

Crop Profile for Turfgrass in Virginia

Prepared: October 2006



General Production Information

- The most common turfgrasses used in Virginia are tall fescue, Kentucky bluegrass, perennial ryegrass, bermudagrass, fine fescue, St. Augustinegrass, and zoysiagrass.
- Grasses with niche uses are creeping bentgrass (golf course putting greens and tees, and some fairways) and centipedegrass in low-maintenance lawns in the Tidewater area.
- There were 1,699,100 acres of turfgrass maintained in Virginia in 2004. Maintenance expenses (including labor, contract services, equipment, supplies, new turf establishment, and crop protectants) totaled \$2.6 billion.
- The turfgrass industry generates over 424,000 jobs per year with an annual payroll that exceeds \$1.62 billion.
- The ten main turfgrass sectors are home lawns (1,048,000 acres), highway roadsides (298,000 acres), general areas such as business lawns (186,600 acres), schools (49,800 acres), parks (42,100 acres), golf courses (36,900 acres), churches (18,900 acres), airports (8,600 acres), cemeteries (5,600), and sod farms (4,600 acres).

Cultural Practices^{2, 3}

An urgent need has developed for pest- and disease-management strategies that do not rely exclusively on chemical controls for several reasons: 1) chemicals are extremely expensive to develop, 2) many reliable pesticides are being phased out due to exposure limits and environmental issues as a result of stricter regulations governing the application of these products, and 3) pests and diseases are developing chemical resistance. Cultural practices can be altered to keep turfgrass healthy and free of pests or diseases depending on the type or variety and the intended use. Turfgrass is grown and maintained in four basic areas of the community: home or commercial lawns, sports fields, sod farms, and golf courses. Specific cultural practices will differ depending on where the turfgrass is grown and for what purpose. For the sake of brevity, general turfgrass cultural practices are detailed below.

One of the most important factors to consider when planting turfgrass is site selection. Choosing turf that is well adapted to its environment is the first line of defense against pests and diseases. Turfgrass sites should have rich, loose soil that drains well. Adequate airflow is necessary to keep foliage dry and discourage fungal growth. Undergrowth and nearby shrubs can be removed and relocated to facilitate air movement. Be sure to analyze the soil before planting turfgrass, make pH adjustments, and replenish any depleted nutrients using an appropriate fertilizer. When choosing turfgrass types or varieties, use a turf that is well suited for the area, activity, and intensity of management.

The best turfgrasses to plant in the northern Piedmont and Blue Ridge Mountain areas are cool-season grasses, particularly Kentucky bluegrass, tall fescue, fine-leaf fescue, and perennial ryegrass. Kentucky bluegrass should be planted in mostly sunny conditions. It is an aggressive creeping grass that spreads by belowground stems called rhizomes. Kentucky bluegrass is typically considered to be a higher maintenance turf than most other cool-season species, responding to an aggressive nitrogen fertility program and irrigation. Under an intensive management program, Kentucky bluegrass will produce thatch that needs to be managed every three to four years. Tall fescue is a bunch-type grass that tolerates a wide range of soil and moisture conditions. It has the deepest root system of the cool-season turfgrasses, and there are many superior cultivars commonly called turf-type tall fescues to choose from. Nitrogen and irrigation management programs are usually less for tall fescue lawns as compared to Kentucky bluegrass. Fine-leaf fescues are the best shade-adapted cool-season turfgrasses. They are sometimes seeded with Kentucky bluegrass in sun/shade mixtures to take advantage of the shade tolerance of this species. Fine fescues are excellent low-maintenance grasses that do very well under limited nitrogen fertility and irrigation programs. Perennial ryegrass is noted for its extremely rapid establishment rate from seed. It is most often used in combination with Kentucky bluegrass and/or fine fescue in sun/shade mixtures in order to maximize its rapid establishment characteristics. This is an excellent low-maintenance grass that prefers arid, slightly acidic soils. Due to its tolerance for extremely low cutting height, creeping bentgrass is well adapted to golf turf in this area. However, it has little application for any other use. Two recent arrivals in the cool-season world that warrant attention are a new hybrid bluegrass (a cross between Kentucky and Texas bluegrass) and rhizomatous tall fescues. Both species look promising as possible additions to grass recommendations for Virginia.

For the southern Piedmont and Tidewater regions, warm-season grasses are best adapted, though tall fescue still receives a lot of use because of its deep-rooting nature. One of the major reasons to choose warm-season grasses is the winter dormancy period (i.e., loss of green color and active growth) that occurs for these grasses from the time of the first killing frost in October/November until May. Of this group, the one receiving the most widespread use is bermudagrass, an aggressive spreading (both rhizomes and stolons, or aboveground stems), full-sun turf that demonstrates excellent drought tolerance and resistance to pest pressure. Recent improvements in cold tolerance have furthered bermudagrass use in Virginia. Zoysiagrass can be used in light shade and has outstanding cold tolerance. Although it too has both above- and below-ground stems, it possesses a very slow spreading habit that is either desirable or undesirable depending on one's needs. On the coast, there are several acres of St. Augustinegrass in lawns, primarily because of its excellent shade tolerance as compared to other warm-season turfgrasses. St. Augustinegrass is an aggressive creeper (stolons) that lacks winter hardiness. There also is quite a bit of centipedegrass in the region. This slow creeper (again, a stoloniferous grass) is noted for its excellent quality under low-maintenance conditions.

A list of recommended turfgrass varieties can always be found at the Virginia Tech Turf website under the Extension link (<http://www.turf.cses.vt.edu/>). This list is updated annually and details the best-performing cultivars in our research trials.

For best results, cool-season grasses (bentgrass, bluegrass, ryegrass, and fescue) should be planted in the fall and warm-season grasses (bermudagrass, zoysiagrass, centipedegrass, and St. Augustinegrass) in late spring or early summer. If necessary, do reseeding and overseeding (when possible) in spring and fall, together with herbicide applications.

Turfgrass is established from seed, sod, sprigs, or plugs depending on the species. Seed is readily available for almost all cool-season species. Often, blends within or across species are marketed to capitalize on the strengths of the various grasses. Although many seeded varieties of bermudagrass, zoysiagrass, and centipedegrass are available, many cultivars cannot be seeded and must be sodded, sprigged, or plugged. All St. Augustinegrass planted in the state is vegetatively established. For either seed or vegetative planting material, it is very important to use certified seed or sod whenever possible.

Ideal soil conditions for turfgrass growth are six to eight inches of nutrient-rich, loose soil with a pH of approximately 6.2. Loose soil allows the grass to establish a deeper root system so water and nutrients can penetrate more easily. Although an annual soil sample should be submitted each year for analysis in intensively managed areas, soil from other types of turf sites can be examined every two to three years. Cool-season grasses should be fertilized mostly in fall, but not in late spring and summer. Conversely, warm-season grasses should be fertilized mostly in late spring through midsummer, but not in late summer and early fall. Slow-release nitrogen fertilizers should be applied before the optimum growth period to avoid leaf burn and lush, succulent growth, which render turfgrass more vulnerable to pests and disease. Fertilizers can be applied by hand or by using walk-behind spreaders or sprayers. In commercial enterprises, however, fertilizers are commonly dispensed using riding equipment. Turfgrass is irrigated throughout the spring, summer, and fall, frequently in conjunction with pesticide

applications. Turf may be watered either before or after a pesticide application (label dependent) to boost the success of the treatment. Turfgrasses need on average at least one inch of water per week during active growing periods. Of course, water management also varies with the species, temperature, light level, and amount of airflow. Typically, an automated irrigation system is used that requires no worker interaction unless a maintenance issue arises. Irrigation should involve watering turfgrasses deeply but infrequently. Light, frequent watering is not advisable because it encourages shallow roots, compaction, and an increased susceptibility to pests or diseases. Turf should be watered early in the day. This will ensure that leaves do not remain wet, and thus vulnerable to fungal infections. Wet soil is more prone to compaction, so turfgrass should not be watered before sporting events.

Turfgrass should be mowed at a height appropriate for the specific needs and the season. In general, not more than one-third of the leaf blade should be removed at a time. Raising mower heights also helps grasses withstand various stressors. Mow one to seven times per week depending on how the turf is used. Grass should not be mowed when it is wet because it promotes the spread of disease and leads to more clumping of clippings that are harder to recycle into the soil. Mower blades should be kept sharp to improve the appearance of the turf and to reduce the prevalence of disease. For most home lawns, this means sharpening at least three times per year. On some high-maintenance golf and sports turf, the blades might be sharpened from 10 to 30 times per year.

Turf can be cultivated by tilling or coring one to five times per year, depending on the turf use. This will reduce compaction and help spread nutrients and water. Heavily trafficked golf and sports turf situations typically require coring several times per season. Many home lawns with little traffic, however, will likely not need regular coring. Coring, topdressing, and power raking help to alleviate thatch buildup. Thatch is the layer of dead and living plant parts above the soil surface (not grass clippings) that can harbor diseases and pests if left uncontrolled. Thatch mostly consists of lateral stems (rhizomes and stolons), and intensive management helps bring it about. Bunch-type grasses such as fescues and ryegrasses should not require dethatching at any time. Large or less-intensely managed turf areas can be dethatched by incorporating soil cores using a drag mat. Light, repeated power raking can be performed on very thick layers of thatch. Perform any of these coring or vertical mowing programs during active growing periods for the respective turf.

Worker Activities²

There are four main sectors of the community in which turfgrass is used and maintained. All of them have their own variable pesticide exposure risks. These areas are home or commercial lawns (including cemeteries, church grounds, and schools), golf courses, sports grounds, and sod farms. Workers may be exposed to pesticides during activities including irrigation, fertilization, mowing, aerification, coring, reseeding, and overseeding. These maintenance activities may occur at any time of year, although most pesticides are applied in spring, summer, and fall. The risk of skin exposure increases when workers perform activities by hand or use walk-behind equipment such as mowers and spreaders. Mowing can

usually be timed to accommodate re-entry intervals (REIs) and avoid exposure. However, activities such as fertilization, reseeding, and overseeding are frequently done along with pesticide applications. For golf courses, most mowing is done using riding mowers, but tees and putting greens are cut using walk-behind mowers. This increases the risk of pesticide exposure. Also, tees are fertilized using walk-behind spreaders, so greater care is necessary to avoid exposure. For sports grounds, skin exposure is most likely to occur when clippings are removed by hand from collection bags for disposal. For sod production, harvesting is the greatest potential source of exposure because the sod is loaded onto trucks by hand. To minimize exposure, safety equipment should include protective footwear, eyewear, clothing, and gloves.

SPECIAL USE LABELS

Section 18 Emergency Use Exemption and Special Local Need 24(c) labels are used to supplement the chemical tools available to producers for pest control. Once the problem or gap in pest control has been identified, specialists submit the proper documentation for the Emergency Use/Special Local Need label. Thus far, Extension specialists have been successful in obtaining these labels. Special Local Need (SLN) labels in Virginia are granted by the Virginia Department of Agriculture and Consumer Services (VDACS) and are usually only valid for limited time intervals. However, a fee must be paid annually by the registrant to keep the product registered for use in Virginia. Section 18 Emergency Use labels are evaluated and granted by the Environmental Protection Agency (EPA) and can be renewed annually.

Insect Pests (and Mites)

ARTHROPOD PESTS 2, 4, 5

Insects and mites damage turf in several different ways. Some pests are foliar feeders, while others suck sap from several plant parts including the roots, leaves, and stems. Insects can also damage turfgrass by burrowing in the soil and disturbing the roots. Furthermore, arthropod pests may harm turf by transmitting pathogens from one plant to another. Infested turfgrass is less attractive and more susceptible to diseases or other pests. Signs of infestation include stunted grass, distorted growth, browning or yellowing of leaves, and dead patches. However, these same symptoms appear when plants are diseased, infested with nematodes, or grown in poor soil conditions. Therefore, be sure to properly identify the source of the damage so the correct treatment methods can be started. The severity of damage depends on soil fertility, climate, the age of the grass, and whether natural enemies are present. Irrigation, mower height, and usage also have an impact on turf damage. General damage thresholds are hard to determine since so many factors must be considered. For example, large numbers of cutworms, fall armyworms, and sod webworms are tolerable on fairways, industrial areas, home lawns, and parks. Just a few of these pests, however, can severely damage a golf green. Also, some varieties of turfgrass are hardier and better able to withstand insect feeding than other grasses. The best option is to monitor

frequently for pests and treat them appropriately, when necessary.

Soil Pests

Soil pests can be difficult to detect. Therefore, the soil and adjacent parts of the turf should be examined very closely by using a spade to dig up the area. Timing and technique are very important when applying pesticides. Insecticides should be applied evenly over the treatment area in coarse spray or granular form. Typically, the treated area should be irrigated immediately after the application. This will help the pesticides move down to the soil through the thatch layer, which is a notorious barrier to chemicals. Post-treatment irrigation should be done before spray deposits dry. Granules may be applied to dry grass, and then covered with one-half-inch of water. Pretreatment irrigation is also good because it adds moisture to the organic matter, which makes the thatch less likely to bind to pesticides. Irrigation has an added benefit because it forces soil pests to move closer to the surface where they are more likely to contact the pesticide.

Ants, Formicidae

Several ant species are annoying and destructive in turfgrass areas. Ants build nests on golf course greens, especially on tees and fairways. Anthills smother grass and make mowing difficult, while the ants themselves destroy grass roots and eat grass seeds. Ants, particularly the red imported fire ant and harvester ant, may bite people or animals.

Monitoring: No specific monitoring protocol is recommended.

Chemical Control: Treat ant mounds with drenches or granules. If many hills are present, a broadcast treatment may be used. Fire ant management is more difficult, especially if several mounds are found.

Biological Control: Natural enemies are being researched and evaluated.

Cultural/Mechanical Control: No cultural or mechanical controls are recommended.

Bees and Wasps, Andrenidae, Vespidae, Scoliidae, and Sphecidae

Bees and wasps (solitary ground-nesting bees, cicada killer wasps, scoliids, yellow jackets, or bumble bees) damage turf by digging in the soil, forming holes, and building mounds. They are typically active from June to October.

Monitoring: No specific monitoring protocol is recommended.

Chemical Control: Spot treatments or broadcast applications of insecticides may be used to control cicada killer wasps, bumble bees, and yellow jackets.

Biological Control: No commercial control agents are recommended.

Cultural/Mechanical Control: Solitary ground-nesting bees and scoliids build nests in areas where turf is thin. Be sure to maintain thick, lush turf, and replenish mulch on bare soil areas.

Bluegrass Billbugs, *Sphenophorous parvulus*

Bluegrass billbug larvae are similar to and often grouped together with white grubs. However, they are actually the offspring of weevils that produce one generation per year. Adults are gray or black and measure 1/4 to 3/8 inch long. Kentucky bluegrass is the primary host, but alternate hosts may include perennial ryegrass, red fescue, and tall fescue. Billbug damage is often mistaken for drought stress, white grub damage, chinch bug damage, dollar spot disease, or late spring greening. Billbug larvae weaken turfgrasses as they feed on stems, crowns, and rhizomes.

Monitoring: Monitor visually for adult activity in order to predict where to treat; they can be seen crawling on paved areas near turf. Identify billbug damage by pulling on grass stems. If they break off at the crown and are filled with fine frass resembling sawdust, then larvae are present. Also, the soil under billbug-infested turf is solid, not spongy, as it is with white grubs. Use the soap flush described in Mole Crickets below to estimate grub populations.

Chemical Control: Typically, a single early-season treatment given in April or May will provide effective control of adults. Begin larval treatments in early June if more than six to eight grubs are found per square foot.

Biological Control: *Beauveria bassiana* is a natural enemy of billbugs, but it is not commercially available for use on this pest. Various nematodes have been shown to be effective controls in laboratory settings.

Cultural/Mechanical Control: Plant resistant ryegrass and bluegrass cultivars along with endophyte-enhanced fescue and ryegrass. Disguise billbug damage by irrigating and fertilizing properly as the grass enters summer dormancy.

Mole Crickets, *Scapteriscus* spp., *Neocurtilla* spp.

Mole crickets are light brown, 1-1/2 inches long, and have shovel-like feet for digging in soil. They feed on turfgrass roots and uproot seedlings as they burrow underground. In a single evening, one mole cricket can damage several yards of a golf green or newly seeded area. Mole crickets make raised tunnels on golf greens that are skimmed off during mowing, thus damaging the greens as well as the equipment. Northern mole crickets (*Neocurtilla hexadactyla*) occur in Virginia, but they are not serious turf pests. Mole crickets hibernate deep underground, emerge in March, feed, and reach maturity in late spring. The adults reproduce and eggs hatch in June and July.

Monitoring: To identify a mole cricket infestation, use a soapy-water flush either early or late in the day (mix 2 tsp. lemon-scented dishwashing liquid in 1 gal. of water, and pour over 1 sq. yd.).

Chemical Control: The best time to control mole crickets is soon after they hatch in June and July. Smaller nymphs are more easily treated than larger crickets, and will have done less damage by the time treatment is applied. For established turf, use sprays or granular applications and water them thoroughly into the grass. Night temperatures should be at least 60°F when pesticides are applied. Turf may be treated in August and September, but there will be minimal residual effectiveness.

Biological Control: Natural enemies include nematodes, e.g., *Steinernema scapterisci*, and parasitic wasps, e.g., *Larra bicolor*.

Cultural/Mechanical Control: No cultural or mechanical controls are recommended. Some varieties of turfgrass may be more resistant than others.

Scale Insects

Bermudagrass Scales, *Odonaspis ruthae*

Ground Pearls, *Margarodes* spp., *Eumargarodes* spp.

Scale insects suck plant juices. Some feed on roots, while others are found on stems and leaves. As a result of their feeding habits, turfgrass dies after turning yellow and brown. Damage from scale insects is more severe in dry periods. The adult bermudagrass scale is 1/16 inch long, oval, and has a hard, white covering. It infests bermudagrass in shady areas and kills the grass, leaving bare brown patches. Ground pearls are 1/8 inch in diameter and attack centipedegrass, St. Augustinegrass, and bermudagrass. Turfgrass will turn brown in the summer and die in the fall, leaving irregular-shaped dead patches. Females lay 100 pinkish white eggs in a white, waxy ovisac. Immature scales hatch and eat fine grass roots, later creating hard, protective shells that resemble pearls.

Monitoring: Damage is more apparent in times of stress or when soil is lacking nutrients.

Chemical Control: Chemical control is not effective or recommended.

Biological Control: No biological control agents are recommended.

Cultural/Mechanical Control: Employ good management practices, and irrigate regularly during dry periods.

White Grubs, Scarabaeidae

White grubs are immature scarab beetles. Japanese beetles, June beetles, northern and southern masked chafers, and black turfgrass atenioides (BTA) are the most important scarab pests of turfgrass. Grubs have cream-colored bodies with yellowish brown heads. Usually, the life cycle takes one year to complete. However, BTA has two generations per year in Virginia. BTA adults occupy the thatch layer, so pesticides targeting this life stage should not be watered into the soil. With the exception of June beetles, white grubs tunnel through the soil, feeding on the roots of grasses. June beetles prefer to eat rotting vegetation and uproot seedlings. Bluegrass and bentgrass sustain more severe damage than other turfgrasses. White grub damage is most obvious when grubs feed heavily in April/May and September/October. Adult beetles appear from May to June and are active for about a month.

Monitoring: Symptoms include spongy turf that can be rolled back like a rug. Monitor for white grubs in July by taking several patches of earth 1 sq. ft. in size from various locations and examining the top 3 to 4 inches of soil and roots. Treatment should be initiated if at least five grubs are found per square foot.

Chemical Control: Chemical control is difficult because populations can never be eradicated. Apply pesticides when grubs are small and feeding actively in August, before June beetles form tunnels. Do not treat for white grubs in late spring or early summer because they are not feeding at that point. Apply pesticides in the evening because white grubs feed at the soil surface at night. Irrigate turfgrass before applying pesticides but not afterward. For BTA, apply pesticides in the spring (May 5 to 15) to treat young grubs before adults become reproductive.

Biological Control: Milky spore disease, *Bacillus popilliae*, has been used against Japanese beetle larvae. This treatment is expensive and slow (grubs take up to 30 days to die), but control is long lasting. *B. thuringiensis* and entomopathogenic nematodes are available to treat various white grubs. However, the nematode *Steinernema carposapsae* is not suitable for grub control. Apply nematodes only when pests are present and soil temperatures exceed 60°F. Apply nematodes at a rate of one billion per acre late in the day to minimize their exposure to lethal UV light. Irrigate both the day before and after the application of nematodes. Moles, skunks, and birds are predators of white grubs, but their foraging activities only further damage the turf. *Beauveria bassiana* can be applied at a rate of 1 oz. per 1,000 sq. ft. to treat white grubs. Be sure to follow the label directions and water the turf after the treatment.

Cultural/Mechanical Control: Reduce thatch to help pesticides move into the soil. For BTA, turf damage can be disguised if the grass is well irrigated, fertilized, and allowed to grow longer than two inches.

Surface Pests

Surface pests of turfgrasses include defoliating insects that chew on foliage (e.g., armyworms, cutworms, and sod webworms) and those that suck plant juices (e.g., leafhoppers, spittlebugs, and chinch bugs). Monitor for defoliators using 1 tbsp. pyrethrum in 1 gal. water applied to 1 sq. yd. turf, or

use the soapy flush recommended for mole crickets. Pests will crawl to the surface within five to ten minutes. Surface pests are usually easier to control than those living in the soil. In general, you should apply insecticides as a spray with little irrigation or rain expected within 24 hours. It is extremely important to monitor and confirm a pest infestation before applying pesticides. DO NOT mow or remove grass clippings for two to three days following the treatment of surface pests. Alternatives to traditional pesticides include nematodes, *Bacillus thuringiensis (Bt)*, azadirachtin (neem extract), and synthetic pyrethroids.

Armyworms

True Armyworm, *Pseudaletia unipuncta*

Fall Armyworm, *Spodoptera frugiperda*

Armyworms are infrequent pests of turfgrass, but they can inflict serious damage in high numbers during the late summer and fall. Caterpillars will eat grass shoots to the ground, resulting in bare circular patches. Fall armyworms are 1-1/2 inches long and greenish, with black stripes on each side and down the midline of the back. Their most distinctive characteristic is an inverted Y on the head. Adults migrate north from southern states and lay their eggs in June. Fall armyworms are more serious following cool, wet springs because their natural enemies do not develop as well under those conditions. The life cycle of the fall armyworm is about 1-1/2 months, and two to three generations occur each year. Fall armyworms are common on newly seeded cool-season turfgrass in the fall and will attack overseeded areas of warm-season turfgrass as well. The true armyworm is similar to the fall armyworm, but it lacks the Y on the head and is not a common pest of turf. Three generations occur each year in Virginia, with caterpillars appearing in April, late June, and August/September. Young larvae skeletonize grasses while older larvae will consume entire blades of grass. Armyworms prefer to eat cereal crops, so turf planted near grains is more at risk.

Monitoring: Use a detergent flush to monitor armyworms, which are most active at dawn or dusk. If the population exceeds one per square foot on general turf or one per square yard on golf greens, begin treatment.

Chemical Control: See the *Chemical Arthropod Control* section for more information.

Biological Control: Apply nematodes at a rate of 1 billion per acre in the late afternoon and evening, making sure to irrigate before and after treatment. Other natural enemies include parasitic wasps, tachinid flies, and birds.

Cultural/Mechanical Control: Remove excessive thatch, and avoid overwatering turf.

Chinch Bugs, *Blissus* spp.

The hairy chinch bug attacks fescues and bluegrass in mountainous regions. The southern chinch bug damages St. Augustinegrass, centipedegrass, and bermudagrass in eastern regions. Adults are black with white markings and 1/6 inch long. Immature chinch bugs are red with a white band on the back, but they become black with a white spot as they mature. Chinch bugs are found in the upper thatch area. Their feeding causes scattered patches of turf to turn yellow, then turn brown and die quickly. Two generations can occur each year in Virginia, but they are rarely a problem in turf. It is important to properly identify chinch bugs before making a chemical treatment. Quite often, big-eyed bugs (*Geocoris bullatus*) are misidentified as chinch bugs and are sprayed. This is a mistake as these insects are actually very beneficial predators of other problem turf and landscape pests.

Monitoring: To detect chinch bugs, use an empty can (both ends removed) with one end pushed two to three inches into the turf where chinch bugs may be living. After filling the can with one inch of water, any chinch bugs living in the grass will float to the surface within five to ten minutes. In general, 15 to 20 immature chinch bugs per square foot can cause significant damage.

Chemical Control: Chemical control is necessary if any chinch bugs are found on St. Augustinegrass. On other grasses, do not treat unless the population exceeds 25 bugs per square foot. Insecticides usually do not need to be watered in, but follow label directions. Chemical controls are effective, but chinch bugs can rapidly recolonize treated areas. Apply pesticides in April or May, and follow with one to two subsequent treatments at two- to three-week intervals.

Biological Control: The fungus *Beauveria bassiana* can be applied to control chinch bugs at a rate of 1 oz. per 1,000 sq. ft. DO NOT apply fungicides immediately before or after application of *B. bassiana*.

Cultural/Mechanical Control: Frequent irrigation helps encourage a natural fungal disease that attacks chinch bugs. Plant resistant and endophyte-enhanced fescue and ryegrass, limit the use of fine or red fescue in sunny areas, reduce the thatch layer, and avoid spring fertilization with high levels of nitrogen.

Cutworms

Black Cutworm, *Agrotis ipsilon*

Granulate Cutworm, *Feltia subterranean*

Variiegated Cutworm, *Peridroma saucia*

Cutworms are the larvae of night-flying moths. They are mostly pests of bentgrass golf greens, tees, fairways, roughs, and lawns. No other turf areas are rarely damaged. Black cutworms are the most common; other species are only occasional pests. Cutworm caterpillars are fat, smooth, dull colored, and 1-1/2 to 2 inches long. Cutworms are active only at night or on cloudy days. They hibernate as pupae or mature larvae and become active adults by mid-March. The cutworm life cycle takes about one month to complete, with two to four generations occurring each year. Cutworms either feed on

leaves or cut off plants at the air/soil interface. Most cutworm damage occurs from March through November.

Monitoring: To detect cutworms, use the soapy flush method, or examine turf in the late afternoon for damage and cutworms. If you see any damage, or find more than three to eight cutworms per square yard of general turf or one cutworm per square yard on golf greens, then you should begin treatment.

Chemical Control: Apply insecticides in late afternoon or early evening to be most effective. Cutworms feed at night, and most pesticides are stomach poisons. Do not water in chemicals unless specified on the label, and do not mow for two to three days after application. Treated areas may become re-infested with cutworms.

Biological Control: Apply nematodes at a rate of 1 billion per acre in the late afternoon and evening, making sure to water before and after treatment. Other natural enemies include parasitic wasps, tachinid flies, and birds.

Cultural/Mechanical Control: Plant endophyte-enhanced fescue and ryegrass varieties. Cut grass at heights greater than 2-1/2 inches because taller grass requires less treatment. Finally, remove grass clippings after mowing since eggs are laid at the tips of grass blades.

Frit Flies, Chloropidae

The frit fly is an occasional pest of golf course greens, collars, and tees. Cool-season grasses, such as bluegrass and bentgrass, are more susceptible than warm-season grasses.

Monitoring: The major symptom of a frit fly infestation is the appearance of yellow central parts while the rest of the plant is healthy.

Chemical Control: Use chemical controls, if necessary.

Biological Control: No biological control agents are recommended.

Cultural/Mechanical Control: Avoid frequent mowing and heavy irrigation or fertilization because new shoots are more attractive to egg-laying adults.

Leafhoppers and Spittlebugs, Cicadellidae and Cercopidae

Leafhoppers feed on the sap in grass stems and leaves, which causes bleaching and drying. New fairways, golf greens, lawns, and other turf areas may be damaged to the point of requiring reseeding or resprigging. Established lawns may also be damaged. Spittlebugs prefer to feed on clovers and grasses, especially centipedegrass. Adults attack ornamentals while nymphs feed on turf.

Monitoring: Turf infested with spittlebugs feel squishy when walked upon. Damage thresholds for leafhoppers are not well established.

Chemical Control: Typically pesticides are unnecessary but sometimes are used on new turf.

Biological Control: No commercial biological control agents are recommended. However, spiders, ants, and ground beetles prey on leafhoppers.

Cultural/Mechanical Control: Control spittlebugs by removing the thatch layer. Reduce leafhopper damage through proper irrigation and fertilization.

Sod Webworms, Pyralidae

Sod webworms primarily attack bentgrass, bluegrass, fescue, and hybrid bermudagrass. The hairy caterpillars are 1/2 to 3/4 inch long with dark heads and two dark spots on each body segment. Larvae build and live in silk tubes close to the soil surface. Sod webworms rest in shrubs or other sheltered areas during the daytime and feed at night. Larvae cut off blades of grass above the thatch line and eat them after pulling them into their tunnels. Damage is most apparent on intensively managed grounds with very short grass (less than 2-1/2 inches). Adults are small, light colored, and hold their wings close to the body at rest. Females lay their eggs while flying over the grass in the evenings from May to October. The life cycle is approximately six weeks, and two generations occur each year in Virginia.

Monitoring: The first signs of damage are irregular-shaped brown spots. Begin treatment if at least 15 sod webworms per square yard are found.

Chemical Control: Treat in spring and early summer to target larvae that have survived the winter. DO NOT mow for one to three days following application. See the *Chemical Arthropod Control* section for more information.

Biological Control: *B. thuringiensis* var. *kurstaki* and entomopathogenic nematodes are used to control sod webworms. Once damage becomes apparent, *B. thuringiensis* is no longer effective.

Cultural/Mechanical Control: Plant endophyte-enhanced fescue and ryegrass.

ARACHNIDS

Bermudagrass Mite, *Eriophyes cynodoniensis*

The bermudagrass mite is a tiny, white, wormlike mite that attacks only bermudagrass. Mite feeding causes grass tips to turn yellow. Furthermore, the leaves and internodes are stunted, creating a tufted rosette known aswitchs broom. Turfgrass is most severely damaged or killed during hot, dry weather.

Bermudagrass mites are most active in the late spring and summer.

Monitoring: Mites can be found living under the leaf sheath.

Chemical Control: Several applications of pesticide are necessary to control bermudagrass mites.

Biological Control: No biological control agents are recommended.

Cultural/Mechanical Control: Fertilize and irrigate to help turf outgrow mite damage. Mow grass closely (3/4 inch) and remove grass clippings. Resistant turfgrass cultivars are available.

Clover Mites

Clover mites are merely nuisance pests, but they can cause silvering of turfgrass. When crushed, they leave a red stain. Clover mite populations are highest in later winter, early spring, and fall. See the *Chemical Arthropod Control* section for more information on miticides.

Chemical Arthropod Control

Control recommendations found below were modified from information presented in the 2005 Virginia Pest Management Guide (Horticultural and Forest Crops), unless otherwise noted. <http://www.ext.vt.edu/pubs/pmg/hf6.pdf>

The list below contains all of the products available to producers for arthropod control in turfgrass along with the recommended application rates. Always consult the label before making an application. **PHI** = Pre-Harvest Interval; **REI** = Re-Entry Interval. REIs are reported for the following pesticides, but they apply only when treated turf is located on sod/seed farms or research plots.

Acephate (*Orthene 75S*)- Organophosphate- REI = 24 hours.

For use only on golf course and sod farm turfgrass. For control of black turfgrass ataenius (BTA), mix 1.5- 1.9 oz. of product in at least 5 gal. of water per 1,000 sq. ft., and apply when BTA first appear. Irrigate lightly following the application. For control of sod webworms, mix 0.5- 1.0 oz. of product in 1- 15 gal. of water per 1,000 sq. ft., and apply when webworms first appear. Reapply as necessary, but not more than once a week. For control of fall armyworms and armyworms, mix 0.5- 1.2 oz. of product in at least 5 gal. of water per 1,000 sq. ft., and apply when the pests first appear. Reapply two weeks later, if necessary. For control of cutworms, mix 1.2- 2.4 oz. in at least 5 gal. of water per 1,000 sq. ft., and apply when pests first appear. Reapply two weeks later, if necessary. For control of chinch bugs, mix 1.2- 2.4 oz. in 1- 15 gal. of water per 1,000 sq. ft., and apply as needed to control adult populations. For control of mole crickets and spittle bugs, mix 1.0- 1.9 oz. in 1- 15 gal. of water per 1,000 sq. ft., and apply when pests first appear. Apply in the late afternoon/early evening and after irrigation. DO NOT

irrigate after application. For mound treatment control of ants, either apply 1 to 2 tsp. evenly over the mound, or mix 1 oz. of product in 5 gal. of water. Apply 1 gal. of mix to each mound area, treating an area around the mound 4 ft. in diameter.

Azadirachtin (*Azatin XL 3EC*)- Limonoid/IGR- REI = 4 hours.

For control of sod webworms, fall armyworms, armyworms, and cutworms, mix up to 0.5 oz. of product per 1,000 sq. ft. in the recommended amount of water and apply to foliage.

Bifenazate (*Floramite 22.6SC*)- REI = 12 hours.

For control of mites, mix 4- 8 oz. of product in 100 gal. of water, and apply 10- 40 qts. per 1,000 sq. ft. (100- 400 gal./A). Do not apply more than 32 oz. of product/A per year.

Bifenthrin (*TalstarOne 7.9F*)- Pyrethroid- REI = 12 hours.

For control of sod webworms, fall armyworms, armyworms, and cutworms, mix 0.18- 0.25 oz. per 1,000 sq. ft. with the recommended amount of water and apply to the turf. Delay irrigation and mowing for 24 hours following application. For control of chinch bugs, BTA, and bluegrass billbugs, use 0.25- 0.5 oz. per 1,000 sq. ft. For BTA, apply in May and July; for chinch bugs, irrigate grass before applying. For billbugs, apply in April and May. For control of mole crickets and ants, apply 0.5- 1.0 oz. per 1,000 sq. ft. Irrigate to bring mole crickets to the surface, and apply late in the day. For ants, apply to the mound in cool weather during early morning or late in the evening.

Carbaryl (*Sevin SL 43F*)- Carbamate- REI = 12 hours.

For control of ants, armyworms, cutworms, and white grubs (including June beetles), use 1.5- 3.0 oz. per 1,000 sq. ft. For armyworms and cutworms, do not irrigate for 24 hours after application. For June beetles, apply when grubs are feeding near the surface, and irrigate afterward. Reapply as necessary at intervals of at least 7 days, but not more than 4 times per year. For control of sod webworms and chinch bugs, use 4.5- 6.0 oz. per 1,000 sq. ft. Treat the entire grass area for chinch bugs and irrigate before treating, but do not water within 24 hours after the application is made. For control of bluegrass billbugs and white grubs, use 6 oz. per 1,000 sq. ft. For white grubs, apply in late March to May or July to September when larvae are feeding near the surface. Water or irrigate after treatment. Repeat as necessary at intervals of at least 7 days, but not more than 2 times a year. DO NOT allow public use of treated areas until applications are completed and have dried.

Chlorpyrifos (*Dursban 50W*)- Organophosphate- REI = 24 hours.

RESTRICTED USE PESTICIDE. For use **ONLY** by commercial lawn pest control professionals. For control of ants, armyworms, chinch bugs, crickets, June beetles, mites, and sod webworms on golf courses, road medians, industrial plant sites, and for grass grown for sod or seed use. Apply 2 lbs./A.

For sod webworms, delay mowing for 12- 24 hours after application. For control of billbugs, use 2- 4 lbs. /A, and apply when adults first appear. For control of white grubs, use 4- 8 lbs./A. Apply when grubs are near the surface in July or August. Soil should be moist before treatment. Irrigate immediately afterward with 0.5- 1.0 inch of water. For control of mole crickets, use 4- 6 lbs./A.

Clothianidin (*Arena* 50WDG)- REI = 12 hours.

For control of turfgrass insects, do not apply more than 0.4 lb. a.i. /A/season. Avoid mowing until after irrigation or rainfall. For control of white grubs, billbugs, and sod webworms, use 8 oz./A. For control of chinch bugs, and to suppress mole crickets and cutworms, use 10.67 oz./A.

Cyfluthrin (*Tempo Ultra* 11.8SC)- Pyrethroid

For use on landscape and recreational turfgrass. DO NOT use on golf courses, research plots, or commercial seed farms. Apply when pests first appear, and reapply as necessary, but not more than 6 times a year. For control of ants, sod webworms, fall armyworms, armyworms, and cutworms, use 0.135- 0.270 oz. per 1,000 sq. ft. Wait at least 24 hours after application to water or mow turfgrass. For control of white grubs, mole crickets, chinch bugs, and bluegrass billbugs, use 0.270 oz. per 1,000 sq. ft. For chinch bugs, water immediately after application to drench the thatch layer. For billbugs, apply when adults first appear.

Cypermethrin (*Demon* 25.3EC)- Pyrethroid

For control of chinch bugs and mole crickets, use 0.33- 0.65 oz. per 1,000 sq. ft.

Deltamethrin (*Deltagard* GC 5SC)- Pyrethroid- REI = 12 hours.

RESTRICTED USE PESTICIDE. Apply when pests appear, and mix with at least 2 gal. of water. For use on golf courses, sod farms, and commercial and residential turf. For control of sod webworms, armyworms, and cutworms, use 0.2- 0.4 oz. per 1,000 sq. ft. Mix with at least 2 gal. of water. Wait at least 24 hours to water or mow. For control of chinch bugs, mole crickets, BTA, and bluegrass billbugs, use 0.6- 0.9 oz. per 1,000 sq. ft. Irrigate after applying for the control of mole crickets.

Fipronil (*Chipco Choice* 0.1G)- REI = 24 hours.

For control of mole crickets, use 4.6- 9.4 oz. per 1,000 sq. ft.

Halofenozide (*Mach 2* 2SC)- Diacylhydrazine/IGR- REI = 12 hours. PHI = 7 days.

For control of white grubs and bluegrass billbugs, use 2.9 oz. per 1,000 sq. ft. Do not reapply. For control of sod webworms, fall armyworms, armyworms, and cutworms, use 1.5 oz. per 1,000 sq. ft. Apply when pest damage first appears. Reapply once, if necessary.

Imidacloprid (*Merit 75WSP*)- Neonicotinoid- REI = 12 hours.

Do not apply more than 8.6 oz. of product/A/year. Irrigate within 24 hours after application. Delay mowing until sufficient irrigation or rainfall has occurred. For control of cutworms, white grubs, and billbugs, use 1.6-oz. packet per 8,250- 11,000 sq. ft. For suppression of chinch bugs and control of mole crickets, use one 1.6-oz. packet per 8,250 sq. ft. Apply before hatching of first instar chinch bug nymphs and mole crickets.

Lambda-cyhalothrin (*Scimitar GC 9.7EC*)- Pyrethroid- REI = 24 hours.

RESTRICTED USE. For use on sod and seed farms, lawns, golf courses, athletic fields, etc. Do not apply more than 52.4 oz./A/year. For control of ants, armyworms, cutworms, Japanese beetles, sod webworms, and mites, apply 3.4- 7.0 mL per 1,000 sq. ft. For control of bluegrass billbugs, BTA, grubs (suppression), and mole cricket nymphs, use 7 mL per 1,000 sq. ft. For control of chinch bugs and adult mole crickets, apply 14 mL per 1,000 sq. ft.

Permethrin (*Astro 36.8EC*)- Pyrethroid- REI = 12 hours.

For control of chinch bugs and sod webworms on lawns, use 0.4- 0.8 oz. per 1,000 sq. ft.

Spinosad (*Conserve SC 11.6F*)- Spinosyn- REI = 4 hours.

For control of large armyworms, cutworm larvae, and BTA, use 1.2 oz. per 1,000 sq. ft. For control of small cutworm larvae, use 0.8 oz. per 1,000 sq. ft. For control of sod webworms and small armyworm larvae, use 0.25 oz. per 1,000 sq. ft.

Trichlorfon (*Dylox 6.2G*)- Organophosphate

For control of white grubs and mole crickets, use 3 lbs. per 1,000 sq. ft. Reapply if necessary to control mature grubs. For control of sod webworms and cutworms, use 2 lbs. per 1,000 sq. ft. Reapply as necessary.

DISEASE and NEMATODE PESTS 2, 6, 7, 8, 9, 10, 11

Fungi and nematodes are the most common causes of turf diseases. However, several non-biological factors can produce similar symptoms (e.g., wilt, low and high temperatures, excess salts, soil compaction, and chemical damage), so it is very important to identify the real cause and to treat it appropriately. Most fungi need both persistent leaf wetness and adequate temperatures to become

pathogenic. Nematodes are more harmful when turf is grown without enough water and nutrients. To prevent turf diseases, create environmental conditions that are suitable for the grass but not the diseases. Keep mower blades sharp, and make sure the site has good drainage, adequate air movement, and low humidity. Avoid overwatering and irrigating late in the day. Do not fertilize cool-season grasses in late spring or summer. Minimize thatch, keep grass as high as possible, and do not mow wet grass. Also, try to plant pest-resistant or less-susceptible cultivars. Make preventive treatments when conditions are conducive to disease development, but before the infection actually takes hold. Preventive treatments are good at controlling fast-spreading diseases such as Pythium blight. Once diseases begin to manifest themselves, apply curative pesticides only after properly identifying the source of the symptoms and selecting the right chemicals.

Fungicides have two general modes of action: contact and systemic. Contact fungicides require frequent, uniform applications and protect only the plant parts on which they are sprayed. These fungicides may also control fungi in soil or thatch if the chemicals are washed into those layers. Systemic fungicides are absorbed into the plant and tend to be specific to particular diseases. Like insects, fungi may develop resistance if they are repeatedly exposed to pesticides over long periods. To prevent fungal resistance use fungicides infrequently, alternate fungicides with different active ingredients and/or modes of action, and do not apply preventive, low-dose treatments unnecessarily.

Diseases

Brown Patch, *Rhizoctonia* spp.

Although brown patch can attack all turfgrasses, it is mostly a problem on bentgrass, bluegrass, ryegrass, tall fescue, and St. Augustinegrass. This disease is more likely to develop on moist foliage in hot, humid weather when day temperatures are above 85°F and night temperatures are above 60°F. Other factors that favor the development of brown patch include lack of air movement, cloudy weather, dew, overwatering, late-afternoon watering, excessive nitrogen, and too little potassium and phosphorus.

Monitoring: Blades of grass become dark, then wilt and turn brown. Brown patches can grow up to 3 feet wide. Dead leaves will stay upright on closely mowed turf but become matted down on taller turf. A smoke ring consisting of gray mycelium and wilted grass may appear at the edges of the patch early in the morning on humid days.

Chemical Control: Apply fungicides as soon as brown patch is noticed. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural/Mechanical Control: Ensure the site has good drainage. Do not apply too much nitrogen when conditions are optimal for disease development. Do not apply more than 1 lb. of nitrogen per 1,000 sq. ft. to cool-season grasses. Do not apply nitrogen to cool-season grasses in late spring and

summer. Phosphorus and potassium supplements should be added to the soil, if necessary. Water turf infrequently in the early morning hours in order to achieve a thorough soaking of the soil to a depth of six to eight inches. Remove unnecessary vegetation and transplant landscape plants. To remove morning dew, drag a hose, whip the greens with a bamboo pole, or run the irrigation system briefly. Keep mower blades sharp, mow when grass is dry, and do not cut the turf too short. Cultivate golf greens regularly, and top-dress to reduce thatch buildup.

Copper Spot, *Gloeocercospora sorghi*

Copper spot affects bentgrasses, especially velvet bentgrass.

Monitoring: Grass blades develop small red spots that gradually enlarge and darken. As with dollar spot infections, small round patches (1 to 3 inches wide) of grass will become infected and die.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Follow general cultural control methods for diseases.

Dollar Spot, *Sclerotinia homoeocarpa*

Dollar spot infests all types of turfgrass and causes small, circular spots to appear on closely mowed turf (e.g., golf greens). Sod-forming grasses (e.g., bentgrass and bermudagrass) are capable of filling in and camouflaging damaged areas. However, unsightly spots will remain in bunching grasses such as ryegrass. Warm, moist weather in spring and fall helps facilitate rapid disease development, but dollar spot will also develop in humid summer weather. Turf that is stressed due to inadequate nutrition and poor growing conditions is more susceptible to disease. Dollar spot can spread on leaf clippings as well as by foot or vehicular traffic.

Monitoring: Spots may merge to form large blighted areas. The blades of turfgrass remain upright, with white or tan lesions and reddish brown margins. You may see mycelium in the morning when dew is present. Mycelium is also a common symptom of Pythium blight.

Chemical Control: Some strains of dollar spot are resistant to treatment. Alternate fungicides. See the *Chemical Disease Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural Control: Plant resistant cultivars and blends of cool-season grasses; apply nitrogen, potassium, lime, and water at appropriate levels; do not water in late afternoon or evening; and remove

dew with light irrigation. Increase airflow and decrease humidity by removing plants in the area. Wash maintenance equipment, have golfers clean their shoes, and remove clippings to avoid infecting other areas. Core and top-dress golf courses to reduce thatch buildup.

Fairy Ring, Class Basidiomycetes

Fairy rings are caused by many different species of Basidiomycete fungi, especially those that produce mushrooms and puffballs. These fungi are very common in the forest, where they grow on tree stumps. Fairy ring fungi tend to cause more damage to turf that is stressed due to lack of water or nutrients. Fungi break down organic matter, which releases nitrogen and causes greening. Fairy ring fungi kill grass by releasing chemicals and invading the root system.

Monitoring: These fungi produce small to large rings (1 to 100 ft. wide) of very green grass, dead grass, mushrooms, and puffballs. The soil underneath the rings becomes very dry and hydrophobic in summer and fall. Mushrooms and puffballs are more common in late summer and fall during wet weather.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Remove organic matter before seeding area. Power rake and vertical mow to remove thatch thicker than 1/2 inch. Also, core and top-dress golf greens to keep thatch low. Remove soil cores or open soil within the ring to let nutrients and water penetrate. Hand water infected areas and fertilize appropriately. Submit annual soil samples for analysis. DO NOT mask the problem with nitrogen, which over-stimulates the turf and allows other more serious diseases to take hold. Masking with foliar applications of iron has met with some success without harming the turf.

Fusarium Patch, *Microdochium nivale*

Fusarium patch, or pink snow mold, infects bentgrass, bluegrass, fescue, and ryegrass. It is very common to see this fungal disease develop under fallen leaves during extended periods of cold, wet weather. Fusarium patch is most damaging when snow falls on unfrozen ground, but it can occur anytime the maximum temperatures are under 60°F. This disease is more likely to occur when turf has poor soil drainage, little air movement, lush growth, and too little potassium. Heavy traffic on frosted turf, excessive leaf growth, and thatch buildup will also contribute to the development of Fusarium patch.

Monitoring: Symptoms include round patches that appear during cold, wet weather. Patches can grow up to 1/2 ft. wide when snow is absent, and up to 2 ft. wide when snowfall occurs. Turf will initially seem water soaked, and the grass later turns tan. The common name pink snow mold refers to the white mycelium that grows and eventually turns pink.

Chemical Control: Apply fungicides before snow covers the turf, or apply when Fusarium patch first appears if snow cover is absent. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Add fertilizer that is high in potassium in late fall. Do not apply excessive amounts of nitrogen just before cold, wet weather or the first snow cover. Use snow fences or landscape plants to prevent excess snow accumulation on turf. Prune trees and remove vegetation that interferes with air circulation. Reduce thatch buildup, remove fallen tree leaves, mow the turf until growth ceases, and rake infected areas to reduce wetness and speed drying. Also, keep foot or vehicular traffic from disturbing infected areas.

Gray Leaf Spot, *Pyricularia grisea*

Gray leaf spot occurs on St. Augustinegrass, ryegrass, and tall fescue. Fungal spores are produced in warm, humid weather and disperse by wind, water, and mowing. This leaf spot disease is more severe on young plants and those fertilized with too much nitrogen.

Monitoring: Small, gray lesions develop on leaves or stems in warm, humid weather. The lesions widen and become round or oval-shaped spots with a tan center and purplish brown margin. The leaf tips of cool-season grasses usually have a characteristic buggy whip appearance.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: To prevent gray leaf spot in St. Augustinegrass, apply slow-release fertilizers during warm, humid weather. DO NOT apply more than 1 lb. of nitrogen per 1,000 sq. ft. per month in July and August to turfgrasses (especially young St. Augustinegrass). Irrigate in the morning or at midday. Prune trees and remove undergrowth to facilitate air circulation.

Helminthosporium Diseases

Helminthosporium, *Bipolaris*, *Drechslera*, and *Exserohilum* spp.

Melting Out, *Drechslera poae*

Zonate Eyespot, *Drechslera gigantean*

Helminthosporium Leaf Spot, *Bipolaris sorokiniana*

Red Leaf Spot, *Drechslera erythrospila*

Helminthosporium Blight, *Drechslera dictyoides*

Helminthosporium diseases cause leaf, crown, and root problems on bentgrass, bluegrass, fescues, ryegrass, and bermudagrass. Some Helminthosporium diseases occur at any time of year. The thatch layer provides a refuge for dormant fungi when conditions are unsuitable for their development.

However, once the weather becomes cool and moist again, fungal activity resumes. Helminthosporium diseases spread to leaves via wind, rain, irrigation, maintenance equipment, and foot traffic. Factors that encourage development include lush, succulent turf due to excessive nitrogen; wet weather in spring or fall; drought stress; and continual, close mowing. Turf is also rendered weak and susceptible to diseases if there is excessive shade and poor air circulation.

Monitoring: Leaf spots initially appear dark but then become tan with a dark margin. Leaves may become girdled as the spots enlarge. Thinning due to root and crown diseases, or melting-out, occurs when the turf becomes stressed. Symptoms of melting-out include stunted shoots with dark lesions on the sheaths. Plants at first turn yellow, then brown, and will die if the infection is severe. Additionally, fungi can cause seedling blights on new turfgrass.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Some cultivars are very susceptible to these diseases, but resistant cultivars are available. Resistant cultivars are the best way to prevent this group of fungal diseases. Other control methods include using blends of cool-season grasses; applying adequate (but not excessive) amounts of fertilizer; raising the mower height, if possible; keeping mower blades sharp; irrigating deeply, but infrequently, in the morning or at midday; and removing excess thatch.

Large Patch, *Rhizoctonia solani*

Large patch, or Rhizoctonia blight, affects warm-season grasses such as bermudagrass, centipedegrass, St. Augustinegrass, and zoysiagrass. Of the different types of turf, centipedegrass is the most susceptible to large patch, while bermudagrass can rebound quickly from infection. This disease develops in fall and spring, as turf enters or emerges from dormancy. Large patch appears in the fall when temperatures dip below 70°F, and development will continue through the spring during cool, wet weather. Factors contributing to the development of large patch include high nitrogen levels during the fall and spring, a deep thatch layer, close mowing, poor soil drainage, and excessive irrigation.

Monitoring: Colorful, round patches with diameters ranging from 1 ft. to several yards wide begin to appear in shades of orange, yellow, reddish brown, or tan. The outer edge of the patch is bright orange

or red when the disease is actively growing. Individual plants pull up easily from the turf. Symptoms typically appear in the spring as greening occurs, but the disease may become apparent in fall if the infection is severe.

Chemical Control: To prevent large patch, apply fungicides in the fall when temperatures drop below 70°F. Repeat applications at four- to six-week intervals until turf enters dormancy. There is no need to apply fungicides in spring. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Choose a proper site for the selected turfgrass, and avoid low-lying areas or places surrounded by trees. DO NOT plant centipedegrass in areas susceptible to this large patch. DO NOT apply nitrogen to warm-season grasses in fall and spring when they are growing slowly. Maintain the mower at an appropriate height, and cultivate the turf to reduce soil compaction and control thatch buildup.

Necrotic Ring Spot, *Ophiosphaerella korrae*

Necrotic ring spot was formerly referred to as Fusarium blight. It occurs in Kentucky bluegrass, red fescue, and annual bluegrass during the late summer. The fungus occurs year after year and can be devastating because it kills the roots and crowns.

Monitoring: Symptoms of necrotic ring spot are similar to summer patch and include round or ring-shaped patches of dead grass.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: To prevent necrotic ring spot, use resistant varieties and good turf management practices. Core-aerate the lawn each year in the spring or fall to reduce thatch buildup. Maintain a mowing height of 2-1/2 to 3 inches. Avoid applying too much nitrogen fertilizer and do not irrigate excessively.

Pink Patch, *Limonomyces roseipellis*

Pink patch is a minor disease of frequently mowed grass, including perennial ryegrass, Kentucky bluegrass, fescues, creeping bentgrass, bermudagrass, and zoysiagrass. However, pink patch is a more serious disease on unmowed or rarely mowed grasses that are lacking in nitrogen. This disease occurs in spring and fall when grass remains wet for extended periods (heavy dew, rain, and fog) on turf with inadequate nitrogen levels. Pink patch is not a form of red thread, although it was once thought to be.

Monitoring: This disease manifests itself in bentgrass as irregularly shaped pink patches that are 2 to 6 inches wide. In other types of grasses, the turf becomes tan colored.

Chemical Control: Controls are not necessary on mowed turf, but see the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Mow and fertilize turf properly.

Powdery Mildew, *Erysiphe graminis*

Powdery mildew primarily affects bluegrasses. These fungi overwinter in living plants, and the spores are spread by the wind the following spring. Powdery mildew spores germinate and infect turf in spring and fall during cool, humid conditions. Free water is not required for a powdery mildew infection to take hold. Powdery mildew is more severe in shady areas with lack of air circulation during long periods of dry weather. Turfgrasses are left weakened and susceptible to other diseases.

Monitoring: Powdery mildew appears as a whitish gray powdery mycelium that grows on leaves, which eventually turn yellow and die.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Prevent powdery mildew by planting shade-tolerant grasses with some resistance to this disease. Use a blend of several cultivars of bluegrass mixed with tall or fine fescue. Fertilize turf properly to avoid lush growth, raise the mower height (greater than 2 inches, if possible) to provide more surface area for making food, and provide adequate irrigation early in the day to prevent drought stress. DO NOT apply more than 1 lb. nitrogen per 1,000 sq. ft. at any one time to bluegrass. Prune and remove shrubs and trees to help air circulate.

Pythium Blight, *Pythium aphanidermatum* and *P. ultimum*

Pythium blight primarily affects cool-season grasses (e.g., bentgrass, ryegrass, and tall fescue) during warm, humid weather. Young turfgrass seedlings are most susceptible to infection.

Pythium blight spreads rapidly and can destroy golf courses in as little as 24 hours. Excessive soil moisture and lush growth encourage the development of this disease.

Monitoring: Symptoms include small, concave round patches (1 to 12 inches wide) that appear in

warm or hot, humid weather. Cottony, gray mycelium develops during humid weather along with greasy, water-soaked, matted black leaves. Root rot may occur in either hot or cool weather, resulting in turf thinning or decline.

Chemical Control: Use fungicide-treated seed to prevent infection. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Water turf deeply but infrequently, use well-drained soil mixes on golf greens, cultivate the soil, and use an appropriate amount of nitrogen to avoid lush growth. To prevent disease transmission, collect and dispose of infected clippings, wash mowing equipment, and clean shoes between golf rounds.

Red Thread, *Laetisaria fuciformis*

Red thread affects bentgrass, bluegrass, fescue, and ryegrass. The disease is more common in spring but may occur in summer at higher elevations. Red thread is more likely to occur when there is an extended period of cool, wet weather and turf is stressed due to drought, pests, or a lack of nitrogen.

Monitoring: The common name, red thread, is derived from the appearance of red mycelium that initially forms at the tips of blades of grass and spreads downward. Red thread is also characterized by the appearance of round or irregular-shaped patches of grass that die quickly during cool, moist weather. Patches are reddish, or they may resemble the bleached appearance of dollar spot. The patches then merge and become larger as the infection spreads.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Fertilize turf appropriately, but avoid using too much nitrogen. Submit soil samples for analysis to identify nutrient needs, and irrigate early in the day. Increase air movement and reduce humidity by pruning or removing vegetation. To prevent the spread of red thread, collect and remove infected clippings, wash maintenance equipment, and have golfers clean their shoes.

Rust, *Puccinia graminis*, *P. coronata*, and *P. zoysae*

Several species of rust can infect bluegrass, ryegrass, tall fescue, and zoysiagrass. Rust fungi overwinter in living plants. Then, spores are spread by the wind during spring, summer, and fall. In order for germination and rapid development to occur, free water must be present on the turfgrass leaves. Factors contributing to rust infections include excessive shade, under-fertilization, drought stress, and infrequent mowing.

Monitoring: Small, yellow flecks appear early on leaves and stems. The flecks become orange or red blisters, which then rupture and release infective spores. Infected turf turns yellow, orange, red, or dark brown from the spores. Orange dust clouds appear in areas of severe infection. Rust diseases result in turf thinning.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: To prevent rust, plant resistant cultivars; use blends of cool-season, shade-tolerant grasses; raise mower height in shady areas; and increase air movement and evaporation of free water by pruning and removing undergrowth. Mow regularly, removing no more than 30% to 40% of the leaf at a time; collect and dispose of clippings; disinfect maintenance equipment; use an appropriate fertilizer; analyze soil; water deeply but infrequently, early in the day. This will encourage deep rooting, reduce drought stress, and eliminate standing water conducive to disease development.

Slime Mold, *Mucilago*, *Physarum*, and *Fuligo* spp.

Slime molds attack all types of turf. When the weather is dry, spores take refuge in the soil and thatch layer. When wet weather returns, the spores germinate, growing over the soil and any adjacent plant parts.

Monitoring: Slime mold fruiting bodies are purple, white, gray, yellow, or orange and appear on turfgrass leaves in small patches. They are more common after long periods of warm, wet weather. Slime molds turn leaves an unsightly yellow color, but they do not kill the turf.

Chemical Control: Fungicides are available but not necessary. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Brush, mow, or wash turf.

Southern Blight, *Sclerotium rolfsii*

Southern blight affects bentgrass, bluegrass, and ryegrass. The fungi overwinter on dead grass and thatch, and then germinate during hot, humid weather. Initially, southern blight fungi grow on dead organic matter, but later they spread to living plants. Southern blight typically occurs when there is a dry spell, followed by a rainy, humid period. Cold weather kills southern blight, so it occurs only in warmer regions.

Monitoring: The first symptoms of this disease are round or crescent-shaped yellow areas. Turf dies in a ring, leaving a spot of green grass in the center, which is commonly known as frog's eye. Southern blight resembles take-all patch. The rings can widen up to 3 ft. in diameter in hot, humid weather. Weeds (e.g., clover) are also killed in spots, which is unique to this disease.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Reduce the thatch layer by power raking, coring, and topdressing. Follow other general protocols for maintaining healthy turfgrass.

Spring Dead Spot, *Ophiosphaerella* spp.

Spring dead spot mostly affects intensively managed bermudagrass growing in the northern part of its range. Infected patches of turf can rebound from this disease, but the grass will be shorter and more susceptible to invasion by weeds. Spring dead spot is more likely to occur when bermudagrass has excessive thatch and lush late-season growth. The disease is more damaging following very cool, wet falls and cold winters.

Monitoring: Dead spots first appear in the spring on three- to five-year-old stands of grass. Each spring the spots will reappear, often in the same place as before. Rings of dead grass with grassy or weedy centers develop in the second or third year. When the disease is present in overseeded bermudagrass greens, it may resemble brown patch because the dead bermudagrass shows through overseeded grasses.

Chemical Control: Apply fungicides at high rates in the fall to areas that were symptomatic the previous spring. Map or mark infected areas before they disappear later in the year. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Controls: Do not overstimulate turf with too much nitrogen. Do not apply nitrogen to grasses after late August, and do not administer more than 1 lb. per 1,000 sq. ft. Other methods of prevention include raising the mower height to 1 or 1-1/2 inches, applying 2 lbs. of potassium per 1,000 sq. ft., and reducing the thatch layer by power raking or coring. Select more cold-tolerant cultivars that seem to exhibit better tolerance to spring dead spot.

Stripe Smut, *Ustilago striiformis*

Stripe smut infects all types of turf and causes yellow or brown stunted areas. In very hot, dry weather it

can kill turfgrass. Wet summer weather can weaken grass and render it more vulnerable to diseases and pests. Stripe smut spores are spread by wind, water, people, maintenance equipment, and animals.

Monitoring: Stripe smut appears in spring and fall. Turfgrasses develop gray streaks on their leaves, which become shredded after more spores are released. Grass blades turn dark brown and die.

Chemical Control: Apply fungicides just before turf enters dormancy in fall, or just before growth resumes in spring. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Plant resistant turf cultivars, fertilize with a complete fertilizer, and water appropriately to maintain vigor.

Summer Patch, *Magnaporthe poae*

Summer patch is a disease of Kentucky bluegrass, annual bluegrass, and fescues. It is only a minor problem on bentgrasses. Summer patch, which was once grouped with Fusarium blight, causes root or crown rot in the summer months. It is less problematic if the weather is cool and wet. The disease is spread underground by way of the root system, but also via infected plant material or contaminated equipment.

Monitoring: A summer patch infection is marked by the appearance of scattered gray-green or tan patches of thin, wilted, or slow-growing turf. The patches grow from 1-1/5 inches up to a foot wide. The diseased areas then merge and form yellow crescents in the turf. Once the center of the patches begins to re-grow turf, necrotic rings form at the edges. A definitive diagnosis can be made only by using a microscope. The most vulnerable lawns are those that receive full sun, are on south-facing slopes, or are near stressed sites (e.g., sidewalks, driveways, or golf courses).

Chemical Control: Apply fungicides only in conjunction with cultural controls. Use fungicides before crown rot is visible. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: To prevent summer patch infections, use resistant cultivars and grass blends (10% to 15% ryegrass mixed with bluegrass), maintain the soil pH above 6.2, and fertilize only in fall and/or late spring using 2 to 5 lbs. of nitrogen balanced with potassium and phosphorus per 1,000 sq. ft. Irrigate deeply every seven to ten days during dry periods; soaker hoses are good for steeper slopes. Remove no more than 30% to 40% of the blade at a time when mowing, and maintain the thatch layer so it is no thicker than 1/2 inch deep.

Take-All Patch, *Gaeumannomyces graminis*

Take-all patch is a problem on bentgrasses, particularly turf grown on sterilized soil. The disease gradually becomes less harmful once beneficial organisms begin to colonize the soil. Take-all patch is more likely to appear during cool, wet weather in spring or fall when the soil pH is high and manganese levels are too low.

Monitoring: Take-all patch first appears in the late spring as round, yellow patches that turn brown by early summer. Annual bluegrasses or fescues grow in the center of the dead spots, which can reach up to 3 ft. in diameter. The roots, stolons, and crowns of infected plants turn dark brown or black.

Chemical Control: Apply preventive fungicides in the fall. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Apply a total of 2 lbs. of manganese/A/year at four- to six-week intervals during fall and spring. Maintain the soil pH near 5.5 by using acid-forming nitrogen fertilizers and very little lime. Do not apply elemental sulfur, which is toxic to bentgrass. Aerate and reseed dead patches. Resod or replug golf green patches.

Typhula Blight, *Typhula incarnata*, and *T. ishkariensis*

Typhula blight, or gray snow mold, is a winter disease caused by fungi that remain dormant during the summer in infected leaves and turf canopy. Disease activity resumes whenever snow covers the ground but subsides when it melts. Turf damage is worsened by activities such as walking, skiing, snowmobiling, or sledding. The succulent growth that results from fertilization in the early fall is extremely vulnerable to Typhula blight.

Monitoring: Typhula blight is also known as gray snow mold because of the dirty-looking white mycelium that appears on infected turf. Other symptoms include rough, dead, and bleached brown patches, and scalded or matted leaves. After the snow melts and the grass dries, the leaves become silvery, brittle, and encrusted.

Chemical Control: See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: To prevent Typhula blight, mow turf until growth stops for the year. Supplement cool-season grasses in late fall with a slow-releasing nitrogen fertilizer. Also, reduce the thatch layer, use snow fences or landscaping to prevent snowdrifts, and prevent compaction by restricting walking and other activities. Treat Typhula blight damage in early spring by raking infected areas and fertilizing turf lightly.

Nematodes

Sting Nematodes, *Belonolaimus* spp.

Stubby-Root Nematodes, *Trichodorus* spp.

Lance Nematodes, *Hoplolaimus* spp.

Nematodes are microscopic roundworms that damage all types of turf by stunting or killing their root systems. These pests are most harmful in light, sandy soils that are deficient in nutrients and unable to hold water. Nematodes spread when infected soil or plants are moved by humans or by natural means. Nematode levels are lowest in the spring and peak in the fall. Therefore, early autumn is the best time of year to collect soil samples for lab analysis.

Monitoring: Nematodes cause slow growth. The symptoms are chlorosis, turf thinning, poor response to fertilization and irrigation, rapid wilting in dry weather, and proliferation of weeds. Nematodes can be positively identified **ONLY** by soil analysis. Take 12 to 15 core samples from the outer edge of the affected area, and maintain them within a normal moisture and temperature range.

Chemical Control: If the sting nematode is present, nematicides may be required on heavily maintained areas like greens and tees. See the *Chemical Disease Control* section for more information.

Biological Control: No biological control agents are recommended.

Cultural Control: Whenever possible, select nematode-tolerant grass varieties. Treat for nematodes by fertilizing and irrigating appropriately to reduce plant stress.

Chemical Disease Control

Control recommendations found below were modified from information presented in the 2005 Virginia Pest Management Guide (Horticultural and Forest Crops) and from the 2005 Turf and Ornamental Reference for Plant Protection and Products. <http://www.ext.vt.edu/pubs/pmg/hf6.pdf>

Mix all products in 1- 2 gallons of water per 1,000 sq. ft., unless indicated otherwise. Lower dosages are for preventive use; higher are for corrective treatment. **MOA** = mode of action; **PHI** = Pre-Harvest Interval; **REI** = Re-Entry Interval.

- **Azoxystrobin** (*Heritage* 50WDG)- Methoxyacrylate- REI = 4 hours.

- For control of gray leaf spot, Helminthosporium leaf spot, and melting-out, use 0.2- 0.4 oz. every 14- 21 days. For control of Pythium blight, use 0.4 oz. every 10-14 days. For control of brown patch, pink patch, summer patch, and red thread, use 0.2- 0.4 oz. every 14- 28 days. For control of pink snow mold, use 0.4- 0.7 oz. every 14- 28 days. For control of gray snow mold, use 0.4- 0.7 oz. every 10- 28 days.
- **Boscalid** (*Emerald 70SC*)- Carboxamide
 - For golf course use ONLY. Apply before symptoms appear or during the early stages of infection. DO NOT administer more than 2 applications of Emerald in a row, and follow with the use of a fungicide with a different mode of action. For control of dollar spot, use 0.13- 0.18 oz. every 21- 28 days. For control of dead spot, use 0.18 oz. every 14 days.
- **Chlorothalonil** (*Daconil Weather Stik 54F*)- Nitrile- REI = 12 hours.
 - Not for home use. For control of copper spot, use 4.0- 5.5 oz. every 14 days. For control of leaf spot and melting-out, use 2.0- 5.5 oz. every 7- 21 days. For control of brown patch, gray leaf spot, and red thread, use 2.0- 5.5 oz. every 7- 14 days. For control of dollar spot, use 1.0- 5.5 oz. every 7- 21 days. For control of gray snow mold, use 5.5 oz. every 30 days.
- **Fenamiphos** (*Nemacur 10G*)- Organophosphate- REI = 48 hours.
 - **RESTRICTED USE PESTICIDE.** For control of nematodes, use 2.3 lbs. on established turfgrass and apply 0.5 inch of water immediately. Not for use in newly seeded areas. For professional use only; not for home lawns. Do not apply more than 200 lbs. of product per acre per year.
- **Fenarimol** (*Rubigan AS 11.6EC*)- Pyrimidine- REI = 12 hours.
 - Do not exceed more than 8 oz. per application. Do not exceed 12 applications per year or 32 oz. total. For control of copper spot, use 0.75- 1.5 oz. every 10- 28 days. For control of Fusarium blight, use 2- 8 oz. every 30 days. For control of dollar spot, use 0.75- 1.5 oz. every 10- 30 days. For control of brown patch, use 1.5 oz. every 7- 14 days. For control of necrotic ring spot and summer patch, use 2- 8 oz. every 30 days. For control of take-all patch, use 4- 8 oz. every 30 days. For control of spring dead spot, use a single application of 4- 6 oz. For control of pink snow mold and gray snow mold, use 1 or 2 8-oz. applications. For control of red thread, use 8 oz. every 30 days. For control of powdery mildew, use one application of 2- 4 oz.
- **Flutolanil** (*Prostar 70WP*)- Carboximide- REI = 12 hours.
 - Do not apply more than 4.5 oz. per growing season. Allow application to dry, and avoid mowing for 24 hours. For control of fairy rings, use 2.2- 4.5 oz. every 21- 28 days. For control of brown patch, use 1.5- 3.0 oz. every 14- 21 days. For control of red thread, pink patch, and southern blight use 1.5 oz. every 21- 28 days. For control of gray snow mold, use 3.0- 4.5 oz. before permanent snow cover. For control of large brown patch, use 2.2

oz. every 30 days.

- **Fosetyl-Al** (*Chipco Signature* 80WDG)- Phosphonate- REI = 12 hours.
 - For the control of Pythium blight, use 4- 8 oz. every 14- 21 days. Not for use on home lawns. Do not mow or irrigate until foliage is completely dry.

- **Iprodione** (*26GT* 23.3EC)- Dicarboximide- REI = 12- 24 hours.
 - For control of leaf spot, brown patch, and dollar spot, use 3- 4 oz. per 1,000 sq. ft. every 14- 28 days from July to August. For control of large patch, use 4 oz. per 1,000 sq. ft. every 14- 21 days in the spring, if necessary. Apply in the fall when conditions are favorable, but disease has not yet developed. For control of red thread, use 4 oz. every 14 days as necessary. For prevention of Fusarium blight and necrotic ring spot, use 8 oz. every 28 days, if necessary. For control of pink snow mold and gray snow mold, use 4- 8 oz. with first application before snow cover and a second, if possible, during mid-winter thaw.

- **Mancozeb** (*Fore Rainshield* 80WP)- Carbamate- REI = 24 hours.
 - Not for use by homeowners. For control of melting-out and rusts, use 4 oz. every 7- 14 days. For control of brown patch and rusts, use 4 oz. every 7 days. For control of copper spot, Fusarium blight, red thread, and slime mold, use 4- 8 oz. every 7- 14 days. For control of dollar spot, use 6- 8 oz. every 7- 14 days. For control of Pythium blight, use 8 oz. every 5 days, or more often if necessary. For control of Fusarium snow mold, use 6- 8 oz. every 2- 6 weeks during the winter. For control of gray leaf spot, use 8 oz. every 14 days.

- **Mefenoxam** (*Subdue Maxx* 21.3EC)- Acylalanine
 - For control of Pythium blight, use 0.5- 1.0 oz. every 7- 21 days. Do not apply more than 3 times per season.

- **Myclobutanil** (*Eagle* 20EW)- Triazole- REI = 24 hours.
 - For control of red thread, brown patch, copper spot, dollar spot, Fusarium blight, pink snow mold, Helminthosporium diseases (leaf spot, melting-out, and crown rot), smuts, necrotic ring spot, powdery mildew, rusts, spring dead spot, summer patch, and take-all-patch, use 1.0- 2.4 oz. of product. Do not apply more than 13.8 oz. per year.

- **Propamocarb hydrochloride** (*Banol* 66.5SC)- Carbamate- REI = 24 hours.
 - For the control of Pythium blight, use 1.3 - 3.4 oz. every 7- 21 days. Do not apply more than 12 oz. of product per year.

- **Propiconazole** (*Banner Maxx* 14.3EC)- Triazole- REI = 24 hours.
 - For control of dollar spot, powdery mildew and rusts, use 1- 2 oz. per 1,000 sq. ft. every 14- 28 days when conditions are favorable for disease development. Use the higher rate

when infections are present. For dollar spot, use no more than 3 consecutive applications before rotating with a fungicide of different MOA. For control of red thread and pink patch, use 2 oz. every 14- 21 days when conditions are favorable for disease development. For control of stripe smut, use 1- 2 oz. applied once in fall after grass becomes dormant or in spring before grass growth begins. For control of summer patch, use 2- 4 oz. every 14- 28 days beginning in April. For control of pink snow mold and gray snow mold, use 2- 4 oz. in the fall or spring. For control of brown patch, use 1- 2 oz. every 14- 21 days beginning in May or June before disease development. For control of spring dead spot, use 4 oz. every 30 days, making 1- 3 applications in late summer or fall. For control of gray leafspot and melting out, use 1- 2 oz. every 14 days when favorable conditions exist. For control of necrotic ring spot, use 4 oz. in fall or spring. For control of take-all patch, use 2- 4 oz. in the spring and fall, making 1- 2 applications each season.

- **Thiophanate methyl (3336 50WP)**- Benzimidazole- REI = 12 hours.

- Do not exceed 3 lbs. a.i. per 1,000 sq. ft. per season. Irrigate lightly following application, and avoid mowing for 12 hours after. For control of take-all patch, apply 4- 8 oz. in mid-July or when disease first appears, repeating at 7- to 14-day intervals. For control of brown patch, necrotic ring spot, and spring dead spot, use 4- 8 oz. in fall before turf enters dormancy. Make a second application in early spring when soil temperatures are 55°F- 60°F, or when disease appears. Reapply at 7- to 14-day intervals in the spring, if necessary. For control of Fusarium blight, use 4- 8 oz. at 7- to 14-day intervals. For control of dollar spot, large brown patch, copper spot, pink snow mold, and red thread, use 2- 4 oz. at 7- to 14-day intervals after disease appears. For control of gray leaf spot, use 4- 8 oz. at 7- to 14-day intervals beginning before disease appears. For control of Helminthosporium diseases, use 4- 8 oz. when disease first appears, and reapply at 7- to 14-day intervals. For control of rusts, use 4- 8 oz., applying twice at 7- to 14-day intervals when symptoms appear. For preventive control of stripe smut, use 4- 8 oz. at 7- to 14-day intervals in spring and fall. For preventive control of summer patch, use 4- 8 oz. Make the first application in April and two more at 21-day intervals. For suppression, apply at 7- to 14-day intervals when disease appears.

- **Triadimefon (Bayleton 50WSP)**- Triazole

- Not for use in commercial seed production. For control of copper spot, brown patch, red thread, powdery mildew, and rusts, use 0.5- 1.0 oz. applied at 15- to 30-day intervals. For preventive control of Fusarium blight and summer patch, use 1- 2 oz. in early spring at 30-day intervals. For control of southern blight, use 0.5- 2.0 oz. applied at 14- to 28-day intervals. For control of stripe smut, use three applications of 1 oz. each in spring, summer (before the heat stress period), and late summer or fall. For control of dollar spot, use 0.25- 1.0 oz. every 14- 30 days. For control of pink snow mold, use 1- 2 oz. every 60- 90 days. For control of take-all patch, use 1- 2 oz. applied at 21- to 28-day intervals. Irrigate after application. For preventive control of gray leafspot, use 0.5- 1.0 oz. applied at 14-day intervals. For control of gray snow mold, use 2 oz. applied in the fall, 30 days before turf enters dormancy. Reapply if turf breaks dormancy during winter.

- **Trifloxystrobin** (*Compass 50WDG*)- Strobilurin- REI = 12 hours.
 - For control of gray leaf spot, use 0.15- 0.25 oz. per 1,000 sq. ft. for 14- 21 days. For control of rusts, use 0.15- 0.25 oz. per 1,000 sq. ft. for 14- 21 days. For control of brown patch, red thread, and pink patch, use 0.1- 0.25 oz. every 14- 21 days. For control of leaf spot, use the same rate, but apply every 14- 28 days. For control of summer patch, use 0.2- 0.25 oz. every 21- 28 days. For control of pink snow mold, use 0.2- 0.25 oz. in the fall to early spring.

- **Vinclozolin** (*Curalan EG 50EC*)- Analide- REI = 12 hours. PHI = 24 days.
 - For control of dollar spot, leaf spots, melting-out, red thread, pink patch, brown patch, gray snow mold, and pink snow mold, use 1 oz. every 10- 28 days.

Weeds²

Weeds are simply unwanted plants that compete with desirable turf for nutrients, light, space, and water. They are unattractive and make it difficult to enjoy lawns, athletic fields, golf courses, and any other areas where turf is grown. Turf weeds can be grasses, grass-like plants, or broadleaf plants with annual, biennial, or perennial life cycles. To control turf weeds effectively, their life cycles, characteristics, growth habits, and mode of spread must be understood. Weeds can be prevented from infiltrating turf by maintaining healthy grass with good soil, and through appropriate irrigation and fertilization. Once weed problems appear, they must be properly identified and treated with an effective herbicide that controls the weed but does not harm the desirable turfgrass.

GRASSY WEEDS

Grassy weeds have annual or perennial life cycles and can grow in cool or warm weather. Annuals complete their life cycle (grow, flower, set seed, and die) in one year. Annual grassy weeds spread primarily by seed dispersal. Summer annuals produce seeds from May to September and die in fall. Winter annuals germinate in fall or winter and die the following spring/summer. Perennials live for more than two years and produce seeds each season. To prevent grassy weeds, select turfgrass species and cultivars that are well adapted to the site, set the mower blades to the proper height, and remove grass clippings (especially seedheads) if weeds are present. Apply the correct amount of nitrogen at the proper time of year for the grass type, have soil samples analyzed to determine nutrient deficits and/or pH imbalances, and apply preemergence herbicides before weed germination.

Annual Bluegrass, *Poa annua*

Typically, annual bluegrass is a winter annual weedy grass, but some subspecies are short-lived

perennials. Annual bluegrass is common in bentgrass golf greens.

Monitoring: Annual bluegrass is a light green grass that bunches or spreads slightly.

Chemical Control: Apply preemergence herbicides in the fall to control annual bluegrass in home lawns, athletic grounds, and fairways. However, these herbicides may prevent seeding of cool-season turf in lawns or overseeding on golf courses. They may also be ineffective on perennial subspecies. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Avoid planting turf on sites with excessive shade and poor drainage. Do not mow turf too short or use heavy equipment that compacts the soil. Make sure fertilization is timed properly. Whenever possible, cultivate the soil and dethatch the turf only when weed germination is unlikely to occur.

Crabgrasses

Large Crabgrass, *Digitaria sanguinalis*

Smooth Crabgrass, *D. ischaemum*

Crabgrasses germinate from March to May when surface soil temperatures are 53°F to 58°F and adequate light and moisture are present. Germination is facilitated by weather that alternates between wet and dry conditions. Crabgrass growth is encouraged by factors such as unsuitably close mowing; thin, open turfgrass; summer fertilization; and light, frequent irrigation.

Monitoring: Crabgrass stems grow prostrate to the ground and root at the lower nodes.

Chemical Control: Apply a preemergence herbicide in spring when soil temperatures are approximately 50°F (around the time of forsythia bloom). See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Grow lush, thick turfgrass, mow grass at the proper height, and do not fertilize in the summer.

Goosegrass, *Eleusine indica*

Goosegrass, or silver crabgrass, germinates at 60°F, about two weeks later than other types of

crabgrass. As with other crabgrasses, moisture and light are required for germination. However, goosegrass is viable in compact soils. Goosegrass competes successfully for resources with warm- and cool-season turfgrasses in the summer months. Goosegrass flourishes in thin, open turf or in grasses subject to heavy traffic, such as athletic fields, golf greens, tees, and fairways.

Monitoring: Goosegrass grows prostrate to the ground but does not root at the nodes.

Chemical Control: See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Do not mow grass too short. Make sure to water soil thoroughly but infrequently, and aerate the soil to reduce compaction.

Barnyardgrass, *Echinochloa crusgalli*

Yellow Foxtail, *Setaria glauca*

Green Foxtail, *S. viridis*

Barnyardgrass, yellow foxtail, and green foxtail are all summer annual grasses. They are rare in maintained turf but very common in utility turf.

Monitoring: Barnyardgrass stems are thick and may reach 5 ft. in height. Barnyardgrass leaves have a white mid-vein that is keeled at the base. Foxtails form clumps and get their name from their distinctively shaped seedheads.

Chemical Control: See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Maintain lush turf and avoid mowing grass too short. Whenever possible, do not disturb turf.

Annual Ryegrass, *Lolium multiflorum*

Annual ryegrass is a winter annual that grows up to 3 ft. in height. It is a common weed on roadsides and near fields of grain.

Monitoring: Annual ryegrass has clawlike auricles and a distinctive spike-shaped seedhead.

Chemical Control: Use preemergence herbicides applied before seed germination in fall. Control annual ryegrass in dormant bermudagrass using postemergence herbicides. There is growing concern over herbicide-resistant ryegrasses. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: No cultural or mechanical controls are recommended.

Dallisgrass, *Paspalum dilatatum*

Field Paspalum, *P. laeve*

Thin Paspalum, *P. setaceum*

Dallisgrass and paspalums look so much alike that field and thin paspalum may be mistaken for dallisgrass. They are all common perennials that are difficult to control in turf. Dallisgrass germinates when soil temperatures are from 60°F to 65°F. It is often found in moist locations, but once established, it is drought resistant and frost tolerant.

Monitoring: Dallisgrass forms clumps, has short rhizomes, a tall ligule, and leaves with hairs near the collar.

Chemical Control: Apply arsenate herbicides in early spring to tolerant turfgrass. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Mechanically remove clumps, clean maintenance equipment, and avoid aerating soil when dallisgrass is capable of germinating.

Quackgrass, *Elytrigia repens*

Quackgrass is a perennial grass weed that is most prevalent in spring or fall when turf is under drought stress.

Monitoring: Quackgrass has an extensive, fibrous root system with rhizomes that store food and auricles that clasp the stem. The seedhead is a long, narrow spike.

Chemical Control: See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Plant clean, pure seed and use uninfested mulching material. Mow grass high and maintain healthy turf. Till soil repeatedly in warm, dry weather to drain food reserves.

Sandbur, *Cenchrus* spp.

Sandbur is an annual weed of warm-season turfgrass often found in the Coastal Plain.

Monitoring: Sandbur seedheads consist of round, spiny burs.

Chemical Control: Control with preemergence crabgrass herbicides, using arsonate herbicides during seedling stage. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Maintain dense and healthy turf.

SEDGES

Sedges resemble grasses, but they have three-sided stems, and their management protocols are radically different. Positive identification is necessary in order to treat sedges appropriately. Unidentified sedges can be removed from the turf site, replanted in a laboratory setting, and observed until seedheads are produced. Sedges are more likely to occur in warm environments with wet, poorly drained soils. However, they can survive in more arid settings.

Annual Sedge, *Cyperus compressus*

Annual sedge is one of the few true annual sedges, which are easier to control than perennial sedges. Annual sedge leaves are light green, which is distracting when they occur in dark turf on golf courses.

Monitoring: Annual sedge has a large seedhead that is flattened with a toothed edge. It is clumpier and emerges later in spring or summer than other sedges.

Chemical Control: Triazine herbicides can be used to control annual sedge. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Make sure turf sites are well drained.

Globe Sedge, *Cyperus croceus*

Monitoring: Globe sedge is a perennial with a globe-shaped seedhead.

Chemical Control: See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Prevent globe sedge from forming seeds because it is most commonly spread by their dispersal.

Green Kyllinga and **False Green Kyllinga**, *Kyllinga brevifolia* and *K. gracillima*

Green Kyllinga and false green Kyllinga are perennial sedges with well-developed rhizomes. Originally from Asia, they are spreading rapidly in the southern United States. Kyllingas thrive in environments with poor drainage that are mowed very closely (1/2 inch or less). These sedges will form mats that can easily overwhelm turfgrass.

Monitoring: Kyllingas are shorter and with a finer leaf texture than other sedges. The presence of three leaves below the seedhead and the lack of tubers help distinguish them from other sedges.

Chemical Control: See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Make sure turf sites are well drained and grass is not mowed too short.

Purple Nutsedge, *Cyperus rotundus*

Purple nutsedge is a perennial weed native to India, but it is an invasive species in the southeastern and southwestern United States.

Monitoring: Purple nutsedge is a pest of warm-season turf and has darker leaves than yellow nutsedge, with a reddish purple seedhead. Purple nutsedge leaf tips are more blunt than those of yellow nutsedge.

Chemical Control: Purple nutsedge is more difficult to control than yellow nutsedge. As with yellow nutsedge, begin chemical control in spring. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Make sure turf sites are well drained.

Yellow Nutsedge, *Cyperus esculentus*

Yellow nutsedge is a perennial that is cold tolerant and spreads rapidly. This sedge is found throughout North America, but it is more problematic in warm- and cool-season turfgrass. It is the most troublesome sedge in Virginia turf. Yellow nutsedge is easier to control than other sedges, but it is still very difficult to control.

Monitoring: Yellow nutsedge has a yellowish brown seedhead and forms brown or tan tubers at the rhizome tips in late June and July.

Chemical Control: Begin chemical control in the spring after maximum shoot emergence, but before new tubers are formed. See the *Chemical Weed Control* section for more information.

Biological Control: No biological controls are recommended.

Cultural/Mechanical Control: Avoid purchasing infested sod, keep maintenance equipment clean, and make sure turf sites are well drained.

PERENNIAL WEEDY GRASSES

Attractive grasses may occasionally become weeds of other turfgrasses. They are often hard to control, so it is best to prevent them from growing in the first place. This can be done by selecting clean seed, choosing a well-adapted turfgrass species for the location, and using proper mowing and fertilization protocols to maintain dense, actively growing, desirable turf. Undesirable grasses can be dug up by hand or removed with a sod cutter. Herbicide spot treatments may also be applied, but the desired grass will likely be killed as well. **Bahiagrass**, *Paspalum notatum*, is drought tolerant, competitive, and can be very unsightly in turf. It is usually planted on highways or roadsides and is very difficult to control. The seedhead is Y-shaped. Several applications of arsenical herbicides may provide some control.

Perennial Ryegrass, *Lolium perenne*, is a very attractive grass that is usually overseeded to add color in warm climates during the winter. It becomes a problem when it survives during cool, wet summers and becomes clumpy.

WINTER ANNUAL BROADLEAF WEEDS

Winter annual broadleaf weeds germinate in the fall or winter and may begin growing whenever there is warm weather, even during the winter months. They set seed in the early spring and die as temperatures rise in the late spring or summer. Winter annual broadleaf weeds will easily infiltrate thin, shady patches of turfgrass grown on moist soil. Many grow prostrate to the ground and are unaffected by mowing, especially chickweeds, parsley-piert, and spurweed. Other winter annual broadleaf weeds include hairy bittercress, buttercups, large hop clover, Carolina geranium, henbit, knawel, corn speedwell, and Johnny jump-up violet. In general, dense, healthy turf is more resistant to encroaching

broadleaf weeds. To maintain turf vigor, choose cultivars well suited to the site, mow grass to an appropriate height, and apply the proper amount of water and fertilizer. Chickweeds benefit from frequent, excessive irrigation, so water turf only when necessary to maintain healthy grass. In general, you can control broadleaf weeds with selective broadleaf postemergence herbicides if the turf is tolerant of the chemical. Combination products can be more effective when dealing with several species of weeds. Usually, winter annual weeds are most effective when applied in February through April. To control weed problems in warm-season grasses, spray for weeds while turf is dormant. Spray cool-season grasses before growth resumes in spring. Turf is better able to grow over weedy areas when herbicides are sprayed at the right time.

SUMMER ANNUAL BROADLEAF WEEDS

Summer annual broadleaf weeds begin to appear in spring. By summer, they are growing and producing seeds. Midsummer rains encourage germination of the next generation. Some examples of problematic summer annual weeds include prostrate knotweed, lespedeza, and prostrate spurge. The horizontal growth habit of these weeds allows them to withstand very close mowing. To prevent summer annual broadleaf weeds and encourage healthy turf, it is important to mow, fertilize, and irrigate properly. Prostrate knotweed can thrive in compacted soil, so it is very important to reduce traffic and cultivate the turf site. Some weeds may be controlled by preemergence herbicides. It is best to treat summer annual broadleaf weeds by spraying postemergence herbicides in late spring or early summer when weeds are young and small. In addition, spraying at that point gives the turf more time to grow over weedy areas.

PERENNIAL BROADLEAF WEEDS

Perennial broadleaf weeds are those that can live longer than two years. Examples include blackseed plantain, buckhorn plantain, broadleaf dock, curly dock, dichondra, dandelion, Florida betony, ground ivy, India mockstrawberry, mosses, Virginia buttonweed, white clover, wild garlic, and common yellow woodsorrel. Most perennial broadleaf weeds are spread by the dispersal of seeds produced in spring and early summer. However, many of these weeds have structures that make them capable of vegetative reproduction. This makes control difficult. Perennial broadleaf weeds flourish in weak, thin turf; golf fairways and roughs; home lawns; fields; and industrial grounds. As with any other grass pest, the first step in controlling it is to maintain healthy turf. White clover can be weakened by fertilizing turf with the correct ratio of essential nutrients. Well-drained, aerated soil is less hospitable to India mockstrawberry and ground ivy than shady, moist areas. When cultural methods cannot control weed problems, apply postemergence herbicides in March or April. Keep in mind that not all turfgrasses are equally tolerant of all herbicidal compounds.

Chemical Weed Control

Control recommendations found below were modified from information presented in the 2005 Virginia Pest Management Guide (Horticultural and Forest Crops) and from the 2005 Turf and Ornamental Reference for Plant Protection and Products. <http://www.ext.vt.edu/pubs/pmg/hf6.pdf>

PHI = Pre-Harvest Interval; **REI** = Re-Entry Interval; **V/V** = volume per volume.

Preemergent Control of Weedy Grasses

- **Atrazine** (*Atrazine* 4L 42.2EC)- Triazine. REI = 12 hours. PHI = 30 days.
 - **RESTRICTED USE PESTICIDE.** For the control of most annual broadleaf and grass weeds on sod farms (St. Augustinegrass, centipedegrass, and zoysia grass), use 4- 8 pints/A. Reapply 2- 4 pints/A, if necessary. For turf grown in sandy soil, do not apply more than 2 lbs. a.i./A per application and not more than 3 lbs. a.i. per year. For turf grown in mucky or peat soils, do not apply more than 4 lbs. a.i./A in a single application and not more than 6 lbs. a.i. per year. For the control of annual broadleaf and grass weeds in warm-season grasses, apply 0.75- 1.5 oz. per 1,000 sq. ft. in late winter before the weeds emerge. Reapply after 30 days, if necessary, but not after April 15. Do not make more than two applications per year.
- **Benefin** (*Balan* 2.5G)- Dinitroaniline. REI = 12 hours.
 - For the control of annual bluegrass, smooth and hairy crabgrass, goosegrass, barnyardgrass, and foxtails in established turf, apply 60- 120 lbs. of product per acre uniformly in spring, about 2 weeks before germination of annual grass weeds. Reapply 2 months later, if necessary. DO NOT reseed within 6 weeks of application.
- **Benefin (1%) + Oryzalin (1%)** (XL 2G)- Dinitroanilines. REI = 24 hours.
 - For the control of goosegrass, barnyardgrass, foxtail, johnsongrass, field sandbur, annual bluegrass, carpetweed, prostrate knotweed, common purslane, common chickweed, henbit, prostrate spurge, and crabgrass in established warm-season grasses and tall fescue, apply 2.3- 3.4 lbs. of product per 1,000 sq. ft. in spring and/or fall. Repeat application after 2- 3 months, if necessary. Delay reseeding turfgrass areas at least 6 weeks after application.
- **Benefin (1.3%) + Trifluralin (0.7%)** (*Team* 2G)- Dinitroanilines
 - For the control of annual bluegrass, crabgrass, barnyardgrass, and foxtails in established turf, apply 1.75- 3.5 lbs. of product per 1,000 sq. ft. in spring before crabgrass germinates. Repeat application 2 months later to maintain late-season control. Delay reseeding by at least 8 weeks. Not for use on sod or seed farms.
- **Bensulide** (*Andersons Weed Preventer* 8.5G)- Sulfonamide
 - For the control of annual bluegrass, crabgrass, barnyardgrass, and foxtails in established turf, use 3.36 lbs. per 1,000 sq. ft. and irrigate for 10- 15 minutes. Not for use on public sites or sod/seed farms.
- **Bensulide (5.25%) + Oxadiazon (1.31%)** Sulfonamide + Oxadiazole (*Andersons Goosegrass/ Crabgrass Control*)

- For the control of crabgrass and goosegrass in established turf, apply 2.62 lbs. of product granules in spring before crabgrass and goosegrass germination. May be used on golf putting greens for goosegrass control. However, weed pressure must be intense. Reapply a half-rate 6- 8 weeks later, if necessary. Wait 5 months to overseed following application. Not for use on sod/seed farms. Use only on golf courses and home lawns.
- **Bromacil** (*Misty Repco Kill III* 1RTU)- Substituted Uracil
 - For nonselective control of annual and perennial weeds and grasses, spray 1- 2 gal. per 1,000 sq. ft. in late spring or early summer. For best results, apply as a postemergence herbicide. Do not apply when the ground is frozen.
- **Dazomet** (*Basamid* 99G)- Fumigant. REI = 24 hours.
 - For soil fumigant control of germinating annual and perennial weeds on golf greens/tees and seedbeds (crabgrass, henbit, foxtails, purslane, etc.), use 8 lbs. per 1,000 sq. ft.
- **DCPA** (*Dacthal* 75WP)- Carboxylic Acid. REI = 12 hours.
 - For the control of crabgrass, barnyardgrass, purslane, common chickweed, goosegrass, johnsongrass, prostrate knotweed, and foxtails in established turf, apply 1 lb. of product in 3- 7 gal. of water per 3,000 sq. ft. in the early spring when forsythia blooms and before crabgrass emerges. Irrigate within 4 hours with 0.1 to 0.2 inch of water. In areas where crabgrass is late germinating, reapply at half the rate 8 weeks later. For control of prostrate spurge, apply 0.33 lb. in 1- 2 gal. of water per 1,000 sq. ft. before seed germination. Repeat application in 6- 8 weeks. Not for use on putting greens or bentgrasses mowed at putting green height.
- **Dithiopyr** (*Dimension* 12.7EC)- Pyridine. REI = 12 hours. PHI = 3 months.
 - For the control of many weedy grasses and broadleaf weeds, apply 1.12- 1.84 oz. of product per 1,000 sq. ft. before or in synchrony with crabgrass emergence. Do not apply more than 1.5 oz. per application, or more than 4.5 oz. per year in split or sequential applications.
- **Ethofumesate** (*Prograss* 19EC)- Benzofuran. REI = 12 hours.
 - For the control of annual bluegrass, crabgrasses, barnyardgrass, foxtails, common chickweed, common purslane, yellow and purple nutsedge (suppression), and clover (postemergent), make 1- 3 applications, depending on turfgrass variety, in fall or spring at 1.5- 6 oz. per 1,000 sq. ft. Reapply every 21- 28 days, as necessary. Not for use by homeowners or on putting greens. Do not use on zoysiagrass or fine fescue.
- **Isoxaben** (*Gallery* 75DF)- Benzamide. REI = 12 hours.
 - For the control of certain broadleaf weeds, use 0.25- 0.5 oz. per 1,000 sq. ft. at any time of year before weed germination. Reapply 0.38 oz. per 1,000 sq. ft. 60 days after the first application, if necessary. Do not apply more than 4 lbs. per acre per year. Do not apply to

golf course putting greens or tees.

- **Napropamide** (*Devrinol 2G*)- Propionamide. REI = 12 hours.
 - For control of annual bluegrass, crabgrass, and goosegrass in warm-season turfgrasses apply 2.25- 3.38 lbs. per 1,000 sq. ft. before weeds emerge.

- **Oxadiazon** (*Ronstar 2G*)- Oxadiazole. REI = 12 hours.
 - For control of crabgrass, goosegrass, field sandbur, annual sedge, and annual bluegrass, use 2.25- 4.5 lbs. per 1,000 sq. ft. Do not exceed 150 lbs. per acre on St. Augustinegrass and bentgrass. Do not apply to bentgrass mowed to less than 0.4 inch. Not for use on putting greens or tees. Reseeding should be delayed for 4 months following treatment.

- **Pendimethalin** (*Pendulum 60WDG*)- Dinitroaniline. REI = 24 hours.
 - For the control of crabgrass, foxtail, annual bluegrass, barnyardgrass, fall panicum, prostrate spurge, purslane, knotweed, hop clover, chickweed, henbit, corn speedwell, goosegrass, and annual spurge, use 2.5 to 3.4 lbs. per acre. Repeat application 5- 8 weeks later, if necessary. Do not use on bentgrass or annual bluegrass tees or greens. Delay reseeding for at least 3 months. Do not exceed 3.4 lbs. per acre per application for residential use. Do not exceed 5 lbs. per acre per application for commercial or nonresidential use.

- **Prodiamine** (*Barricade 65WG*)- Dinitroaniline. REI = 12 hours. PHI = 90 days.
 - For the control of annual bluegrass, crabgrass, goosegrass, barnyardgrass, chickweed, henbit, johnsongrass, knotweed, panicum, purslane, prostrate spurge, yellow woodsorrel, and foxtails in established turf and sod farms, apply 0.185 to 0.83 oz. per 1,000 sq. ft. per year (no more) in spring before crabgrass and goosegrass germinate. Irrigation or rainfall is desirable within 7- 10 days. Wait 6 months to overseed by broadcasting over the surface. If seeds are drilled directly into the soil, the wait period is only 4 months. Not for use on putting greens. Do not apply to creeping bentgrass less than 0.5 inch high.

- **Prometon** (*Misty Weed-A-Cide 3.7EC*)- Triazine
 - For nonselective control of weeds, use 1.0- 2.75 gal. of product per 650- 1,000 sq. ft. One application should provide effective control, but a second application can be made, if necessary, during seasons with excessive rainfall.

- **Simazine** (*Princep 4L 42F*)- Triazine. REI = 12 hours.
 - For control of annual bluegrass, burclover, lawn burweed, chickweeds, corn speedwell, henbit, hop clover, spurweed, and parsley-piert in established bermudagrass, centipedegrass, St. Augustinegrass, and zoysiagrass, apply 0.75 to 1.5 oz. of product per 1,000 sq. ft. before annual bluegrass germinates. Do NOT overseed or seed for 4 months before or 6 months after treatment. Hybrid bermudagrasses are slightly more sensitive to this product. Reapply 30 days later, if necessary, but not after June 1. Do not apply more

than 2 times per year. For use **ONLY** in coastal plain region of Virginia. Do not use on golf greens.

- **Sulfentrazone** (*Surge* 0.67EC)- Triazolinone. REI = 48 hours.
 - To treat weeds on sod farms, ornamental lawns, and turfgrass sites, use 1.0 to 1.5 oz. per 1,000 sq. ft. (lower dose is for warm-season grasses). Reapply at 2- to 6-week intervals, if necessary. Wait 3 weeks to reseed treated areas. Not for use on bentgrass golf green or tees or desirable clovers. Do not apply to warm-season grasses during spring green-up or in the fall when the grass transitions into dormancy.
- **Siduron** (*Tupersan* 50WP)- Substituted Urea. REI = 4 hours.
 - For the control of crabgrasses, barnyardgrass, and foxtails on cool-season grass sod and seed farms, golf courses, lawns, and other public areas, apply 4- 24 lbs. per acre of product at seeding. DO NOT use on bermudagrass. Does not control annual bluegrass. Application must be watered in within 3 days to be most effective.

Postemergent Control of Weedy Grasses

- **2,4-D** (*Hardball* 19.6EC)- Phenoxy. REI = 48 hours.
 - For control of weeds on cool-season grasses on sod farms, apply 1.0- 3.25 pints per acre. Do not use on centipedegrass, St. Augustinegrass, bentgrass, or where desirable clovers are present. For control of weeds on cool-season ornamental and recreational turf, use 1.0- 1.75 quarts per acre (0.75- 1.28 oz. per 1,000 sq. ft.) in the early spring when weeds have emerged and are actively growing. Reapply 2- 4 weeks later, if necessary.
- **Asulam** (*Asulox* 36.2SC)- Carbamate. REI = 12 hours.
 - For the control of crabgrass, goosegrass, and sandbur in established Tifway 419 bermudagrass and St. Augustinegrass ONLY, apply 5 pints per acre in 20- 50 gal. of water per acre.
- **Bentazon** (*Basagran* T/O 44)- Benzothiadiazole. REI = 48 hours.
 - For the control of common purslane, yellow nutsedge, globe sedge, and annual sedge in established turfgrass, apply 0.75 oz. of product per 1,000 sq. ft. when sedges are actively growing but are less than 8 inches tall. Add a crop oil (0.25% V/V) to the treatment (0.75 oz. per 1,000 sq. ft.). Reapply 1- 2 times, if necessary, at 10- to 14-day intervals, not to exceed 1.5 oz. per 1,000 sq. ft. per season. NOT labeled for use on golf greens. Perennial ryegrass may sustain significant injury from this treatment.
- **Bispyribac-Sodium** (*Velocity* 80SP)- Benzoate. REI = 12 hours.
 - For control of annual bluegrass and certain broadleaf weeds (clover, chickweed, dandelion, henbit, burweed, parsley-piert, plantains, yellow nutsedge, and yellow woodsorrel) on creeping bentgrass and perennial ryegrass on golf courses (not greens) and

sod farms, use 0.44- 2.0 oz. per acre when weeds are actively growing. Do not apply more than 2 oz. per application. Do not apply more than 2 oz. per 0.75 acre per 28 days. Wait 10 days to reseed or resprig. Do not apply to grass shorter than 0.4 inch. Do not apply to greens or roughs.

- **Bromacil** (*Misty Repco Kill III* 1RTU)- Substituted Uracil
 - For nonselective control of annual and perennial weeds and grasses, spray 1- 2 gal. per 1,000 sq. ft. in late spring or early summer.
- **Bromoxynil** (*Buctril* 33.4EC)- Hydroxybenzotrile. REI = 12 hours.
 - **RESTRICTED USE PESTICIDE.** For the control of many broadleaf weeds on nonresidential turf and sod/seed farms, use 0.375- 0.75 oz. per 1,000 sq. ft.
- **Cacodylic Acid** (*Selectrol* 10.3SC)- Organic Arsenical
 - For control of crabgrass, barnyardgrass, and foxtails, use 8 oz. per 1,000 sq. ft. Reapply 5- 7 days later, if necessary. Do not use on St. Augustinegrass, and only apply at half the rate on bentgrass.
- **Carfentrazone-Ethyl** (*QuickSilver* 21.3EC)- Triazolinone
 - For control of certain broadleaf weeds, use 0.012- 0.034 oz. per 1,000 sq. ft. when weeds are small and actively growing. Reapply after two weeks, if necessary, but do not make more than 3 applications per year. Do not apply more than 6.3 oz. of product per acre per season.
- **Clopyralid** (12.1%) + **Triclopyr** (33%) (*Confront* EC)- Picolinic Acids
 - For broad-spectrum control of certain broadleaf weeds, use 0.37- 0.74 oz. per 1,000 sq. ft. Reapply at 30-day intervals, if necessary. Do not use more than 4 pints of product per acre per year. Not for use on sod and seed farms. Do not use on warm-season grass that is less than 0.5 inch tall. Do not use on residential lawns. Wait three weeks after application to reseed. Do not use on putting greens or tees.
- **Dicamba** (*Banvel* 48.2SC)- Benzoic Acid. REI = 24 hours.
 - For control of many broadleaf weeds on sod farms and general noncropland areas, use 1.0- 4.5 tsp. per 1,000 sq. ft. Do not use more than 2 pints of product per acre per season. For control of broadleaf weeds on seed farms, use 0.5- 1.0 pint of product per acre on seeding grass after it has reached the 3- 5 leaf stage. Do not apply after the grass seed begins to joint. Do not use on bentgrass unless damage can be tolerated.
- **Dithiopyr** (*Dimension* 12.7EC)- Pyridine. REI = 12 hours. PHI = 3 months.
 - See the recommendations under Preemergent Control of Weedy Grasses.
- **Diquat Dibromide** (*Reward* 37.3SC)- Bipyridylum. REI = 24 hours.

- For control of grasses and weeds for turf renovation and to control broadleaf weeds in dormant bermudagrass, use 1- 2 pints per acre.
- **Fluroxypyr-Methyl** (*Spotlight* 26.2EC)- Pyridine. REI = 12 hours.
 - For control of broadleaf weeds, use 0.25- 0.9 oz. per 1,000 sq. ft. Not for use on putting greens or tees. Wait 4 weeks before reapplying. Do not apply more than 0.9 oz. per 1,000 sq. ft. per year.
- **Fenoxaprop** (*Acclaim* 6.59EC)- Aryloxyphenoxypropionate. REI = 24 hours.
 - For control of crabgrasses, goosegrass, barynyardgrass, foxtails, panicum, johnsongrass, and sandbur, use 0.8 to 0.9 oz. per 1,000 sq. ft. Do not apply to bentgrass putting greens. Do not apply more than 2.75 oz. per 1,000 sq. ft. per season. Delay repeat applications for at least 14 days.
- **Glufosinate-Ammonium** (*Finale* 11.3SC)- Phosphoric Acid. REI = 12 hours.
 - For control of grassy and broadleaf weeds in dormant bermudagrass, use 3- 6 pints per acre. Do not apply more than 6 pints per acre per year. For control of weeds in recreational and public areas, apply 2- 6 pints per acre.
- **Glyphosate** (*Roundup PRO* 41SC)- Phosphoric Acid. REI = 4 hours.
 - For general weed control, use 1- 2 qt. per acre.
- **Halosulfuron** (*Manage* 75WDG)- Sulfonylurea. REI = 12 hours.
 - For the control of Kyllinga, yellow nutsedge, purple nutsedge, and other sedges in established turf, mix 1 bag with 1- 2 gal. of water per 1,000 sq. ft. Avoid treating when grass and sedges are stressed. NOT labeled for use on putting greens.
- **Imazaquin** (*Image* 70DG)- Imidazole. REI = 12 hours. PHI = 30 days.
 - For the control of nutsedges, Kyllinga, globe sedge, buttercup, chickweeds, Carolina geranium, hairy bittercress, henbit, knawel, parsley-piert, white clover, wild onion, and garlic in established warm-season grasses, apply 0.2- 0.26 oz. of product per 1,000 sq. ft. when weeds are actively growing. Product may be tank-mixed with MSMA for control of yellow nutsedge. Not for use on golf greens. Do not apply when grass is emerging from dormancy or struggling, do not use on St. Augustinegrass for winter weed control, and do not use on tall fescue when desirable.
- **MCPA** (*MCP Amine* 4 52EC)- Phenoxy. REI = 48 hours.
 - For control of broadleaf weeds on seed farms, golf courses, lawns, and other turf, apply 1- 2 pints per acre in spring before head comes into boot and after seedling grass has tillered. The product may injure bentgrass and other creeping grasses.
- **Mecoprop** (*Chem-Weed* 18.45SC)- Phenoxy

- For control of clover, chickweed, plantain, mouseear chickweed, knotweed, ground ivy, and other broadleaf weeds on lawns, fairways, and golf greens, use 1.5 oz. per 1,000 sq. ft. Do not mow lawn for 2- 3 days before or after application.
- **Metribuzin** (*Sencor 75DF*)- Triazine
 - For the control of Carolina geranium, common chickweed, corn speedwell, henbit, hop clover, white clover, parsley-piert, prostrate knotweed, annual bluegrass, and goosegrass in established bermudagrass (at least 0.5 inch mowing height), apply 0.33 to 0.66 lb. in 40 lbs. of water per acre. Product should be tank-mixed with MSMA where the labels do not prohibit this treatment, at the users discretion. Apply to actively growing bermudagrass and goosegrass in 1 gal. of water per 1,000 sq. ft. Repeat application 2- 3 weeks later, not to exceed 2 applications per year. DO NOT use on golf greens, tees, bluegrass, fescues, or perennial ryegrasses. Expect some discoloration of bermudagrass. Do not apply more than 2 lbs. per acre per season. Do not apply more than once to dormant turf and no more than twice to actively growing turf per season. Delay mowing for at least 3 days, and mow after irrigating. Not for use on sod or seed farms.
- **Metsulfuron-Methyl** (*Blade 60*)- Sulfonyl Urea. REI = 4 hours.
 - For control of bahiagrass, foxtails, ryegrass, and many broadleaf weeds, use 0.125- 1.0 oz./A. Do not apply to turf less than one year old. Do not overseed for at least 8 weeks.
- **MSMA** (*Target 6 Plus 48.3SC*) - Organic Arsenical. REI = 12 hours.
 - For the control of barnyardgrass, crabgrass, chickweed, dallisgrass, johnsongrass, sandbur, nutsedge, wood sorrel, and goosegrass in established turf, mow turf to 1- 1.5 inches. Then, mix 1- 2 oz. of product in 1.0- 2.5 gal. of water per 1,000 sq. ft. Repeat application at 14-day intervals, if necessary. Do not water turf for at least 24 hours after treatment. Do not apply to St. Augustinegrass or centipedegrass; bent/fescues may be damaged. Delay reseeding for at least 2 weeks.
- **Quinclorac** (*Drive 75WDG*)- Quinoline. REI = 12 hours.
 - For the control of crabgrasses, foxtails, clover, dandelion, Carolina geranium, morningglory, speedwell, and wild violet in creeping bentgrass, make 2 - 3 applications of 0.245 oz. per 1,000 sq. ft. 21 days apart. Use 0.55 oz. of methylated seed oil. For control of these weeds in other turfgrasses, use 0.367 oz. per 1,000 sq. ft. with 0.55 oz. of methylated seed oil. Do not mow for 2 days before and after treatment. Wait 24 hours to irrigate. Mix with methylated seed oil to improve effectiveness. Do not apply more than 0.73 oz. per 1,000 sq. ft. per year. Do not apply to golf course collars or greens. Do not apply to bahiagrass, carpetgrass, St. Augustinegrass, centipedegrass, or desirable clovers.
- **Sethoxydim** (*Sethoxydim G Pro 13EC*)- Oxime. REI = 12 hours.
 - For control of weedy grasses, apply 0.5 to 1.4 oz. per 1,000 sq. ft.

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ON-LINE RESOURCES

Virginia Agricultural Statistics Service

<http://www.nass.usda.gov/va/>

Virginia Cooperative Extension: Horticultural and Forest Crops Pest Management Guides

<http://www.ext.vt.edu/pubs/pmg/>

Virginia Turfgrass Council

<http://www.vaturf.org/>

Virginia Tech Turf

<http://www.vtturf.com>

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