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Spring and Summer Lawn Management Considerations for Warm-Season Turfgrasses

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There is no time of year that generates as much excitement in the management of lawns and landscapes as spring. Sales of all lawn and garden products soar as many homeowners strive for the best looking lawn possible. However, your enthusiasm for returning the lawn to tip-top shape should be tempered enough so that you make sound agronomic and environmental management decisions. Smart choices now will result in a healthy, dense turf canopy that will better withstand the environmental extremes of the summer months.

Soil testing. Sampling the soil to determine pH and nutrient levels is always a prudent choice in developing a management program for a lawn, especially if a soil test has not been done within the past three years (Figure 1). Any time of year is appropriate for sampling. A majority of Virginia soils are acidic and need to be amended with periodic applications of lime. For information on how to properly sample your soil, consult *Soil Sampling for the Home Gardener,* Virginia Cooperative Extension publication 452-129, at *http://www.ext.vt.edu/pubs/compost/452-129/452-129.html*. For additional soil testing information, see the presentation "Soil Testing for the Lawn and Landscape," at http://breeze.ag.vt.edu/p36588349/.

Figure 1. Sample your soil at least once every three years to determine pH and nutrient status.

Selecting the appropriate grass. The primary warm-season species, bermudagrass and zoysiagrass, are well adapted throughout the Tidewater and southern Piedmont regions of Virginia. Most zoysiagrasses and selected cold-tolerant bermudagrasses also have application in the northern Piedmont. Centipedegrass and St. Augustinegrass are limited only to the Tidewater region. Use the "Lawns" link under the "Home Gardening" Educational Programs and Resources section at the Virginia Cooperative Extension Web page at *http://www.ext.vt.edu/resources/* to find links to publications and articles on how to make the best selection of a grass to fit your needs. For a list of the best adapted cultivars for the state, review the current Virginia/Maryland Turfgrass Recommended Variety lists posted at *http://www.vtturf.com/Publications%5CExtension%5C2005-06VarietyRecommendations.pdf.*

Monostands (single cultivars) are recommended for warm-season turfgrasses in almost all situations. Choose these grasses according to climate, the lawn site, and the level of maintenance you desire. It is important to understand that not all warm-season grasses can be established from seed. Many of the highest quality cultivars of bermudagrass, zoysiagrass, and St. Augustinegrass must be established vegetatively. Also, many of the select grasses likely are not available at the garden centers of large retailers, so you will need to approach stores that deal in specialty turf products, farmer's cooperatives, or specialty nurseries to obtain these best varieties. If you can not locate a variety

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from the recommended list, all is not lost. Fortunately, most of the cultivars being sold at the garden centers of large retailers are still quality grasses that will likely perform satisfactorily in most parts of Virginia. You can obtain information on Virginia's sod producers in the *Virginia Sod Directory*, Virginia Cooperative Extension publication 418-040, at *http://www.ext.vt.edu/pubs/turf/418-040/418-040.html*. Do some research, utilize the resources in the Web links from Virginia Cooperative Extension, and don't be afraid to ask the "tough" questions regarding the suitability and quality of grasses that are for sale. Always select certified ("blue-tag") seed and/or sod when choosing a grass. A lawn is something you expect to have indefinitely, so a commitment to choosing the best possible grass goes far towards long-term success.

Timing for establishing warm-season grasses. Mid-spring through mid-summer is the optimum time to plant warm-season grasses. Warm-season grasses need soil temperatures in the 65 ° to 75°F range for seed germination, but the optimal establishment period continues into mid-July as long as irrigation is available to support initial growth and establishment. Soil temperatures are suitable for planting as late as August, but the turf is less likely to mature satisfactorily to ensure winter survival following such a late planting date.

Soil preparation. For renovations that are needed due to an abundance of weeds, apply nonselective chemicals such as glyphosate or glufosinate in advance of planting to control existing vegetation. The temperature must be warm enough that the existing vegetation will absorb and translocate the chemical, so avoid making the application during cold weather when temperatures are less than 50°F. When possible, completely till the soil to a four- to six-inch depth prior to seeding. If soil tests indicate lime or other nutrients are needed, apply them prior to tilling in order to incorporate the material into the profile. Apply a starter fertilizer emphasizing phosphorus (P) levels as compared to nitrogen (N). These products will have typical nutrient ratios of N-P-K (potassium) of 1:2:1 or 1:2:2. It is equally important to provide some degree of soil preparation even for interseeding situations into existing turf. A few passes with a coring machine (often called an aerifier), a power rake, or a vertical mower (often called a dethatcher) can be used to prep the soil prior to planting to encourage seed-to-soil contact. Simply applying seed over the top of an existing turf without any soil preparation usually does nothing more than feed birds and other wildlife. All the warm-season turfgrasses that are routinely seeded have very small seed that should remain at the soil surface. You want good soil to seed contact, but you do not want to bury the seed. Lightly rake or drag the seed in to maximize seedling establishment.

Some tillage also is required for the successful establishment of sod (either warm- or cool-season grasses), sprigs (shredded sod), or plugs. The warm-season grasses recommended for Virginia can all be planted by sprigs or plugs because they possess the ability to creep laterally (Figures 2 and 3). Remember that suitable tillage does not mean destroying the existing soil structure by disking it into powder; leaving some clods is fine (Figure 4).

For further information on planting rates and successful establishment methods, consult *Establishing Lawns*, Virginia Cooperative Extension publication 426-718, at *http://www.ext.vt.edu/pubs/envirohort/426-718/426-718.html.*

Figure 2. Bermudagrass sprigs (shredded rhizomes and stolons) have been pressed into the soil with a walk-behind planting machine.

Figure 3. Most warm-season grass plugs can be installed on 6 to 12-inch centers.

Figure 4. Tilling the soil is critical for success, but leaving some clods is preferable to pulverizing the existing soil into powder.

Initial irrigation and mowing strategies. After planting the seed, irrigate lightly and frequently until seed germination is complete. Avoid excessive amounts of water because this could wash away or drown the seed. As establishment progresses, gradually cut back on the amount of water applied in order to start promoting a deep root system. The irrigation philosophy is similar for sod and plug establishment, but larger amounts of water can be applied to sod and plugs less frequently because these plant materials have soil and some root mass intact. The initial irrigation strategy for sprigs is to keep the sprigs and the soil thoroughly moist until rooting is initiated. The potential for desiccation of sprigs is very high, so keeping the soil on the "wetter" side is better than dry until the sprigs have begun to tack down into the soil. Then reduce watering requirements as described above. Irrigation during the summer months requires special considerations due to high water use and loss rates. Consult *Summer Lawn Management: Watering the Lawn*, Virginia Cooperative Extension publication 430-010, at *http://www.ext.vt.edu/pubs/turf/430-010/430-010.html* for complete information.

Mow turf when it needs to be clipped according to its recommended cutting height and follow the one-third mowing rule that says you should never remove more than one-third of the leaf blade at any mowing event. For example, if the current height of your zoysiagrass lawn is one and one-half inches, mow the turf no lower than one inch. Regular mowing at the low end of the recommended range for the respective grasses encourages lateral growth. Mowing height recommendations and guidelines for recycling clippings are presented in *Mowing to Recycle Grass Clippings: Let the Clips Fall Where They May!*, Virginia Cooperative Extension publication 430-402, at *http://www.ext.vt.edu/pubs/turf/430-402/430-402.html*. Be sure your mower blade is sharp, properly balanced, and that your soil surface is sufficiently firm so you do not cause ruts or footprints on the surface.

Fertility programs

Mid-spring through summer is the optimal period to fertilize bermudagrass, zoysiagrass, St. Augustinegrass, and centipedegrass. As a rule of thumb, initiate fertility programs after the complete spring greening of the warm-season turf. The warm-season grasses begin to emerge from winter dormancy as soil temperatures gradually rise above 50°F, but it usually takes three to four weeks for complete greening. There is an important balance between shoots and roots that must be maintained in order to maximize turf performance. Warm-season species essentially have annual root systems that must be replaced each spring. However, shoot systems are regenerated first because the food-making process (photosynthesis) is essential for new growth and development. Until photosynthetic rates (and leaf emergence) are complete, root development and food storage are put on hold. Anything that excessively depletes food reserves or causes an excess in spring shoot production (i.e. heavy nitrogen fertilization) reduces root formation and promotes shoot growth at the expense of roots for warm-season grasses.

Heavy nitrogen fertility (levels of one pound of water-soluble nitrogen per 1,000 square feet in the months of April and May) can be very detrimental to the grass, especially if there is a late frost after green-up. Frost events during and/or after spring greening are very damaging to the spring root development of warm-season turfgrasses. Depending upon the degree of injury, the plant may be forced to completely exhaust its food reserves, to initiate another generation of leaves and shoots.

Many of the products available to homeowners in the spring are "first step" components in lawn care product lines that are designed for the entire growing season (spring through fall). These initial products are frequently called "weed-and-feed" because they contain a preemergent herbicide on a fertilizer carrier. These products must be applied either during or just before the spring transition to kill the crabgrass seedlings that are emerging just as the warm-season grass starts to break dormancy. This is well before the transitioning turf can efficiently utilize the nitrogen, so be sure to select fertil-

izers or "weed-and-feed" products that are either low in total nitrogen or have 50 percent or greater water-insoluble nitrogen. Again, excessive levels of water-soluble nitrogen tend to promote shoot growth at the expense of roots, and the effects of a weak root system can become very evident when the hot, dry weather of summer ensues. Consult *Lawn Fertilization in Virginia,* Virginia Cooperative Extension publication 430-011, at *http://www.ext.vt.edu/pubs/turf/430-011/430-011.html* for more information on how to distinguish between nitrogen sources and their recommended seasonal application rates. Apply other supplemental nutrients (for instance, phosphorus or potassium) and lime according to soil-test results.

If you want an early-season color response, foliar applications of iron will provide a rapid greening response without a flush of shoot growth on actively growing turf. Since iron is a micronutrient, its application levels are very low. The color response is short-lived (typically two to three weeks) because the iron-induced color response in the leaves is removed by mowing. Other nutrients such as magnesium and sulfur can also provide a greening response, but applications of these elements should be based on need as indicated by soil tests.

Cultural management programs

Core cultivation. Core aeration (commonly called "aerifying" or "plugging") is the typical type of cultivation done on home lawns to relieve soil compaction (Figure 5). Aeration on warm-season grasses should be done when the turf is actively growing and not during the spring transition period. It can be done anytime from mid-spring through mid-summer as long as the soil is sufficiently moist (not saturated) to allow for tine penetration. Core aeration is very disruptive to surface smoothness, but it is the best way to relieve the physical limitations of soil compaction and improve soil oxygen levels.

Figure 5. A walk-behind core aeration machine can be used on home lawns.

Many commercial lawn-care services provide core cultivation as part of their annual service programs. Also, you can rent an aerator from an equipment supply business. To encourage turf recovery, use an aggressive fertility and irrigation program to restore turf density to its desired level after core aeration during the growing season.

Spring cultivation can disrupt weed control if you applied a preemergent herbicide. If possible, avoid aerating until four to six weeks after the herbicide application to keep from breaking the desired chemical barrier in the soil. Ideally, core aeration of warm-season grasses should not take place until after complete greening of the turf. An actively growing grass is better able to quickly recover from the cultivation event later in the year.

Vertical mowing. Perform vertical mowing (often called dethatching) as needed on warm-season grasses during the primary growing months of summer. The key words here are "as needed" – its effects are very disruptive to the turf and detract from a lawn's appearance. A vertical mower has blades that penetrate into the turfgrass canopy rather than across the turf as does a normal rotary mower (Figure 6). One of the primary reasons for vertical mowing is thatch removal. Thatch, a layer predominantly comprised of undecomposed stems, signals

Figure 6. A vertical mower has blades that remove the thatch layer.

an imbalance between the biomass that the turf is producing and how fast it can be decomposed (Figure 7). Leaf clippings are not a significant component of thatch, so it is still wise to return clippings to the turf rather than bagging them. Roots residing in thatch layers that are more than one-half inch in depth will quickly suffer from moisture stress during the summer months. Plus, the thatch layer is a haven for many insect pests and fungal spores that can incite disease.

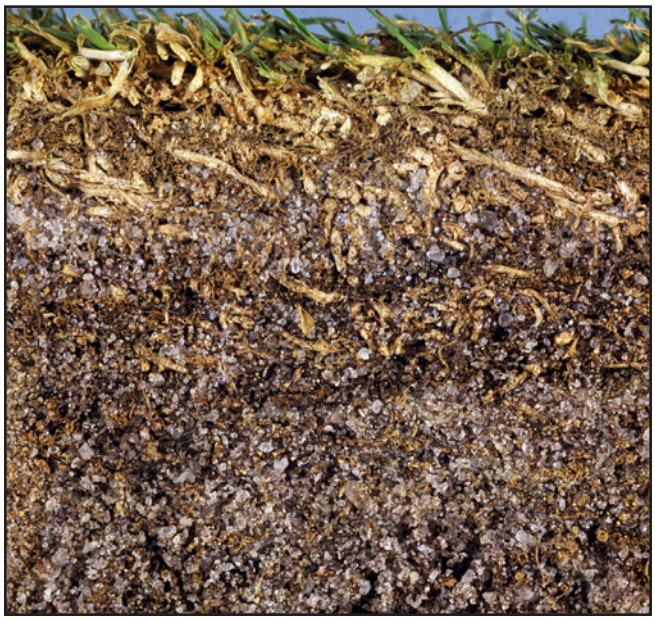

Figure 7. This turf has developed a thatch layer significantly greater than one-half inch in depth.

All warm-season turfgrasses grown in Virginia lawns can produce thatch because each has the ability to creep by lateral stems (stolons and/or rhizomes), plant parts that resist rapid microbial decomposition. Aggressive management programs (high levels of fertilizers and other chemicals) that produce high rates of turf growth also produce greater amounts of thatch. Anticipate that high-maintenance lawns will accumulate a significant thatch layer every two to three years.

Vertical mowing physically removes thatch. Expect significant turf thinning due to the process (Figure 8). Once vertical mowing is complete, remove the thatch and other debris that has been brought to the surface by raking or sweeping. Note that many of the stems that have been brought to the surface can actually be used as planting material, i.e. sprigs, in other areas of the lawn. You can vertically mow warm-season turfgrasses from late spring through mid-summer when the turf can quickly recover by way of proper fertility and irrigation applications. Avoid this cultivation in late summer and fall because there is insufficient turf

Figure 8. Significant turf disruption is expected when using a vertical mower for thatch removal.

recovery time prior to winter dormancy. Finally, vertical mowing is not a tool to improve soil aeration, and you should use it only when needed for thatch removal or in the preparation of a seedbed.

Pest management

The best way to minimize pests is to maintain a healthy, dense turf. You can achieve this by following sound management programs based on the principles previously discussed and by buying the correct turfgrass for the situation. However, weeds, diseases, and insects will invade turf periodically even with the best management programs in place. The occurrence of diseases and insects usually is sporadic, but it is highly likely that most lawns will have some level of weed pressure. For that reason, more detail is provided for chemical control alternatives for weed management than for disease and insect pests.

Proper identification of the pest is obviously crucial in determining how (and even if) a treatment is made. Virginia Tech provides numerous resources for the identification of weeds, insects, and diseases. The general instructions on the proper way to collect and to submit a sample for identification are found at *http://www.ppws.vt.edu/~clinic/instructions.html*. For weed identification, there are two excellent resources available through Virginia Tech websites that serve as "do-it-yourself" programs. The *Weed Identification Guide* can be found at *http://www.ppws.vt.edu/scott/weed_id/rightsid.htm*. This website will lead you through each step in plant identification keys, as well as provide pictures of the plant. A website more specifically for turfgrass weeds is *http://www.turfweeds.net/*. This site is maintained by Virginia Cooperative Extension Turfgrass Weed Scientist Shawn Askew.

The following sections detail only the primary pests likely to occur in Virginia's warm-season lawns and successful cultural and chemical strategies to deal with them. Complete details of pesticides, the pests controlled, and the application rates and timing are provided in the *Pest Management Guide* found at *http://www.ext.vt.edu/pubs/pmg/.*

Weeds

Preemergent weed control in established turf. Summer annual grasses (crabgrass, goosegrass, foxtail, etc.) are the most common targets for preemergent herbicide treatment in the spring but many other grass and broadleaf weeds also germinate as soil temperatures warm and days grow longer. The rapid growth potential of these summer annual weeds warrants the use of preemergent herbicides to prevent weed germination and the subsequent reduction in turfgrass quality. The key to the effectiveness of preemergent herbicides is timing the applications to before the weeds emerge. Mother Nature provides reminders for proper preemergent herbicide treatment timing in the form of the following ornamental plants: daffodils, forsythia, and dogwoods (Figure 9). Apply preemergent herbicides for crabgrass and other summer annual weeds when these ornamentals are blooming prolifically. Forsythia and daffodils bloom early in this window of application, and dogwoods bloom at the end of the recommended application period. Several preemergent herbicides are available for lawn applications and Table 1 lists some of the most common products.

Figure 9. The bright yellow flowers of the forsythia serve as a reminder for timing preemergent crabgrass herbicide applications.

Table 1. Preemergent herbicide options available for home-lawn applications to warm-season turfgrasses by the homeowner and/or professional applicators.

Common chemical name	Some popular trade names[z]
Benefin	Balan™
Dithiopyr	Dimension™
Metolachlor	Pennant™
Oxadiazon	Ronstar™
Pendimethalin	Pendulum™, Pre-M™
Prodiamine	Barricade™
Simazine	Princep™

[z] Always follow label directions.

Corn gluten meal is an organic compound that is marketed for preemergent crabgrass control. Note that this material is usually about 8 percent to 10 percent nitrogen by weight, and normal application rates to gain weed control will also typically supply approximately one pound of nitrogen per 1,000 square feet, more than is recommended for a spring nitrogen application. The limitation with this product is that it has rarely provided better than 60 percent weed control in research trials at Virginia Tech. Breakthroughs in crabgrass control are likely to occur.

In addition to applications of herbicides alone, many formulations of "weed-and-feed" materials (products with a preemergent herbicide impregnated on a fertilizer carrier) are popular in spring lawn applications. Simply check the product bag for the common chemical names in Table 1. These products are well suited for warm-season turfgrass in spring and early summer. When applied before warm-season turfgrass starts growing, choose weed-and-feed products with high percentages of slow-release nitrogen (water-insoluble nitrogen). Choose products that do not have preemergence herbicides for extended fertilizer applications during the summer season.

It is necessary for all preemergent herbicides to be watered in soon after application to the turf surface. Most products must receive at least one-quarter inch of water within 48 hours of application or the herbicide will begin to decompose due to the effects of the sun and lose efficacy.

Crabgrass control at seeding. None of the products in Table 1 may be safely applied when seeding warm-season turfgrasses. However, some of these herbicides,

especially oxadiazon, can be safely applied to warm-season grasses that are being established vegetatively by sprigging or plugging (consult the label).

Quinclorac (Drive™) can be applied just before or at seeding of bermudagrass for crabgrass control. After seedling emergence, postemergent herbicides such as MSMA (many trade names), and the aforementioned Drive™ can be applied. You must follow label directions very carefully in order to maximize crabgrass control without damaging or killing turf seedlings.

Postemergent crabgrass control in late spring and summer. The previously mentioned Drive™ is an early postemergent crabgrass herbicide with excellent safety in warm-season grasses. As a postemergent herbicide, quinclorac requires an adjuvant such as crop-oil concentrate or methylated seed oil to maximize effectiveness. There are also several arsonate products (for example, MSMA) that can be used when temperatures are 80°F or greater on bermudagrass and zoysiagrass. For postemergent crabgrass control in centipedegrass, sethoxydim (Vantage™) is the labeled product. Unfortunately, there are no postemergent herbicides labeled and/or readily available for crabgrass control in St. Augustinegrass lawns.

Spring and summer broadleaf weed control. In mature turf, applications of broadleaf herbicides can usually be made as soon as temperatures warm such that the weed is actively growing. Typically, this will be when air temperatures are ≥ 70°F. Some of the most popular broadleaf herbicides and their combinations are listed in Table 2.

Table 2. Some popular broadleaf weed herbicides used in warm-season turfgrasses.[z]

Common chemical name(s)	Trade name
2,4 dichlorophenoxyacetic acid[y]	Many products available
Dicamba[y]	Banvel™ and others
Mecoprop[y]	Many products available
Carfentrazone + 2,4-D + dicamba + MCPP	Powerzone™
Metsulfuron	Manor™, Blade™

[z] Always follow label directions.

[y] Two- and three-way combinations of these and other similar chemistries are readily available and their combinations are often desirable due to synergistic activity.

Controlling weeds before they flower in the early spring is an excellent way to prevent them from completing their life cycle and producing seed. This strategy applies to either perennial (e.g. dandelions, clover, plantains, etc.) or annual weeds. However, if the primary weed problem consists of winter annual plants (for instance weeds such as henbit, chickweed, or geranium) that have already flowered, then the herbicide will be of little value since the weeds have completed their life cycle.

As temperatures warm, the use of many broadleaf herbicides require extra caution because of the potential for damage to the turf (especially centipedegrass and St. Augustinegrass), and other desirable landscape and garden plants. Pay careful attention to environmental conditions such as wind and relative humidity in the summer because of the potential for off-site movement onto desirable plants.

Control of sedges. Sedges can be distinguished from grasses by their distinctive triangular stem. Sedges are highly competitive in poorly drained soils, but they can be a problem anywhere in the landscape. There are both annual and perennial sedges, but the primary sedge of importance in Virginia is the perennial yellow nutsedge. Halosulfuron (Manage™) controls more species of sedge than any other herbicide available for use in warm-season turf lawns. Bentazon (Basagran™, Lescogran™) and MSMA can be used to control a variety of annual sedges and yellow nutsedge but they do not control other perennial sedges such as kyllinga and purple nutsedge. These two herbicides should be applied to young sedge and at least two to three treatments are needed for complete control. Treat sedges when they are actively growing in late spring through summer.

Control of winter weeds. When warm-season turfgrasses enter dormancy, they turn brown and contrast with emerging green winter weeds such as annual bluegrass, chickweed, wild garlic, etc. Winter broadleaf and grass weeds can be controlled in **dormant** (emphasize dormant!) turf in late winter to early spring with glyphosate (Roundup™, Touchdown™) and glufosinate (Finale™). Annual bluegrass and other cool-season grasses (perhaps ryegrass from winter overseeding) can be controlled in bermudagrass and zoysiagrass with Revolver™. Metsulfuron (Manor™) controls many broadleaf weeds and suppresses annual bluegrass and some other cool-season grasses. Products like Manor™ and Revolver™ work most ef-

fectively when applied at temperatures above 60°F. (If you are dealing with a major winter-weed problem in the spring in your warm-season turf, you might want to consider a fall preemergent herbicide application using one of the chemicals in Table 1 or depending on the weed and your location, an application of a product such as simazine (Princep™) for grass and broadleaf control or isoxaben (Gallary™), probably the best broadleaf preemergent chemistry available.

Wild garlic and onion can be controlled with repeated applications of products that contain 2,4-D. These products also perform best when applied in fall while the garlic is young, but many times garlic control is not attempted until late winter or early spring. Wild garlic control can be improved by soaking a scrap of synthetic carpet with herbicide (e.g., Speedzone™) and rubbing garlic plants by dragging the carpet scrap over them. The carpet fibers tend to break the waxy barrier found on wild garlic leaves that restricts herbicide absorption.

Diseases

Diseases on warm-season grasses are typically not as severe as on cool-season grasses. This is due primarily to the relative health of plants during the disease development period. The fungi that cause the most severe diseases in turf are active during the warm, summer months. This is also the time when warm-season grasses are growing the best; therefore, they are more able to tolerate disease. It is very important to know that you actually have a fungal-incited disease before planning a treatment program. One of the most common "diseases" in the lawn is incited by dull mower blades (Figure 10). Once you have determined that there is a disease affecting the turf, the first step is to properly identify the pest. Pictures of the disease symptoms (leaf spots, patches, etc.) or signs (the fungus itself) of the predominant spring and summer diseases in Virginia's warm-season turfgrasses are provided here. There are also numerous websites and books that have detailed information on many turf diseases. You can also send samples of diseased turf to your Extension agent for help in identifying the pest so that proper treatments can be recommended. When collecting a sample for disease diagnosis, be sure it includes the margin between the healthy grass and the diseased leaves as this is where the pathogen is most likely to be located. Get the sample to a specialist promptly after sampling.

Figure 10. This turf "disease" on zoysiagrass is incited by clipping with dull mower blades.

While the control recommendations for each disease can vary, there are several cultural strategies that can reduce the severity of most diseases. Minimizing the duration of leaf wetness will decrease the chances of most diseases developing. While we have no control over Mother Nature, we can modify irrigation schedules and air circulation. Set irrigation to run in the early morning hours with the cycle being completed around sunrise. In areas with poor air circulation, thin and "limb-up" surrounding trees. The increased circulation and decreased shade will result in more rapid drying of the turf. Another strategy to reduce disease pressure, as discussed above, is thatch management. The thatch layer should not exceed one-half inch. Large thatch layers can reduce the overall health of the plant, while also serving as a reservoir for many fungi. Fertilization schedules should be balanced and constantly amended based on ever-changing conditions. High levels of nitrogen may increase the severity of Rhizoctonia blight, while low levels may promote dollar spot.

There are certain diseases that tend to be more prevalent on specific warm-season turfgrasses. Typically, St. Augustinegrass has the highest disease pressure of the warm-season turfgrasses with diseases such as gray leaf spot and brown patch likely to occur each year. Zoysiagrass is particularly susceptible to yellow patch, a disease incited by a species of *Rhizoctonia* that occurs in early to mid-spring. Bermudagrass has particular problems with spring dead spot. Centipedegrass usually has minimal disease pressure unless it is receiving higher than recommended nitrogen levels. The primary diseases likely to occur on warm-season turfgrasses are discussed here.

Spring dead spot. This is by far the most serious disease of bermudagrass. As the name implies, the symptoms appear in the spring as bermudagrass emerges from winter dormancy (Figure 11). However, the dis-

Figure 11. As bermudagrass emerges from winter dormancy, the symptoms of spring dead spot become obvious.

ease is caused by a soil-borne fungus that attacks the turf's root system in the fall and there is no evidence of the damage until the dead grass is seen next spring. Treating with a fungicide in the spring is futile and at this time, the best thing to do is to make note of the location because this is where the disease is likely to occur next year. Treat the noted areas with a fungicide in September in order to control the disease next season. For more effective control, a sequential application should be made in October. Multiple studies have shown that control is less than stellar after the first year of applying fungicide. The level of control is greatly increased after consecutive years of spraying in the fall. Raising the mowing height and ensuring that potassium nutrition is satisfactory are two cultural methods of reducing disease pressure. Avoiding excessive nitrogen applications in late summer and early fall can reduce disease severity. In addition, when thatch accumulation exceeds one-half inch, the disease is more severe. High levels of spring dead spot are often associated with compacted and poorly draining soils. Core cultivation is recommended to reduce this stress.

Dollar spot. Dollar spot can occur on any warm-season grass beginning in the spring during the first warm, moist periods of the season, and continuing into early fall. The cottony-like web of the fungus is clearly visible early in the morning when dew is present (Figure 12), and the leaves will have characteristic hour-glass shaped lesions (Figure 13). Straw-colored patches may range from one to three inches to several feet in diameter. This disease is often an indicator of low nitrogen fertility, but do not apply excessive nitrogen because it can increase the likelihood of other diseases and negatively affect the root to shoot ratio. Limited infections usually do not cause massive turf loss, but the plant

Figure 12. The cottony-like mycelia of dollar spot often appear under heavy dew conditions in the morning.

Figure 13. The "hour-glass" shape lesion is characteristic on leaves infected by dollar spot.

can be weakened such that it is subject to environmental stress later in the summer. Plants that have been stressed by drought become more susceptible to this disease. Dollar spot can be confused with webs spun by spiders or insects, or with "dull-mower injury," so be sure to properly diagnose the pest before making any chemical application.

Leaf spot. There are many fungi that incite leaf spots (gray leaf spot, melting out, etc.) that can appear on all warm-season turfgrasses during warm, wet periods of mid- to late spring through early fall. As the name implies, the symptoms of most leaf-spot diseases are dark, water-soaked lesions that appear first on the leaves (Figure 14). If the fungus only attacks the leaves, it is more of a nuisance than a serious pest. However, pay attention so that the disease does not progress

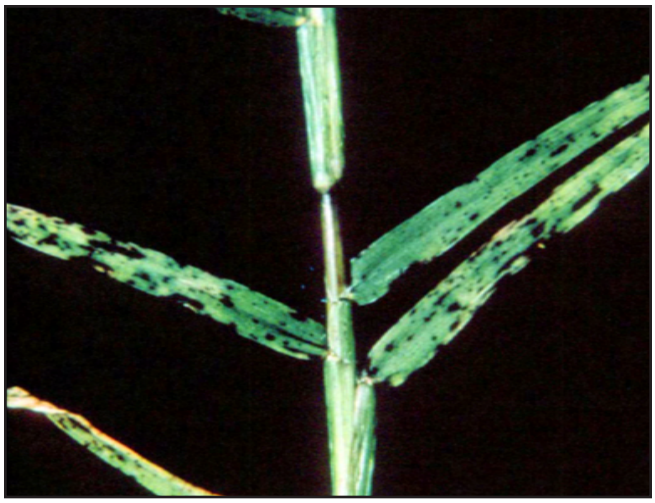

Figure 14. This photo shows the characteristic symptoms of a leaf spot disease that is rapidly progressing to a crown blight as the fungus moves from the leaves to the stems.

into a stem blight that ultimately attacks the growing points. This phase of the disease is often called "melting out." If infections are severe, like dollar spot, they can possibly lead to turf damage later in the summer when environmental conditions are more stressful. St. Augustinegrass is particularly susceptible to gray leaf spot (Figure 15). This disease is most severe when night temperatures exceed 70ºF. The gray spots on leaves are round to oval and are often surrounded by a brown or yellow border. Leaves may have a grayish cast with dieback from the tip.

Rhizoctonia-*incited diseases.* There are three important diseases incited by *Rhizoctonia* fungi. Collectively, these diseases are referred to as "brown patch." "Cool-weather brown patch," also called "yellow patch," occurs on zoysiagrass and bermudagrass in the early spring just after the turf emerges from dormancy. The classic symptom is a yellow to straw-colored circular patch or ring that gradually increases in size as the fungus spreads through the foliage (Figure 16). The primary *Rhizoctonia*-incited disease is Rhizoctonia blight or "brown patch" that can attack all warm-season turfgrasses. While Rhizoctonia blight is most severe on cool-season turfgrasses during warm, wet periods, the disease is more severe on warm-season grasses in the spring and fall, when the turfgrass is not thriving. This disease, though unsightly, often does not warrant fungicide treatment if the turf inside the patch is recovering as shown in Figure 17. However, if the fungus begins to attack the growing points of the plant, the disease can be quite destructive. Rhizoctonia leaf and sheath spot, or "hot-weather brown patch," can cause irregularly shaped leaf lesions similar to those associated with Rhizoctonia blight. This disease develops during hot, wet weather but generally does not progress beyond the leaf lesions phase. The lesions on the leaves affected by a Rhizoctonia fungus are quite distinct from those of dollar spot (Figure 18). High levels

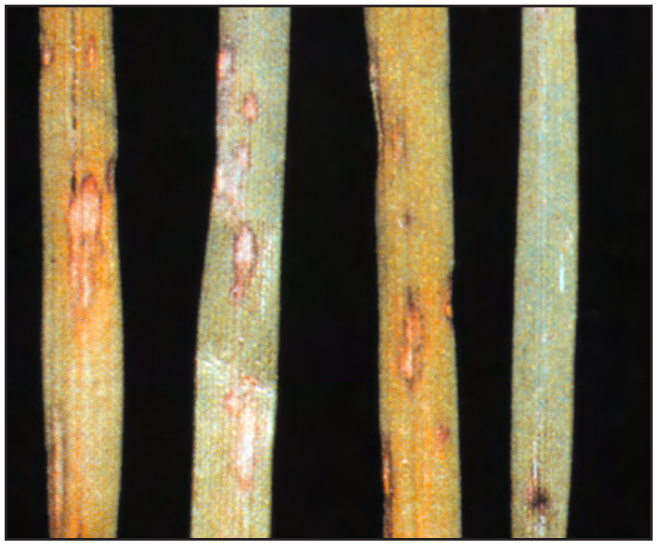

Figure 15. This photo shows the characteristic symptoms of gray leaf spot on the leaves of St. Augustinegrass.

Figure 16. Yellow patch causes the light rings in the bermudagrass turf of a golf course fairway in late March.

Figure 17. Bermudagrass shows signs of recovery from a mid-spring infection of brown patch.

Figure 18. Brown patch does not have characteristic leaf symptoms as observed for dollar spot (Figure 13).

of nitrogen fertilization often exacerbate each disease. Apply moderate levels of nutrients monthly, or in accordance with soil-test results.

Table 3 lists the fungicides that have provided the best levels of control for these diseases in trials conducted by Virginia Tech plant pathology personnel.

Insects

Due to the rapid growth rate of warm-season turfgrasses, most insect pests are not major problems. However, grubworms, chinch bugs, and caterpillars such as armyworms, cutworms, and webworms can all cause significant damage if their numbers are high enough and the turf is under stress. As for diseases, proper identification of the pest and an understanding of where the pest is feeding (above ground or below ground) is necessary to maximize control. If you suspect an insect is feeding on your turf, a soap flush is an excellent way to identify aboveground pests. Simply remove both ends of a large coffee can and drive the cylinder into the soil at least an inch deep. Fill the can half way with a soapy-water solution and watch for the pests to float to the surface (Figure 19). If you do not know what the pest is, Virginia Cooperative Extension personnel can aid you in its identification and control.

Figure 19. A soap flush can aid in the identification of surface insect pests.

The most significant insect pest most often is the white grub. When disturbed in the soil, the grub will curl into a "C" shape and lay motionless for a brief period as pictured in Figure 20. White grubs are the larval stages of several different beetles, and they come in many dif-

Table 3. Fungicides recommended for the control of the most problematic diseases on warm-season turfgrasses in Virginia lawns.[z]

Common chemical name[y]	Trade name	Dollar Spot	Leaf spot	*Rhizoctonia*-incited diseases[x]	Spring dead spot[w]
Triadimefon	Bayleton™	X		X	X
Myclobutanil	Eagle™	X		X	X
Azoxystrobin	Heritage™		X	X	X
Mancozeb	Fore Rainshield™		X	X	
Propiconazole	Banner™	X	X		
Flutolanil	Prostar™			X	

[z] For complete listing of diseases and fungicide controls, consult the *Pest Management Guide* at *http://www.ext.vt.edu/pubs/pmg/.*

[y] Apply all chemicals according to label directions.

[w] Do not treat in the spring, but note location and plan to treat in early fall.

Figure 20. A white grub, the larval stage of several beetles, feeds on turfgrass roots.

ferent sizes ranging from less than one-quarter inch in length for grubs of the Black Turfgrass Aetinius to over one inch in length for the grubs of the Green June beetle. Grubs feed on turfgrass roots with chewing mouthparts. Because of the damage to the roots, the most noticeable symptom is wilting turf during dry periods.

Most grubs have an annual life cycle similar to that pictured in Figure 21. Overwintering grubs burrow several inches in the soil to survive the cold and then begin to migrate to the surface as the soil temperatures warm in the spring, all the while feeding on plant roots. By late spring they will reach their maximum size as worms before they go through their final metamorphosis from grub to beetle. Due to their size, chemical control is very difficult at this time. As the adults emerge, they are going to emphasize mating in order to set the stage for next season's grubs, and a few of the beetles (such as the Japanese beetle picture in Figure 22) can be a major problem on other landscape plants. From a turfgrass perspective, this is still not the appropriate time to chemically treat the beetles. This should be done in mid-July through mid-August after the recently laid eggs have hatched and the immature grubs are very small and near the soil surface. Based on the location of feeding, chemicals must be watered into the soil according to label directions in order to be effective.

Figure 22. The adult stage of the Japanese beetle is a serious pest on many plants in the landscape.

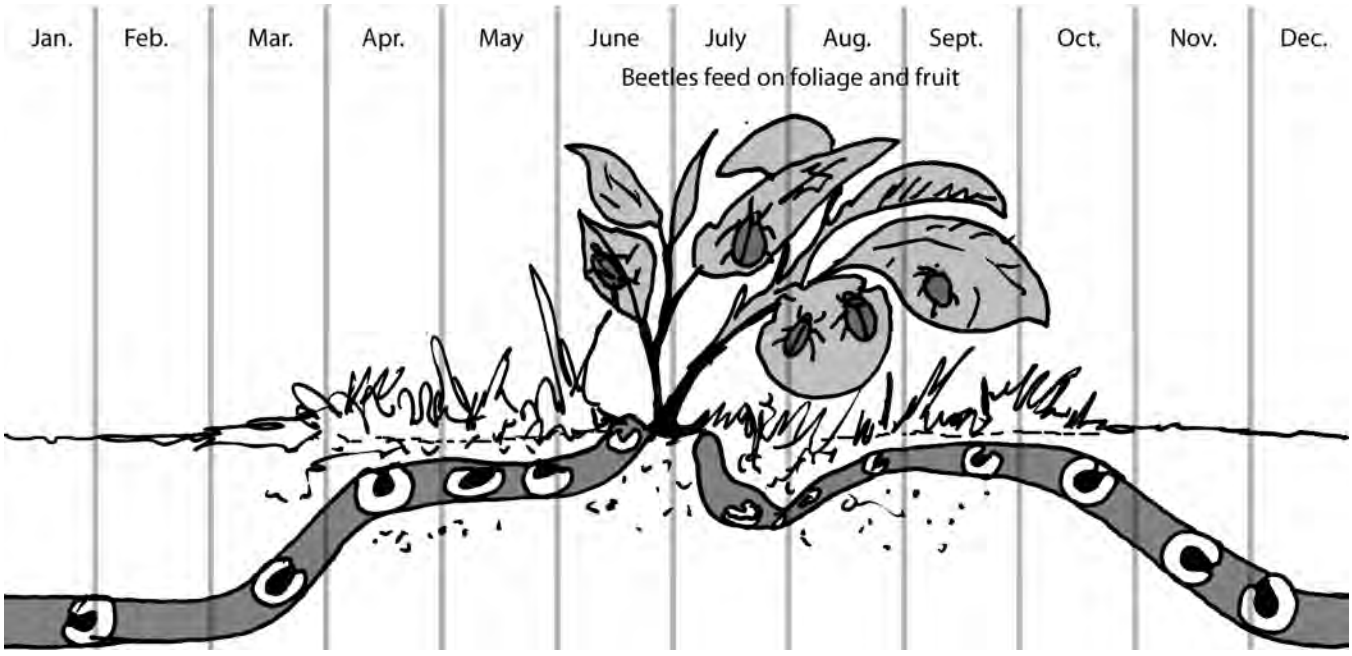

Figure 21. The life-cycle stages of most annual beetles include above- and belowground activity.

Any insecticide application should be carefully considered before treatment because of the potential for killing non-target, beneficial insects. In particular, it is not always necessary to treat for grubs. If only a few are present, their damage to turf is negligible. Scout the turf using a shovel to lift the sod in a one-square-foot area if you suspect grubs might be causing damage. Numbers of six to ten grubs per square foot justify treatment for most species. Still, just because you see a few grubs when digging in the lawn and garden in the spring does not mean that you should apply chemicals. Grub damage will be associated with moisture-stressed (i.e. wilted) turf that simply does not respond quickly to irrigation or rainfall events because its root system has been attacked. Warm-season turfgrasses usually grow so quickly that they can withstand grub attacks, and you never see signs of wilt. Another likely sign that you have a grub problem is if you observe lawn damage by burrowing animals (especially skunks) that feed on grubs. As mentioned above, be sure to scout the soil to identify the problem before you make a broad-spectrum chemical application.

Chinch bugs (pictured in Figure 23) feed on above ground stems with piercing and sucking mouthparts. They are gold and black in color and are typically one-quarter inch in length. Damage can be significant when 15 to 20 insects per square foot are observed from a soapy-water flush. Both immature and adult chinch bugs feed on grasses, usually feeding on the stems under the protection of the leaf sheaths. This can make them difficult to see, so soap flushes as previously described can be beneficial. There can be multiple generations of chinch bugs over the summer and damage most likely occurs in full sun areas. The turf will take on a mottled yellow cast that can be confused with a disease (the loss of color is due to the injection of a toxin by the insect into the stem). Since chinch bugs feed above ground, foliar applications of insecticides are recommended and irrigation or rainfall immediately after the application is undesirable.

Figure 23. St. Augustinegrass is a favorite host of chinch bugs seen here feeding on a stem.

The most common caterpillars to attack turf are sod webworms, fall armyworms, and cutworms. These pests feed aboveground on leaves and stems with chewing mouthparts. Most appear in mid- to late summer and while their damage can be significant (particularly in dry periods), chemical treatment often is not necessary. The caterpillars will eventually pupate and transform into a moth as an adult. The fall armyworm can be identified by an inverted "Y" on its head (Figure 24) and it can be seen feeding on foliage at any time of day, typically notching the leaf as it feeds. Cutworms live in a hole in the ground but emerge from the hole to clip the foliage off at the soil surface. Similarly, sod webworms also reside in a hole in the ground and clip the turfgrass stem off at the soil surface. An important identification feature is the silken web that they spin

Figure 24. A fall armyworm has the characteristic "Y" on the top of its head.

Figure 25. You will find a hole in the ground and an area of turf that has been cropped off at the soil surface underneath the silken web spun by the sod webworm.

to camouflage their hole (Figure 25). The web can be confused with the fungal body of dollar spot or simply that of a spider. Be sure to properly identify the pest in order to choose the appropriate pesticide. Since all of the caterpillars discussed here feed above ground, surface applications of insecticides are recommended.

Carefully consider the non-target effects of any insecticide before treatment because of the possibility that beneficial insects might also be controlled. Fortunately, many of the newest generation insecticides (e.g. imidacloprid and halofenozide) target very specific pests, rather than possessing broad-spectrum activity. This reduces the likelihood of the insecticide harming beneficial, non-target insects and improves their environmental safety. Apply insecticides only when damage (or potential damage) warrants treatment. If chemicals are necessary, Table 4 details some of the most popular chemicals recommended by Virginia Cooperative Extension personnel for the major turf insect pests.

There are numerous biological control alternatives that have demonstrated significant activity on these pests as well. The products that have shown the most activity are certain entomopathogenic nematodes, a bacterium called *Baccillus thuriengensis,* and a fungus called *Beauvaria bassiana*. These biological-control products require careful selection (particularly regarding shelf life and the target pest) and application in order to be effective. They typically do not provide pest control as complete as standard insecticides, but they are specific to target pests, do not harm beneficial insects, and are safe to handle and for the environment. Single applications of biologicals are rarely successful in significant control. You must make a commitment to make regular applications of these products in order to replenish their populations in the environment.

Summary

This publication should help you appreciate the limitations and possibilities of spring and summer management of warm-season turfgrasses. By following these recommendations on turf selection and establishment, fertility, maintenance, and pest management, you can achieve a healthy, visually appealing warm-season lawn that is up to the challenge of Virginia's ever changing weather extremes.

Table 4. Insecticides recommended for the control of the most problematic insect pests in Virginia lawns.[z]

Common chemical name[y]	Trade name	Grubworm	Chinch bug	Caterpillars
Carbaryl	Sevin™		X	X
Imidacloprid	Merit ™	X	X	
Halofenozide	Mach 2™, Grubex™	X		X

[z] For a complete listing of insects and control recommendations, consult the *Pest Management Guide* at *http://www.ext.vt.edu/pubs/pmg/.*

[y] Apply all chemicals according to label directions.