billbugs are first observed, usually in April and May. Check labels for details.
deltamethrin (Deltagard G)	2.0-3.0 lb	87.0-131.0 lb	Residential and nonresidential sites (check label for details). For best results, treat when insects first appear.
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 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)	7.0 ml (use 2-10 gal water)	10.0 oz	RESTRICTED USE . Residential and nonresidential sites. For best results, water lightly after treating (<0.5 inch) to move AI into thatch layer. Check label for details.

■ Fall Armyworm, Cutworms, and Armyworms

Monitoring and treatment strategies are similar for fall armyworm, cutworms, and armyworms. A detergent drench flushing technique 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.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
acephate (Orthene Turf, Tree, and Ornamental Spray 97)	0.4-0.9 oz (use minimum 5 gal water)	1.0-2.5 lb	Golf courses and sod farms only. For best results, treat when insects appear. Repeat application at 2-week intervals may be necessary. Do not graze or provide livestock treated grass.
azadirachtin (Azatrol EC)	≤1.3 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 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)	4.0-8.0 ml	6.0-12.0 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.
carbaryl (Sevin SL)	1.5-3.0 oz	0.5-1.0 gal	For best results, apply granules to dry turf. Water lightly after treatment to release AI from granule. Sevin SL: Residential and nonresidential sites (check labels for details). Do not water for 24 hours after treating.
chlorantraniliprole (Acelepryn 1.67SC)	0.046-0.092 oz	2.0-4.0 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.
chlorpyrifos (Dursban 50W)	0.75 oz	2.0 lb	Dursban 50W: RESTRICTED USE. Golf courses, road medians, and industrial plant sites. Dursban 50W: Can also be used on sod farms and turfgrass grown for seed. For best results for both products, turf should be moist at time of treatment.

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 (check label for details). Use minimum of 130 lb/A. Apply enough water to move AI to where target insects are active.
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 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. Check labels for details.
clothianidin (24.70%) and bifenthrin (12.30%) (Aloft GC SC)	0.27-0.44 oz	11.65-19.0 oz	
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		100 million-1 billion	Check label for details.
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G)	1.2-2.9 lb	50.0-125.0 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 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.
(Allectus GC)	1.2-2.9 lb	50.0-125.0 lb	
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	0.67-1.65 oz	1.8-4.5 pt	
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)	3.4-7.0 ml (use 2-5 gal water)	5.0-10.0 oz	Scimitar GC: RESTRICTED USE . Residential and nonresidential sites (check label for details). For best results, do not water or mow for 12 to 24 hours after treating.
spinosad (Conserve SC Turf and Ornamental)	0.25-1.2 oz	10.0-52.0 oz	Residential and nonresidential sites (check label for details). 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.
trichlorfon (Dylox 420SL)	4.6-6.9 oz	200.0-300.0 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.

■ Clover Mite

Clover mites are more of a nuisance than a pest; however, they may build up populations near building foundations that can cause silvering of nearby turfgrass. The clover mite, as its name suggests, does not feed primarily on grasses. Their nuisance status occurs when they invade

buildings. When crushed, they leave a red stain that can be difficult to remove. Populations high enough to warrant treatment usually occur in late winter or early spring and, occasionally, in the fall.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
azadirachtin (Azatrol EC ¹)	≤1.3 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 to azadirachtin are the early larval and nymphal 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.
chlorpyrifos (Dursban 50W)	0.75 oz	2.0 lb	Dursban 50W: RESTRICTED USE . Golf courses, road medians, and industrial-plant sites. Dursban 50W: Can also be used on sod farms and sod grown for seed. For best results for both products, turf should be moist at time of treatment.
deltamethrin (Deltagard G)	2-3 lb	87.0-131.0 lb	Check label for details.
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC ²)	0.9-1.65 oz	2.3-4.5 pt	Allectus GC SC: RESTRICTED USE . Golf courses and sod farms only.
lambda-cyhalothrin (Scimitar GC [9.7%=0.88 lb AI/gal])	3.4-7.0 ml (use 2-5 gal water)	5.0-10.0 oz	Scimitar GC: RESTRICTED USE . Residential and nonresidential sites (check label for details). For best results, do not water or mow for 12 to 24 hours after treating.

¹Check labels when treating for Bermudagrass mite.
²Check labels when treating for eriophyid mites.

■ Frit Fly

The frit fly is occasionally a pest on golf-course greens, collars, and tees. There are no action thresholds worked out for this pest. Damage can be recognized as yellowing of the central parts of the plant while the rest of the plant looks healthy. Cool-season grasses such as bluegrass or

bentgrass are most susceptible to injury. Typically, bluegrass and/or bentgrass greens and tees, which are heavily irrigated, fertilized, and frequently mowed, produce many new shoots that are highly attractive egg-laying sites to the female frit fly.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
imidacloprid (0.2%) and bifenthrin (0.16%) (Allectus G)	1.7-2.9 lb	75.0-125.0 lb	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 within 24 hours after treating to move AI through the thatch (check labels for details).
(Allectus GC)	1.7-2.9 lb	75.0-125.0 lb	
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	1.32-1.65 oz	3.6-4.5 pt	

■ 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.

Insecticide	Amount product per 1,000 sq ft	Amount product per acre	Remarks
acephate (Orthene Turf, Tree, and Ornamental Spray 97)	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 [11.8%=1.0 lb AI/gal])	8.0 ml	12.0 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 before treating to drive the adults and nymphs to the surface, especially if soil is dry (check label for details).
bifenthrin (Talstar EZ [granule]) (Talstar GC [granule]) (Talstar PL [granule])	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 (check labels for details). 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 (check labels for details).
chlorpyrifos (Dursban 50W)	1.47-2.2 oz	4.0-6.0 lb (use ≥50 gal water)	RESTRICTED USE. For mole cricket control, Dursban 50W can only be used on sod farms and sod grown for seed. For best results, treat when young nymphs are active. Water soil before treating, especially if soil is dry, to bring insects to surface. Treat in late afternoon or early evening.
clothianidin (Arena 0.25G) (Arena 50WDG)	0.4 lb 0.294 oz	160.0 lb 12.8 oz	Arena 0.25G and 50WDP: Residential and nonresidential sites (check label for details). 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. Application should be made during peak adult flight and egg laying. Check labels 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 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 7.12 - 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)	2.9 lb 2.9 lb (for Allectus G and GC, a single annual application may be made using 4.6-5.7 lb)	125.0 lb 125.0 lb (for Allectus G and GC, a single annual application may be made using 200.0-250.0 lb)	Allectus G: Residential and nonresidential sites, but not for use on golf courses or sod farms (check labels for details). Allectus GC SC: RESTRICTED USE . Golf courses and sod farms only (check labels for details). 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 (check labels for details).
imidacloprid (5%) and bifenthrin (2%) (Allectus GC SC)	1.32-1.65 oz (for Allectus GC SC, a single annual application may be made using 2.64-3.3 oz)	3.6-4.5 pt (for Allectus GC SC, a single annual application may be made using 7.2-9.0 pt)	
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 (check label for details). For best results, apply bait in spring to control adults before they lay eggs, and in late summer and fall to control large nymphs and newly emerged adults. Water soil before treating to bring mole crickets to surface, and treat infested areas in late afternoon. If necessary, treat again in 7 days. Rainfall or irrigation within 2-3 days after treating may reduce bait effectiveness.
lambda-cyhalothrin (Scimitar GC)	7.0 ml (nymphs and young adults) (use 4-10 gal water) 14.0 ml (adults) (use 4-10 gal water)	10.0 oz (nymphs and young adults) 20.0 oz (adults)	RESTRICTED USE . Residential and nonresidential sites (check label for details). 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 (check label for details).
thiamethoxam (Meridian 25WG)	1.5-1.95 oz/5,000 sq ft	12.7-17.0 oz	Residential and nonresidential sites (check label for details). For suppression of mole crickets (check label for details).
trichlorfon (Dylox 6.2G) (Dylox 420SL)	3.0 lb 6.9 oz	130.0 lb 300.0 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 (check labels for details). 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

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■ 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.

Herbicide	Crabgrass	Goosegrass	Annual Bluegrass	Foxtail	Sandbur	Annual treatments ²
Preemergent						
Benfenin	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
Benfenin + Oryzalin	S	S-I	S-I	S	S-I	1
Benfenin + 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

¹The 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.
²Lower label rates may require additional applications.
³Not for use in residential or athletic turf.
⁴For use on warm-season grasses only.

Table 7.14 - 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 7.14 - 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 7.15 - 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 7.15 - 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 environmental 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 ingredients. 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 tbs/1000 sq ft.

Rate Desired	Formulation available					
	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

¹One 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.

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, shepherdspurge, broadleaf and buckhorn plantains). Is safe in and around various trees, shrubs, and groundcovers in May or June.

Table 7.18 - 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 7.18 - 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	I-R	April & May

¹S = 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 7.19 - 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 (MCP) 1.5-2.0 oz of 2.0 lb/gal formulation	Seaside, Arlington, and Congressional bents may be injured.
	2,4-D + MCP + 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 7.20 - 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.

Application	Turfgrass Shoot Regulation	Chemical Rate/1000 sq ft	Remarks
Established rough turf (Highway rights-of-way, airports, cemeteries, 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.

Table 7.21 - Use of Growth Regulators (cont.)			
Application	Turfgrass Shoot Regulation	Chemical Rate/1000 sq ft	Remarks
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.

Pests of Forestry and Christmas Trees: Forest Insects

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Every tree species serves as host to numerous insects that feed on roots, stems, branches, leaves, and fruits. Most of these insect species are of limited consequence. Some species occasionally reach outbreak population levels that can cause damage and impact tree and forest health. There are also well known species that are considered primary pests and frequently cause significant impact on tree and forest health. Non-native invasive insects have also become part of Virginia's forests, and in some cases these pests are the worst, since there is often little host-tree resistance or natural enemies to help keep their populations in check. Pest populations tend to be cyclic, especially for native pests. A critical part of pest management is to survey and identify when pest populations are on the rise in an area. Knowing this helps with planning and decision-making.

For native pests, sound forest management practices can be used to limit site conditions responsible for allowing the pest populations to build up. Such practices are a basis for effective integrated pest

management. Proper site selection, stand density, stand and tree vigor, and proper sanitation are among the most important. Under poor management and inadequate protection practices, salvage operations may be the only recourse. Pesticide applications may be utilized for prevention of potential insect population buildup and suppression of outbreaks that threaten the vigor as well as survival of trees. However, use of pesticides is not recommended without knowledge of pest status. Use pesticides only if pests are present or are predicted to be present from a standard or systematic sample survey. They should be used in settings where compatible with management and of limited risk to the environment.

Technical assistance is available from the Virginia Department of Forestry and the U.S. Forest Service - Forest Health Protection, as well as the Virginia Cooperative Extension Service. State and federal forestry agencies may provide control services on a cost-sharing basis as well as survey and detection programs in cooperation with public and private forest land owners. Control programs for new, introduced, or as yet not established pests such as the gypsy moth are conducted by the Bureau of Plant Protection and Pesticide Regulation of the Virginia Department of Agriculture and Consumer Services with the Cooperation of the Animal and Plant Health Inspection Service, the USDA, the US Forest Service, the Virginia Department of Forestry, and Virginia Cooperative Extension.

Table 8.1 - Insects and Insecticides		
Special Note: Some of the following chemicals may be restricted to conifers only or tree nurseries only; read the label and use only as directed.		
Insect Host	Recommended Control	Remarks
Adelgids Balsam woolly adelgid	Carbaryl Chlorpyrifos Dormant oil Esfenvalerate Imidacloprid Permethrin	Scout regularly for adelgid or trees losing apical dominance; remove infested trees if practical. Spray bark and foliage to runoff in June or when found May-October. If infested plants are few and scattered, rogue and burn, and spray trees in a 20 foot diameter circle around rogued trees. When removing infested trees, wrap trees in tarp so no adelgids fall off as the tree is removed. For additional information on this pest, refer to: http://bit.ly/1Rx5aMS
Adelgids Hemlock woolly adelgid (eastern and Carolina hemlock)	Dormant oil Imidacloprid Dinotefuran (Safari)	For soil applications of the systemic, amount applied is based on diameter of trunk at breast height. Dinotefuran and imidacloprid soil applications, trunk injections, or basal spray should be applied in spring (March – April) or late fall (Oct. – Nov.). Do not use on trees with less than 50% foliage. For dormant oil use 1% rate during the spring months and 2% during the fall or winter. For foliar applications, spray foliage and twigs to run off in early spring. For additional information on this pest, refer to: http://bit.ly/1kHQosy
Aphids (various hardwoods)	Carbaryl Esfenvalerate Imidacloprid Malathion Permethrin	Thorough coverage of foliage for leaf-feeding aphids or twigs and branches for bark-feeding aphids. Treat when aphids are first seen. May occur throughout the season. For additional information on this pest, refer to: http://bit.ly/1Xtt6EA
Aphids (various conifers)	Carbaryl Esfenvalerate Imidacloprid Malathion Permethrin	Aphids rarely harm forest trees; heavily infested seedlings can be sprayed. Thorough coverage of new shoots, twigs and branches. Treat when first seen. May occur throughout season.
Bark Beetles Ips engraver beetles Southern pine beetle Turpentine beetle (pines) Walnut Twig Beetle	Bifenthrin Permethrin Imidacloprid	Bark beetle impact can be prevented or reduced by growing trees at lower densities, thinning during rotation, and in general keeping the basal area at about 80 square feet. In forest stands, salvage timber with a buffer strip of uninfested trees at the active head(s) of the infestation as soon as possible. This is called "cut and remove." Turpentine beetle infestations can be treated without felling by spraying the lower boles of infested and adjacent uninfested trees. In these situations, repeated sprayings may be necessary due to short residual time on the bark. Walnut Twig Beetle: If the tree is already infested, limited control with bark sprays of permethrin can be obtained. If wishing to protect an uninfested tree, soil drenches of imidacloprid can be used but walnuts cannot be harvested, the following year walnuts are OK to eat. For additional information on this pest, refer to: http://bit.ly/1PPPCVY

Table 8.1 - Insects and Insecticides (continued)		
Special Note: Some of the following chemicals may be restricted to conifers only or tree nurseries only; read the label and use only as directed.		
Insect Host	Recommended Control	Remarks
Borers	Permethrin	This chemical is registered for preconstruction lumber and logs against wood destroying insects. For wood borers in standing trees, heavily infested trees should be salvaged for fuel wood or felled and bucked to encourage predation of borer larvae by ants; if left standing, such trees serve as breeding grounds for borers that will infest and degrade additional trees. Spraying is impractical. Do not move infested wood out of area. For additional information on this pest, refer to: http://bit.ly/1NvZUYV
Fall Cankerworms (many hardwoods)	<i>Bacillus thuringiensis</i> (BT) Carbaryl Diflubenzuron Tebufenozide	Apply treatment when egg hatch is complete and larvae are young, usually in early to mid- May. For all but Bt, do not allow spray or run off to get into bodies of water or streams. See label for aerial application dosage rates. Sticky banding of the trunk in the fall for fall cankerworm can be used to prevent wingless females from climbing the trees and mating with males. They also can be used to monitor activity.
Defoliators Caterpillars, beetles, etc.	<i>Bacillus thuringiensis</i> (BT) Carbaryl Diflubenzuron Tebufenozide	There are many other insects that occasionally defoliate Virginia forests. The impact of defoliation depends primarily on host condition, time of year, and degree of foliage loss. Tree growth and vigor are reduced most by heavy defoliation early in the year. Trees that are in good health at the time of defoliation will survive. Trees already under stress at that time of defoliation will lose vigor and sometimes die from the effects of secondary agents and adverse environmental conditions.
Emerald Ash Borer (Ash)	Systemic insecticides Azadirachtin Dinotefuran Emamectin benzoate Imidacloprid Contact insecticides Bifenthrin Carbaryl Cyfluthrin Permethrin	After cutting trees, do not move wood out of area. Destroy, chip, or leave wood on site. For additional information on this pest, refer to: http://bit.ly/1Mmvvza
Fall Webworm (many hardwoods)	<i>Bacillus thuringiensis</i> (BT) Carbaryl Diflubenzuron Tebufenozide	Rarely has significant impact on forest trees; high density populations rarely persist for more than two seasons. Stressed trees can be protected against defoliation impact by spraying the first webworm generation in mid- to late June. Treat first generation in mid- to late June and, if necessary, the second generation in mid- to late August. For additional information on this pest, refer to: http://bit.ly/1p6aa1C
Gypsy Moth (many hardwoods)	<i>Bacillus thuringiensis</i> (BT) Carbaryl Diflubenzuron Tebufenozide	Treat in the spring when most larvae are in second instars and most oak leaves are at least half expanded. Most treatments are coordinated through local- state-federal cooperative suppression programs. This may no longer be necessary since gypsy moth is now established throughout Virginia. For additional information on this pest, refer to: https://www.vdacs.virginia.gov/plant-industry-services-gypsy-moth.shtml#:~:text=The%20gypsy%20moth%20is%20a,the%20United%20States%20in%201869.&text=The%20Office%20of%20Plant%20Industry,the%20Spread%2C%20Quarantine%20and%20Regulatory%20 .
Mites Spruce spider mite (conifers, especially spruces, hemlock, Fraser fir in nurseries, and plantations. Seldom on pine)	Avid Clofentazine Dormant oil Etoxazole Floramite Spiromesifen	Treat in early spring and fall (usually late April and mid- September) when mites are most active; use oil as a dormant spray (makes foliage oily) For additional information on this pest, refer to: http://bit.ly/1PPQ7iS and http://bit.ly/1k4Wr9Z
Mites Eriophyid mite (Needle Sheath Mite)	Carbaryl Chlorpyrifos Dimethoate Dormant oil	Treat as soon as detected (early spring); oils may alter foliage appearance.

Table 8.1 - Insects and Insecticides (continued)		
Special Note: Some of the following chemicals may be restricted to conifers only or tree nurseries only; read the label and use only as directed.		
Insect Host	Recommended Control	Remarks
Pine Tip Moth Nantucket pine tip moth (2 and 3 needle pines only)	Carbaryl Confirm Diflubenzuron Esfenvalerate Imidacloprid Imidan Permethrin Tebufenozide	Thoroughly wet all shoots and needles in the spring and repeat 1 to 2 times later in the summer. Pheromone traps are used to time male flight activity. A general rule is to treat 10 days after catching males in traps so that susceptible early instar larvae are at their first peak. The distinct 1st generation that this rule depends on break down with each succeeding generation, of which there are three in Virginia.
Pine Webworm (white, Scots, red pine)	<i>Bacillus thuringiensis (BT)</i>	Rarely contributes to seedling mortality. Spray only when webworm population density is high and seedling stocking marginal. Treat as soon as detected.
Sawflies Virginia pine sawfly, introduced pine sawfly, red-headed pine sawfly	Carbaryl Esfenvalerate Imidacloprid	Treat Virginia pine sawfly in April; introduced pine sawfly on white pine in June and September; red-headed pine sawfly, June to September. Since pine sawflies tend to avoid current season's foliage, defoliation is rarely total and trees can survive repeated infestations. See label for aerial application directions. For additional information on this pest, refer to: http://bit.ly/1MmwGi2
Scale Insects Pine needle scale, pine tortoise or scale, elongate hemlock scale, etc.	Carbaryl Dormant oil Malathion Permethrin	Treat for pine needle scale mid- to late May and mid- to late July; pine tortoise scale mid- June and July. For all other scale insects treat at crawler date. Scale insects rarely reach high densities or have serious impact on hardwood forests; spread of invading beech scale and associated beech bark disease can be slowed through salvage of infested trees. Spraying is not practical in the forest setting. For additional information on this pest, refer to: http://bit.ly/1XtvMIV
Spotted Lanternfly	Dinotefuran	Apply as a soil drench. May not be economical or feasible for large forest tracts. Loggers shipping trees out of the Quarantine zone are required to get a Spotted Lanternfly Permit, see: https://www.vdacs.virginia.gov/plant-industry-services.shtml and see: HYPERLINK "http://ext.vt.edu/spotted-lanternfly"
Tent Caterpillars Forest tent caterpillar (many hardwoods)	<i>Bacillus thuringiensis (BT)</i> Carbaryl Diflubenzuron Malathion Tebufenozide	Treat for forest tent caterpillar in early spring when first leaves are fully expanded. Forest tent caterpillars occasionally cause extensive hardwood forest defoliation. They do not make the web tents in the crotch of the tree branches.
Eastern tent caterpillar (wild cherry)		Eastern tent caterpillar can fully defoliate trees in early spring but only have minor impact and should not be treated in the forest setting. For additional information on this pest, refer to: http://bit.ly/1AdP9Gq
Weevils Pine reproduction weevils, Pales weevil, Eastern Pitching weevil. (conifers: feed on first year stumps and the base of recently dead trees as larvae. The adults may feed on live twigs.)	Esfenvalerate Imidan Permethrin	In forest plantations, wait one year to replant with seedlings if harvesting took place after June 1. Seedlings are currently treated in nursery beds prior to lifting under SLN registration; foresters and landowners can order seedlings that are already treated. In Christmas tree plantations, stump removal or stump treatment with insecticide (as described below) is recommended. Thoroughly soak stumps and ground surface 1 to 2 ft around stumps or slash prior to mid- March. Apply Imidan as 4% top dip for seedlings prior to planting. Follow label directions. For seedlings: Apply as a full coverage spray to seedlings immediately after planting. For stumps: Thoroughly soak stumps and ground surface around stumps or slash prior to mid- March. Only stumps or wood cut since previous summer need treatment. Dilute Asana in kerosene. For additional information on this pest, refer to: http://bit.ly/207eddq
White Pine Weevil (eastern white pine, Scots pine, and Norway spruce: feed in the tops of trees only.)	Permethrin	Treat when plantations show 5% or more weeviled tips. Applications must be made prior to adult egg laying, usually April 1. Treat only 1.5 to 2 ft of the main terminal shoot, not the entire tree or laterals. A full 4 gal knapsack sprayer will treat approximately 200 terminal shoots. For additional information on this pest, refer to: http://bit.ly/1XtwDD1
Precautions: Do not allow any insecticides as sprays, drift, or runoff to contaminate bodies of water, streams, or drainage systems. Carbaryl is highly toxic to honeybees. Follow precautionary instructions on labels and use protective equipment wherever specified.		
Equivalents: 1 lb WP/100 gal = 1 Tablespoon/gal; 1 pt EC/100 gal = 1 teaspoon/gal		

