MISSISSIPPI STATE UNIVERSITY EXTENSION

Establish and Manage Your Home Lawn

The home lawn and turf areas surrounding churches, parks, and office buildings do more than just serve as pleasant green backdrops. The grass plants that make up the lawns serve as miniature air-conditioners and pollution-abatement centers.

On a block of eight houses, the front lawns have the cooling effect of 70 tons of air-conditioning. The plants, in transpiring water to cool themselves, also cool the surrounding area. Roughly 50 percent of the heat striking a turf area is eliminated by transpiration. When the temperature of the sidewalk is 100°F, the temperature of the adjacent turf remains near 75°F. This cooling may last into the night, with studies showing a 13-degree cooling at 9 p.m.

This air-conditioning is not free, however. An average 5,000-square-foot lawn transpires about 3,000 gallons of water on a hot summer day. If this water is not supplied by rain, it must be applied by some other means.

Turfgrass also functions as a noise barrier. Studies at the Riverbank Acoustical Laboratory in Geneva, Illinois, found Kentucky bluegrass turf more sound-absorbent than a heavy carpet on a felt pad.

One of the most significant byproducts of a living, green backdrop is its effect upon the atmosphere. A 250-square-foot lawn produces enough oxygen for a family of four. The average lawn traps significant amounts of carbon dioxide, peroxyacetyl nitrates, and ozone, as well as particulate matter.

A most important effect is the prevention of soil erosion and enhancement of groundwater recharge. Research shows infiltration is much higher on turfed areas than on areas of bare ground. The higher infiltration prevents water from running off and encourages it to enter the groundwater stream. Grass roots bind the soil more effectively than any other plant.

Many gardeners enjoy maintaining a quality turf. Others despise lawn work and demand a low-maintenance turfgrass. Still others are confused about how to keep a lawn. You don't have to be an expert to have a quality lawn; neither do you have to spend all your leisure time working on it. By learning a few basic facts about turfgrass, you can have the best lawn on the block. Also, you can choose a turfgrass to suit the time and money you have for maintenance.

The question is, "What is the best lawn grass for you?" Choosing the best grass involves personal judgment based on your needs and the conditions of your property. Each variety of grass has its advantages and disadvantages. Some grow in the shade; others need full sun. Some grow in all parts of the state; some grow only in certain areas. Some require lots of time and patience; others are less troublesome. Some are fast growers, and some are slow growers.

Sound confusing? It really isn't. Be aware of the great versatility of lawn grasses and the choices you have. Remember, a quality lawn can make or break your landscape design. Learning the basics of turfgrass establishment and care, followed by a little hard work, will ensure success.

Select the Right Grass

Turfgrasses are divided into two groups by the temperature range under which they grow best. Warm-season grasses grow best at temperatures above 80°F, while cool-season grasses grow best at temperatures between 60 and 75°F.

Warm-season grasses form a thick mat of turf through horizontal growing stems called stolons or rhizomes. Stolons are stems that grow above the ground, and rhizomes grow just beneath the surface of the soil.

Cool-season grasses, with the exception of the bluegrasses, do not have these specialized stems. Cool-season grasses are referred to as "bunch" grasses, since each grass plant forms one clump (or bunch) and does not spread extensively.

The warm-season grasses are native to tropic and subtropic Africa, South America, or Asia. The adaptation of bermudagrass to Mississippi's climate is apparent when you see it establishing in any bare patch of soil.

Other warm-season grasses grown for turf in Mississippi include St. Augustinegrass, centipedegrass, zoysiagrass, carpetgrass, and bahiagrass. These grasses grow actively in the spring, summer, and fall and go dormant when the temperature cools in the winter.

The brown color of winter can be relieved by seeding a cool-season grass into the dormant turf as discussed in Establishing Winter Lawns on page 14 or by painting the dormant turf with specially developed dyes. Many people appreciate the warm brown hue of bermudagrasses and zoysiagrasses in the winter and wouldn't think of changing it.

The cool-season grasses grown in Mississippi originated in Europe. Only the northern counties in Mississippi can successfully grow these species as a permanent lawn. Zone 7a is an area where warm- or cool-season grasses can be grown. The choice is a warm-season grass that may be winter-killed in a severe winter or a cool-season grass that must be nurtured through the long, hot days of summer. Cool-season grasses that can be grown in this area include tall fescue, Kentucky bluegrass, and creeping red fescue. Annual ryegrass and perennial ryegrass can be grown throughout the state as winter lawns but should not be considered permanent lawn species for any region of Mississippi.

Choosing the best grass for your situation involves four basic factors:

- sunlight
- temperature extremes
- maintenance work and costs
- soil

Sunlight—The most important factor in selecting the grass to grow is the amount of sunlight and shade you have. **No species of turfgrass will grow in complete shade.** If the area receives at least a half-day of direct sunlight, you can grow any of the grasses adapted to your region.

Bermudagrasses require the most light, followed by carpetgrass, bahiagrass, zoysiagrass, centipedegrass, Kentucky bluegrass, tall fescue, and red fescue. St. Augustinegrass is the most shade-tolerant, and it requires at least 3 hours of direct or high-quality, filtered sunlight a day to grow properly.

One deviation from the more-light-is-better rule of thumb is tall fescue. The temperature reduction from shade allows this cool-season grass to persist longer in summer in the shade than in full sun.

If you have areas (under trees or between buildings) that do not receive direct sunlight, consider other landscaping options, such as ground covers, mulched beds, or no plants at all.

Temperature—Temperature is important in determining which grasses will grow. Only in the northern tier of counties should cool-season lawns be expected to thrive. The climate zone map on page 4 indicates in which climate zone you

Figure 1. Half-day sun (top) and half-day shade (bottom).

live. The description of the individual grasses tells you which grasses are adapted to which climate zones.

The major limiting factor for warm-season grasses in Mississippi is the low temperatures experienced in winter. People who grow St. Augustinegrass or centipedegrass in zone 7a and the northern areas of zone 7b should expect to have some damage in severe winters. Carpetgrass growers in the northern counties should expect some damage every winter. The grasses can be grown outside their adapted areas, but efforts outside the ordinary are required to maintain them.

Maintenance—After you have narrowed the possibilities by eliminating grasses that won't grow due to light and temperature factors, decide how much work you want to put into this lawn. Some grasses are easily established with seed, while others require sprigs or plugs.

After the lawn is established, some grasses require little care other than occasional mowing, while others require almost constant attention to fertility, water, and pest control. If you want to take advantage of the ability of hybrid bermudagrass to give you a green carpet effect, plan on investing large amounts of time and money in fertilizing, watering, and mowing. If all you want is something to keep the mud off your shoes when you walk from the car to the door, consider centipedegrass or carpetgrass.

Soil—Each species of grass has a soil type to which it is best adapted. All the grasses perform well in well-drained, loamy soils, but most Mississippians do not have this ideal soil. The acid sandy soils of southeast Mississippi are very suitable for growing centipedegrass. Areas that stay too wet for centipedegrass support carpetgrass nicely. The heavy clay soils of the Blackland Prairie and Delta will not support good growth of bahiagrass, centipede, or carpetgrass.

The most important consideration of soils is the ability of water to move into and through the soil. No grass survives long in standing water. A second factor is the acidity level, or pH, of the soil. Although the pH is modified by adding limestone or sulfur, it is easier to plant an adapted grass than to constantly fight to adjust the pH.

Table 1. Turfgrass selection guide. (For winter hardness, see Figure 2 on state climate zones.)

	Light Requirements			Establishment					
Turfgrass	Half Day or More Sun	Filtered Sunlight	Shade	Seeding*	Sprigs, Plugs	Rate of Growth	Normal Color	Maintenance Requirements	Recovery from Stress
bahiagrass	Yes	Yes	No	Yes	No	Fast	Yellow green	Medium	Good
bermudagrass	Yes	No	No	Yes	Yes	Fast	Medium green	High	Excellent
St. Augustine-grass	Yes	Yes	Yes	No	Yes	Moderate	Medium green	High	Good
centipedegrass	Yes	Yes	No	Yes	Yes	Slow	Yellow green	Low	Fair
carpetgrass	Yes	Yes	No	Yes	Yes	Moderate	Yellow green	Low	Fair
zoysiagrass	Yes	Yes	Yes	No*	Yes	Slow	Medium green	Medium	Good
Kentucky bluegrass	Yes	Yes	No	Yes	Yes	Moderate	Blue green	Medium	Fair
tall fescue	Yes	Yes	Yes	Yes	Yes	Fast	Dark green	Low	Fair
creeping red fescue	Yes	Yes	Yes	Yes	Yes	Moderate	Yellow green	Low	Fair

*Some bermudagrass and zoysiagrass cultivars can be seeded and others established vegetatively only.

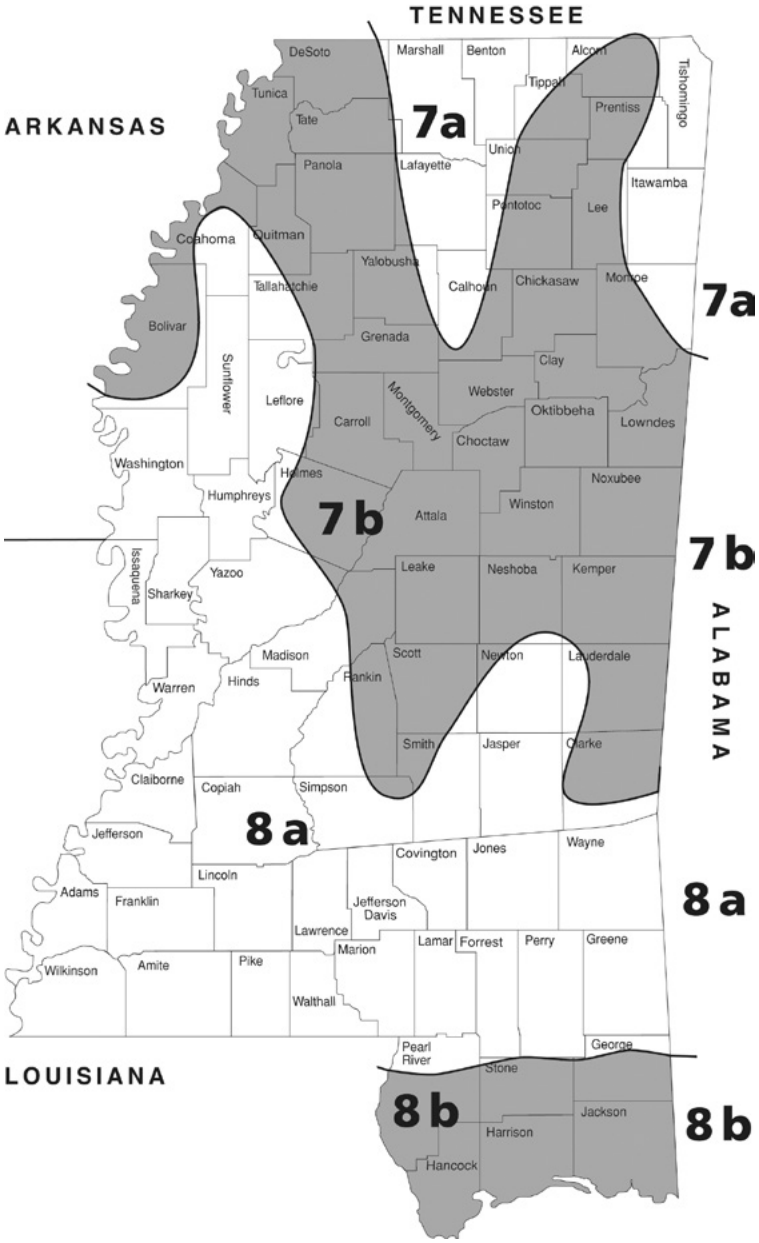

Figure 2. Climate zone map.

Warm-Season Grasses

Bermudagrasses—Despite its name, bermudagrass came to America from Africa in 1751. Also known as devilgrass, wiregrass, and couchgrass, it is a serious weed problem in cropland and flower beds due to its rapid growth and persistence. Bermudagrass is the most widely grown turfgrass in Mississippi because of its adaptation to climates and soil types.

Bermudagrass forms a dense, attractive sod. It spreads primarily through stolon growth, although rhizomes do play a part in its aggressive growth habits. It is not unusual for a stolon to grow 6 feet in 1 year when spreading over bare ground.

This aggressiveness makes bermudagrass the preeminent turf for areas of high traffic, since it can spread quickly to cover damaged areas. Bermudagrasses also have good wear tolerance.

The major limiting factor to bermudagrass growth is the amount of sunlight it requires. It does not tolerate full shade and only tolerates partial shade for half of a day. It is best to have full sun for the highest quality lawn.

Bermudagrass is responsive to management. Quality lawns require large amounts of fertilizer and water and frequent mowing. Although bermudagrass is drought-tolerant, it has a high water requirement to produce an attractive turf.

Bermudagrass is adapted to a range of soil types and survives in alkaline and acid conditions, but it prefers well-drained soils with a pH of 6 to 7. The vigor of bermudagrass is reduced on poorly drained soils, but it produces an acceptable turf on clay soils. Bermudagrass is the most tolerant turfgrass to being submerged and is the preferred grass for stream banks.

Bermudagrass is easily planted and is the most rapidly established of all the grasses. Common bermudagrass is established from seed. There are improved varieties that can be seeded, but the hybrids and other improved types are established vegetatively.

Seeded Types

Common bermudagrass (*Cynodon dactylon L. Pers.*) is found everywhere in Mississippi. The seed found in most outlets was probably grown in Arizona and may be called "Arizona common." It is well adapted to all of Mississippi as long as there is sufficient sunlight. When compared to other species, it is heat- and drought-tolerant and has excellent wear tolerance and recovery from injury. Common bermudagrass may not be cold hardy in zone 7a.

Common bermudagrass is a good, inexpensive choice for areas that receive heavy traffic, such as school yards, athletic fields, play areas, and rights of way. It is susceptible to several pest problems (dollar spot, melting out, and nematodes), but these can be controlled through proper maintenance and correct use of pesticides.

Improved seeded types of bermudagrass include Princess 77, Savanna, Sultan, Sydney, Sunstar, Mohawk, Yuma, Yukon, and Riviera. These grasses have been shown to produce significantly better quality lawns since they are finer textured and more dense than common bermudagrass.

These grasses are for people who want something better than common bermudagrass but do not want the problems or expense associated with the vegetatively propagated grasses. They do not produce a lawn as attractive as the vegetatively

propagated grasses. The availability of these new seeded types may be limited.

Vegetatively Propagated Types

Many hybrid bermudagrasses have been developed by crossing common bermudagrass with African bermudagrass (*Cynodon transvaalensis* Burtt Davy). These hybrids have short internodes that give a dense, lower growing turf.

Do not grow these hybrids unless you are willing to devote much time and effort to the higher levels of management they require. Tifdwarf and Tifgreen were developed at Tifton, Georgia, for use on golf greens. Most homeowners should avoid these grasses because of the daily mowing required.

Tifway and Tifway II were developed to be used on golf course fairways and tees and athletic fields. Tifway is the standard for high-quality lawns. These grasses can be grown by homeowners who want the highest quality lawns.

Grasses developed at Mississippi State University for home lawns include MS-Choice and MS-Pride. MS-Choice is a naturally dark green grass that seldom produces seed heads. It is shade tolerant for a bermudagrass. This does not mean it is as shade tolerant as St. Augustinegrass, just that it will grow better than other bermudagrasses in the shade. MS-Pride is a dense, finely bladed grass that will compare favorably with Tifway.

These bermudagrasses do not produce viable seed. They must be established vegetatively. This adds to the expense of establishing a lawn from these types.

Centipedegrass (*Eremochloa ophiuroides*) is rapidly becoming the grass of choice for some Mississippians. The low level of maintenance required is a joy to those who want an acceptable quality of turf with the least amount of effort. The problems with centipedegrass often are caused by overzealous homeowners trying to make centipedegrass look better.

Centipedegrass is a slow growing, naturally lime green, somewhat coarse turfgrass adapted to growing in acid sandy soils. Centipedegrass grows best in a slightly moist, well-drained soil with a pH of 4.5 to 6.0. Iron deficiency causes the leaves to have a bleached appearance when the grass is grown on high-pH soils. Centipedegrass responds to foliar iron applications by giving a darker green color.

Centipedegrass can be established from seed, but the germination period is 21 days, and the seedling centipedegrass is slow growing. Vegetative propagation is preferred, and if expense is not a primary consideration, solid sodding gives the most satisfactory result.

Centipedegrass has poor wear tolerance and is slow to recover from injury because of its slow growth rate. Shade tolerance is better than bermudagrass, but not as good as St. Augustinegrass. **Do not grow common centipedegrass in zone 7a**, and some winter injury may occur in northern sections of zone 7b. TifBlair, Oklawn, and Tennessee Hardy have better cold tolerance than does common centipedegrass.

Supplemental iron applications can have a marked effect on the appearance of centipedegrass. Many people object to the natural light green color and tend to overfertilize with nitrogen trying to darken the hue of the turf.

Iron in the form of iron sulfate, ferrous ammonium sulfate, or chelated iron applied to the foliage often provides a noticeably darker color. The darker color lasts until the leaf that has been sprayed grows enough to be mowed. The iron must then be reapplied to the new growth. The advantage to iron is that it does not increase the growth rate of the grass and, therefore, decreases the risk of disease and insect pressure.

The major factor in centipedegrass popularity is the low level of care it requires. If left alone, the height of turf rarely exceeds 4 inches, and the thick turf crowds out most weeds. The seedheads do not extend much above the canopy and are not objectionable. It is often called the poor or lazy man's grass for this ability to thrive under neglect.

Centipedegrass has a shallow root system and is more subject to drought stress than bermudagrass or St. Augustinegrass. Since it is slow to recover from stress, you should water on a timely basis.

Centipedegrass has one other strong point: professional applicators can apply sethoxydim herbicide to remove most other species of grass.

St. Augustinegrass (*Stenotaphrum secundatum*) is a popular choice for lawns in south and central Mississippi. Outstanding shade tolerance makes this grass the overwhelming favorite for lawns under the stately live oaks of the Gulf Coast as well as the tall pines midstate. Winter damage occurs to lawns in zone 7a and the northern reaches of zone 7b. Severe winters may cause damage as far south as the northern reaches of zone 8a. St. Augustinegrass is the most cold-sensitive of all of the turfgrasses grown in Mississippi.

St. Augustinegrass is propagated by sprigging, plugging, or sodding. Some seed of St. Augustinegrass may be available, but the cost of seed and the ease of establishment from stolons make vegetative establishment the preferred method.

St. Augustinegrass is a coarse to very coarse turf that is quick to establish and recover from injury due to aggressive stolon

growth. It is not unusual to have St. Augustinegrass stolons grow right over the top of established centipedegrass turf. The grass has only fair wear tolerance and will not tolerate long periods of water stress.

Most problems with St. Augustinegrass are caused by disease and insect pressure made worse by heavy fertilization. Chinch bugs are a serious insect problem, and brown patch is a major disease. Both of these problems are encouraged by the application of too much nitrogen fertilizer and too much water. Although St. Augustinegrass grows rapidly, it requires only a moderate level of fertility.

One problem of St. Augustinegrass is not due to mismanagement. St. Augustine decline (SAD) is a disease caused by a virus. It is present in Mississippi and cannot be alleviated once it is present in a lawn. The only control measure is to plant a resistant variety.

Many varieties of St. Augustinegrass have been released. Those resistant to SAD include Raleigh, Palmetto, Mercedes, Captiva, and Delmar, which are more cold-tolerant than common. None of these are resistant to chinch bugs. Varieties resistant to chinch bugs include Floratam and Floratam II, which have shown some resistance to SAD. It is recommended that any new lawn established to St. Augustinegrass in Mississippi be of a SAD-resistant variety.

Zoysiagrass (Zoysia species) is gaining popularity as a choice for lawns in the central and northern portions of the state. The zoysiagrasses have superior cold tolerance to the above-named grasses and are not as likely to sustain winter damage. The zoysiagrasses form dense, thick sods of high quality. They have more shade tolerance than bermudagrass and form a finer, more attractive lawn than St. Augustinegrass or centipedegrass.

Three zoysia species are grown for turf in Mississippi. The least cold-tolerant is mascarenegrass or Korean velvetgrass (*Zoysia tenuifolia*). It is recommended only for zones 8b and 8a. It forms a fine-textured, dense turf. It has severe thatch tendencies and should be grown only by those who want an unusually thick and distinctive lawn. Manilagrass (*Zoysia matrella*) is intermediate in cold tolerance and fineness. It is increasingly popular in Mississippi and produces a good quality lawn. Japanese lawngrass (*Zoysia japonica*) is coarser in texture but much more cold-hardy than the other species. It is grown as far north as coastal New England, although it has a very short season in that climate. A hybrid between *Z. japonica* and *Z. tenuifolia* called Emerald is also widely grown in Mississippi.

Rapid improvement has been made in the use of zoysiagrass establishment from seed. Seeds are treated by the supplier to produce a more uniform, higher percentage germination. The seed still require excellent moisture management during germination. Placing a spun-bonded polyester cloth over the seedbed during germination has improved the initial stand and early growth. Better quality varieties are now available from seed and are much finer textured and more dense than Chinese or Korean common.

Trials in Mississippi have shown Zenith to grow acceptably from seed and produce a good quality turf. Solid sodding is still the preferred method of establishment. The slow lateral growth rate makes strip sodding and plugging a 2-year project in most lawns.

Zoysiagrasses have good drought tolerance. Their ability to form a very thick sod makes weed control easy, and they do not produce objectionable seedheads. The zoysiagrasses are relatively free of disease problems, but they do suffer from rust, unlike most of the other turf species.

Stems and leaves of zoysiagrasses are tough and difficult to mow with a rotary mower unless the blades are kept very sharp and the grass is not allowed to get tall. Motors have been ruined on rotary mowers trying to cut a too-tall zoysiagrass turf. For these reasons, you should mow zoysiagrass with a reel mower.

Meyer, also known as Z-52, is the most widely available improved variety of *Z. japonica*. Emerald was developed to compete with the hybrid bermudagrasses. It will form a very dense, beautiful lawn that can be cut at a lower level than other zoysiagrasses.

Several new cultivars have been recently released with qualities that include faster establishment, disease resistance, and shade tolerance. These new varieties include Empire, Cavalier, Palisades, Royal, Diamond, and Zorro.

Zoysiagrasses require a moderate level of management. They do not grow well in clay soils or other poorly drained sites. They require less fertilization than the bermudagrasses but more than centipedegrass. They prefer a pH of 6 to 7 but tolerate a wide range.

Carpetgrass (*Axonopus affinis*) and tropical carpetgrass (*A. compressus*) are coarse, low-growing turfgrasses adapted to the wet, acidic, sandy soils of southeast Mississippi. They form a moderately dense, light green turf that is similar to centipedegrass in color and texture. Individual carpetgrass plants resemble St. Augustinegrass.

Tolerance to drought, wear, and cold is poor, and the rate of recovery from damage is slow. Carpetgrass develops many tall, unattractive seedheads that require frequent mowing to keep the turf attractive, even though the foliage may not have grown sufficiently.

Even with all these drawbacks, carpetgrass is widely grown as a turfgrass. The major advantages are its ability to survive wet soil, its easy establishment from seed, and its low fertility requirements.

Bahiagrass (*Paspalum notatum*) is grown more as a mistake than as a planted turfgrass in Mississippi. It is native to South America and is widely used as a pasture species. Bahiagrass has short stolons, but it does not spread well and often makes an open, almost clumpy turf. It has good wear tolerance but recovers slowly from damage. Shade tolerance is better than bermudagrass, and it is extremely drought-tolerant because of an extensive root system. It is this extensive root system that enables bahiagrass to invade lawns during times of drought and displace more desirable species.

The main disadvantage to bahiagrass is the tall seed stalk that grows quickly when the grass is under stress. One story told is that only a very small lawn can be completely free of seedheads, because they arise so quickly that the started edge will have new seedheads before the far edge is cut. The "V" of the bahiagrass seedhead is a common sight throughout southern Mississippi in the summer.

Two varieties are commonly available. Pensacola is a fine-textured cultivar used for roadsides. Argentina is coarser but has superior color and density. A new variety, Wilmington, develops fewer seedheads and is finer textured.

Seashore paspalum (*Paspalum vaginatum*), although having been in existence for thousands of years, is a relative newcomer to Southern lawns with attributes that certainly fit some specific niches. Seashore paspalum is a warm-season grass having excellent tolerance to high salt levels found in reclaimed water, effluent, salt spray, and seawater. It tolerates a wide range in soil pH and requires relatively low inputs of fertility, irrigation, and pesticides. It adapts well to variable mowing heights, has good wear tolerance, and does well in wet conditions. Cold tolerance is somewhat limited.

Several cultivars are available, making seashore paspalum suitable for use on golf courses, athletic fields, and commercial and residential lawns. Presently, cultivars available vegetatively include Aloha, SeaDwarf, SeaIsle I, Sea Way, and others.

Cool-Season Grasses

Only those people living in zone 7a should attempt to grow cool-season grasses as permanent lawns in full sun. People with shady lawn areas in zone 7b north of Highway 82 could attempt the cool-season grasses, but the heat of Mississippi summers causes these species to go dormant, and could shorten the life of these grasses.

Fescues

The fescue group of turfgrasses has greatly improved in the last decade. The "turf-type" tall fescues were selected and extensively bred to improve heat and drought tolerance and to have narrower leaves. Red and chewings fescues were evaluated for disease and heat resistance. These grasses are not widely grown in Mississippi, but you should try the improved varieties.

Tall fescue (*Festuca arundinacea*) is a relatively coarse-leaved, dark green grass that is almost as shade-tolerant as St. Augustinegrass. Consider it as a permanent lawn for shady areas in the northern portion of the state. Tall fescue has short rhizomes, but it does not spread well and should be managed as a bunch-type grass. It goes dormant in summer in sunshine and eventually thins out in the shade; so you should expect to reseed on a regular basis. Fortunately, the seed is not expensive and does not require extensive soil preparation to accomplish a successful reseeding.

Mow tall fescue high, about 3 inches. The leaves are relatively tough and require a sharp blade to keep from having a ragged edge.

Tall fescue has a deep root system and tolerates short periods of drought, but it turns brown from lack of water, so adequate watering is necessary. Water is especially critical in the summer to keep the grass from going dormant. Tall fescue is susceptible to several diseases, including brown patch and fescue leaf spot. Since it most often is grown in the shade, arrange the watering regime so the leaves are dry by nightfall.

There are many improved turf-type tall fescues. Do not plant the forage-type tall fescues such as Kentucky 31 or Alta. Recommended new varieties include Faith, Falcon V, Monet, Firenza, and Catalyst. In Mississippi conditions, the differences among the turf-type tall fescues are small, so the differences in appearance may not be great.

Fine-leaved fescues are not grown often in Mississippi but can produce a good quality lawn in the northern counties. Creeping red fescue (*Festuca rubra*) and chewing fescue (*Festuca rubra*) are fine-leaved fescues that are shade-tolerant. Chewing fescues do not have rhizomes. They will not grow in moist conditions, however, so well-drained soil is a must.

These grasses have a low fertility requirement and a limited root system. They are not as tolerant as tall fescue to alkaline soil conditions. They can be cut shorter than tall fescue, have a finer leaf, and produce a less coarse lawn. They are susceptible to several diseases, so water carefully to provide enough to maintain the grass with its shallow root system but not to keep the foliage wet for a great length of time.

These fescues are similar to centipedegrass in that too much fertilizer is more dangerous than not enough. As little as 1 pound of nitrogen per year is enough to produce an excellent turf. Overfertilization leads to problems with diseases (dollar spot and red thread).

Recommended varieties of red fescue include Ruby, Flyer, and Pennlawn. Recommended chewing fescues include Atlanta, Jamestown, and Banner.

Kentucky bluegrass

Kentucky bluegrass (*Poa pratensis*) is the king of the turfgrasses in the northern United States. Unfortunately, it does not grow well in Mississippi, even in the northern counties. It does not tolerate shade very well, so it cannot hide from the summer sun the way tall fescue does. It is a rhizomaceous and stoloniferous grass that forms a dense sod.

It is fine-leaved and dark green and forms an excellent quality turf. The aggressive root system makes it the most drought-tolerant of the cool-season grasses. It is more shade-tolerant than bermudagrass. It tends to go dormant in the summer but recovers when temperatures fall. It requires more maintenance than the fescues, but it gives an attractive turf that can be mowed at 2 inches in the cool season.

Kentucky bluegrass requires a well-drained and slightly acidic soil. It does not thrive in alkaline soils. It depends on correct management, especially in the summer months. Proper fertilizing, watering, and mowing are necessary to have the dormant turf survive the summer heat.

Recommended varieties include Everglade, Bar, Impact, Rhythm, and Granite. The bluegrasses are easily established from seed, and the seed is relatively inexpensive.

Ground Covers

Use ground covers where shade is too dense or the terrain is too rough for turfgrass. Many types of ground covers can provide color and texture differences in the landscape and keep soil in place.

Ground covers are less than 18 inches in height and generally require little maintenance once they are established. Some, such as mondo grass, resemble grass in growth form while others, such as Sweet William and violets, are grown as much for flower color as for the foliage.

Select ground covers to blend with the overall landscape plan. While the dark green of mondo grass or English ivy blends well with well-maintained bermudagrass or St. Augustinegrass, it contrasts sharply with carpetgrass or centipedegrass.

Tables 2–4 help to determine how much square footage can be planted with 100 plants when spaced at various measurements.

Table 2. Ground cover planting guide (per 100 plants).

Spacing (in apart)	Coverage (sq ft)
4	11
6	25
8	44
10	70
12	100
15	156
18	225
24	400

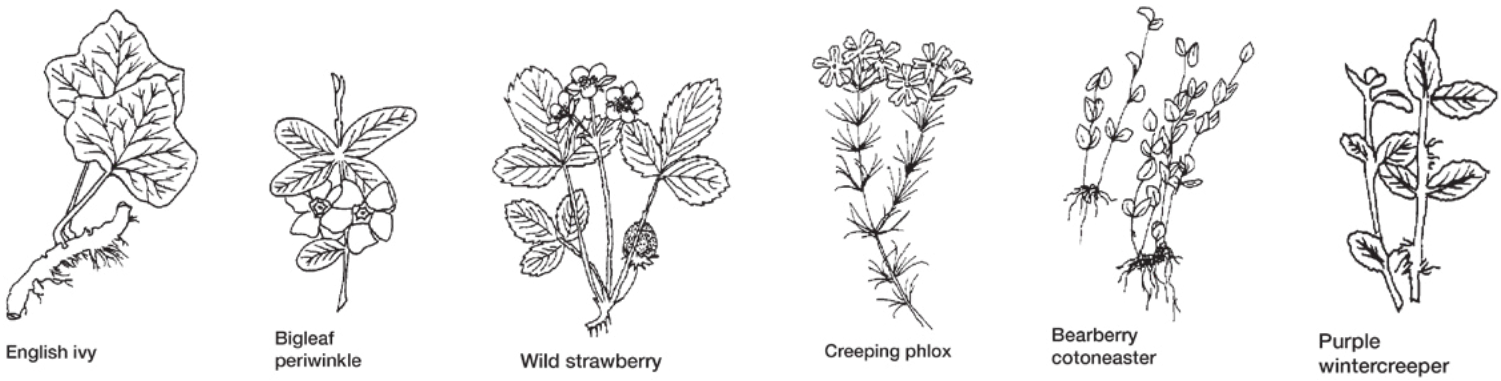

Figure 3. Common ground cover varieties.

Table 3. Number of ground cover plants needed for planting areas.

Planting Area (sq ft)	Spacing in Both Directions (in)					
	6	8	9	12	18	24
100	400	225	178	100	45	25
200	800	450	356	200	90	50
300	1200	675	534	300	135	75
400	1600	900	712	400	180	100
500	2000	1125	890	500	225	125
600	2400	1350	1068	600	270	150
700	2800	1575	1246	700	315	175
800	3200	1800	1425	800	360	200
900	3600	2025	1602	900	405	225
1000	4000	2250	1780	1000	450	250

Table 4. Guide for selecting a ground cover and lawn substitute.

Common Name	Botanical Name	Plant Spacing	Sun	Part Shade	Shade	Remarks
bigleaf periwinkle	*Vinca major*	18 in	X	X	X	Vigorous. Spreads rapidly. Prefers some shade. Easy to establish and grow. Difficult to confine in small areas. Variegated form available.
blue rug juniper	*Juniperus horizontalis* "Blue Rug"	3–4 ft	X			6 in high and 6–8 ft spread. Bright silver-blue foliage. Hugs ground more than most junipers.
creeping phlox	*Phlox subulata*	12 in	X	X		Long-standing, excellent ground cover and rock garden plant. Propagate by seed or division. Massive flower display in spring. Flowers are available in white, blue, pink, and fuschia.
dwarf sweetwilliams	*Dianthus deltoides*	12 in	X	X		Plants spread to give full color if planted 9 in × 9 in. New cultivars are excellent. Brilliant flowers in spring; most are susceptible to foliar diseases.
English ivy	*Hedera helix*	18 in	X	X	X	Many new cultivars available. Deep-rooted. Will take sun,but needs close watering.
mondo grass or little monkey grass	*Ophiopogon japonica*	9 in	X	X	X	9 in high. Spreads by underground stolons. Vigorous, dependable; adapted to variety of soil conditions. Excellent ground cover.
monkey grass	*Liriope muscari*	12 in	X	X	X	Excellent border and ground cover. Spreads slowly; space 12 in × 12 in for quick cover. Many varieties available, including those with variegated foliage. Responds well to fertilizers.
sweet violets	*Viola odorata*	9 in		X	X	Many new cultivars are available. Need well-drained and high-organic matter to perform well. Try Royal Robe and White Czar.
wild strawberry	*Fragaria chiloensis*	18 in	X	X	X	Excellent, vigorous ground cover for wide range of zones and soils. Easy to grow and propagate. Susceptible to spider mites. May be invasive.

Establish Your Lawn

Planting a new lawn is not hard if you plan and manage carefully. Lack of planning is a serious error that often leads to failure. Organization is needed for successful lawn establishment.

Planting time. The time of year is crucial in successful establishment of turfgrasses. A turfgrass planted at the wrong time of year will be a disaster, so don't waste time and money by planting at the wrong time of year.

Prepare for Planting

Cleanup. The first step is cleanup. Remove all construction materials such as scrap lumber, gravel, concrete, mortar and brick chips, shingles, and other debris.

Drainage. When the planting area is clean, check drainage patterns and runoff of surface water. Check the soil for compacted areas by inserting a 6-inch knife blade or screwdriver. The blade should slip into the soil with minimal effort. If great effort is required to push the blade into the soil, it is mostly clay or is compacted. Clay soils must have surface drainage since water movement through the soil is too slow for good grass growth.

Compaction is often caused by the heavy equipment used by contractors to move soil. (The soil is squeezed together by the weight of the machinery.) Grass roots cannot penetrate the compressed layer, and the root zone is limited to the soil above the compaction. The problem can be relieved by an aerator if the compaction is near the surface, or it can be relieved by a chisel plow or deep-tined aerator if the compacted layer is more than 3 inches deep.

Identify low, wet areas that need correction for proper drainage. Drain water away from the house and toward the street. Do not channel water onto the neighbor's property. Water can be directed by constructing shallow drainage ditches or swales or by constructing subsurface drainage ways.

Slope and grading. The slope of your property is important. A 3 to 5 percent slope is ideal. Lots that slope more than 20 percent will be difficult to mow and maintain. If your property poses a difficult situation for grading and drainage, ask for help from a licensed landscape architect or nursery person. A small cost to correct these problems is money well spent. You will have a lawn that drains well and prevents erosion. This helps protect the house and foundation from structural damage caused by soil settlement, erosion, or water seepage.

Save topsoil. When grading is needed, be sure to stockpile the topsoil for later use. In most cases, the top 3 inches should be stockpiled as topsoil. After the rough grading is completed, the topsoil can be spread and made ready for planting.

Soil test. The next step is soil testing, an important step in establishing a new lawn. Many soils in Mississippi lack the proper amounts of nutrients necessary for establishment and development of turfgrasses.

The soil testing can be conducted by the Soil Testing Laboratory at Mississippi State University. There is a minimal charge. Ask your county Extension agent for soil sample boxes and instruction sheets for sampling. The benefits of soil testing are discussed under "Fertilization" in this publication.

Correct nutrient deficiencies. Use a fertilizer spreader to distribute the recommended amount of fertilizer and lime before soil preparation. This will ensure the materials are worked into the soil during preparation. This procedure encourages deep rooting of the new grass seedling.

Prepare soil. Immediately after you spread the fertilizer, prepare soil for planting. This involves disking or tilling, followed by harrowing or hand-raking to the finished grade or slope. You are now ready for planting.

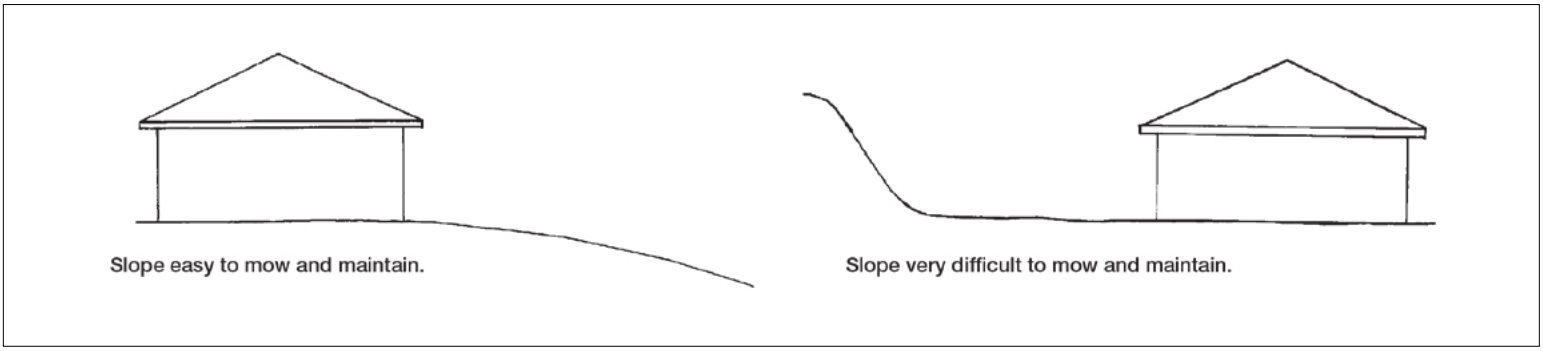

Figure 4. The slope of property is a very important consideration.

Table 5. Planting time for warm- and cool-season grasses.

Grass	Gulf Coast Zone 8b*	South and Central Zones 7b and 8a*	North Zone 7a*
Warm-season grasses			
bermudagrass	4/15–9/30	5/1–8/1	5/15–7/15
St. Augustinegrass	3/15–9/15	4/15–8/1	N/R*
centipedegrass	4/15–9/15	5/1–8/1	N/R
carpetgrass	4/15–9/15	5/1–8/1	N/R
zoysiagrass	3/1–9/15	4/1–8/1	5/1–8/1
Cool-season grasses (seeding only)			
Kentucky bluegrass	N/R	N/R	9/1–11/1
tall fescue	N/R	9/15–11/1 (7b only)	9/1–11/1
creeping red fescue	N/R	N/R	9/1–11/1

*N/R = not recommended

Planting Method

When you select a turfgrass for your lawn, consider the method of establishing the grass. Some grasses can be seeded. Others must be planted by vegetative sprigs, plugs, or solid sod. Table 1 on page 3 lists the method of planting for each turfgrass. Also refer to Table 6 on page 13.

Seed. When seeding, use top-quality seed from a reliable nursery or seed company. Seed should be fresh and certified as to purity and germination percentage. Do not buy old seed left over from the last planting season. They are not a bargain at any price.

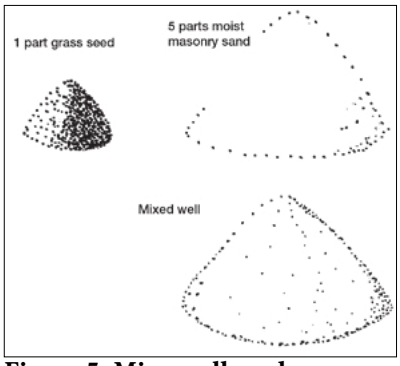

Figure 5. Mix small seed with moist masonry sand for even spreading.

The seeds of many turfgrasses are extremely small and difficult to plant. This is especially true of bermudagrass, centipedegrass, and carpetgrass. They are also expensive. To prevent waste and ensure even spreading, you can mix these seeds with moist masonry sand before planting. For best results, mix five parts moist sand with one part seed in a dry container; then use a fertilizer spreader to distribute the seed evenly. Be sure to calibrate the fertilizer spreader to deposit seed in small amounts. Spread the seed with several applications, using crisscrossing patterns.

Determine how much seed you need before buying grass seed. The planting rates are given in pounds needed per 1,000 square feet of planting area. The amount of sprigs, plugs, and sod are also shown per 1,000 square feet in Table 6. To find how many square feet you have, measure the length and width of the area to be planted. Then multiply the length times the width.

Here is an example: The lawn measures 110 feet by 80 feet. Multiply 110 feet by 80 feet to get 8,800 square feet of total area. You would need 4.4 pounds of common bermudagrass seed to plant this lawn.

Scarify. After seeding, harrow or scarify the planting area lightly. You can do this with a conventional farming harrow or with a yard rake. You also can make a homemade

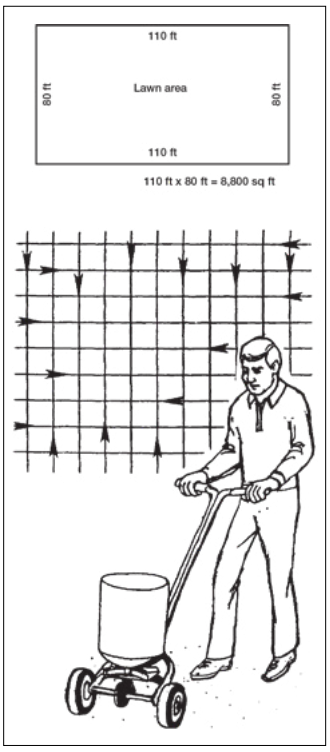

Figure 6. Spread the seed with several applications, using a crisscrossing pattern.

scarifier. The harrowing or scarifying ensures a shallow coverage of the seed. If you do this with power equipment, be sure the seeds are covered with no more than one-eighth inch of soil. Don't scarify Kentucky bluegrass, since the seed need light for best germination.

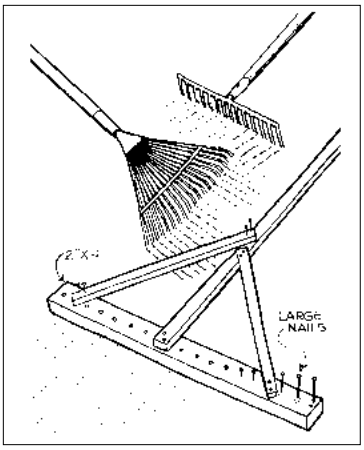

Figure 7. Make your scarifier from scrap lumber. Use large nails for the teeth.

After the seeds are covered by scarification, roll or pack the planting area. Homeowners sometimes skip this step, since lawn rollers and cultipackers are difficult to find in some communities. However, if you can find this equipment, roll the planted area to firm the soil and seed.

Seed germination is more rapid if you water the planting area immediately after planting and keep it moist, but not wet, during germination. However, it is almost impossible to water large areas evenly without irrigation equipment, and many homeowners, therefore, wait for rain rather than trying to moisten large planting areas.

Don't overwater, since this can wash the seed away. Be sure to keep the planted area moist by shallow watering during germination. Once the grass has sprouted and begins active growth, apply more water less frequently to promote deeper root growth.

Vegetative planting with sprigs, plugs, and solid sod. If you use sprigs, plugs, or solid sod to establish your lawn, be well organized for the planting procedure. You will be using live turfgrass rather than seed. The planting area must be prepared and "all systems go" before you purchase your planting stock.

The amount of sprigs, plugs, or sod you need is determined by the size of the planting area. It is a good idea to contact your nursery before the planting day, since certain varieties of turfgrass may not be available and must be ordered.

Vegetative planting takes more time than planting seed. Be sure to budget your time for the amount of area you are planting. A good worker can plant about 300 plugs in an hour. That covers about 300 square feet on 12-inch spacing. It takes about the same amount of time to plant sprigs in rows 12 inches apart.

Plan your time carefully when dealing with live sod. If you must hold your sod for several days, be sure to protect it properly. Unstack it and unroll the single sheets of turf. Place the turf in an area protected from sun and drying wind. Water as needed to keep turf moist. Do not allow sod to dry. Plant it within 3 days.

Preparing vegetative stock for planting. Turfgrasses are sold in solid strips about 18 inches wide and 30 inches long. An easy way to change sod to plugs is to use a sharp butcher's knife or axe to cut the plugs approximately 2 inches square. Solid sods can be changed to sprigs by shredding the sod in a clean soil/leaf shredder commonly used for composting in the home garden.

Another commonly used method for shredding sod is cutting long, narrow strips approximately 1 inch wide from the solid sod. These strips are then planted continuously in the rows that have been prepared in the planting area. Rolling and cultipacking are important for sprig and plug planting. This ensures firmly planted sprigs or plugs.

Planting solid sod is the easiest method of vegetative establishment. It is also the most expensive, since it requires more turfgrass per planting area. The sod is laid, individually, side by side and end to end. The process is similar to laying tile blocks on a floor. Cultipacking or rolling is recommended to firm and even the planting area.

Watering is crucial. When planting sprigs, plugs, or solid sod, water immediately after planting. This is crucial. The sprigs, plugs, or sod have few roots when planted. The foliage can dry very quickly. Drying can occur within a few minutes when planted in hot summer sun. You should water sprigs, plugs, and sod within 5 minutes after planting.

It is necessary to have a helper responsible for watering during planting. You should closely monitor the watering procedure to avoid overwatering, which can cause erosion, especially between the rows of plugs or sprigs. When watering solid sod, be sure to check several areas to ensure that water is being applied evenly and thoroughly. The soil beneath the sod must be moist during establishment. Applications of water may be necessary each day for sprigs, plugs, or sod. Within 2 weeks, vegetative plantings should show obvious signs of establishment, and watering can be less frequent and at greater depth to encourage deeper root growth.

Get ready to mow. When a new lawn is planted, there will always be weed competition. Weed seeds are turned up in planting. They sprout and grow more quickly than desirable

grasses. Mowing height is a major method of controlling weed growth during the establishment of a new lawn. Weeds can quickly overgrow and shade out desirable turfgrasses and must be mowed regularly for best control. The mowing height for newly established lawns, therefore, is critical.

Mow new grasses at 2 inches to ensure more leaf area to make food for new roots. Mowing heights can be adjusted to normal height in 6 weeks. Chemical weed control is not recommended on newly planted grasses until at least 2 months after establishment.

Table 6. Recommended rates for planting turfgrass.

Kind	Planting Method	Germination Time	Seed Amount / 1,000 sq ft of Planting Area
seeded bermudagrass	Seeding	10 days at > 70°F	½ lb seed*
centipedegrass	Seeding	21 days at > 70°F	4 oz seed**
carpetgrass	Seeding	10 days at > 70°F	1 lb seed*
Kentucky bluegrass	Seeding	14 days at > 70°F	1½ lb seed*
creeping fescue	Seeding	14 days at > 70°F	3 lb seed*
tall fescue	Seeding	10 days at > 70°F	4 lb seed*
bermudagrass centipedegrass St. Augustinegrass carpetgrass zoysiagrass	Vegetative sprigs *Set sprigs in rows 12 in apart*		10 yd of solid sod; shred into sprigs or cut into thin 1-in strips. Plant strips in rows 12 in apart.
bermudagrass centipedegrass St. Augustinegrass carpetgrass zoysiagrass	Vegetative plugs *Place 2-in × 2-in-size plugs 12 in aprt in rows that are 12 in apart*		3½ yd solid sod; this yields about 1,000 plugs if cut 2 in × 2 in when planted 12 in × 12 in
all grasses, if available	Solid sod		112 sq yd of sod

*Mix seed with clean masonry sand as described in the Planting Method section (page 11). Use fertilizer spreader for even distribution.

**Quicker coverage will occur if 8 oz. are used.

Renovating Your Lawn: Work with What You Have

If your current lawn is not all you want it to be, you may need to renovate—to make it new again. The first step in renovation is to determine if you have enough of the desired turfgrass present to make renovation more feasible than just starting over from scratch.

If you do not have at least one live plant per square foot of the grass you want, or if you do not have at least 30 percent cover of the grass you want, you should start at the beginning of this publication. If you have

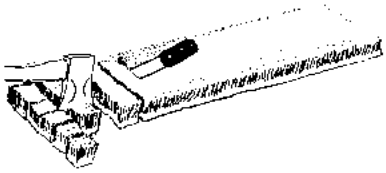

Figure 8. Cut the sod into 2-inch squares for plugging.

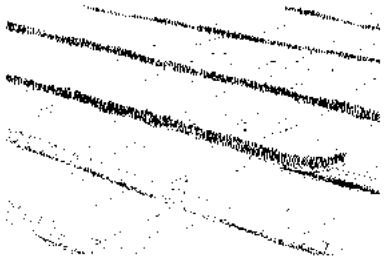

Figure 9. Plant the 1-inch strips in continuous rows.

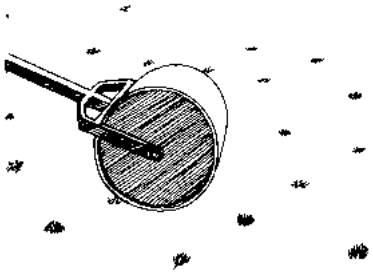

Figure 10. Roll or cultipack the plugs and strips to firm the soil around the roots.

Figure 11. Alternate the ends and middles when laying solid sod. Butt each piece tightly against the other.

Figure 12. Water immediately after planting.

patches of the grass you want, the next step is to see why the grass isn't growing in other places.

Shade is the problem we face most often in Mississippi. When we start our lawn, we put out sapling oaks, maples, and pines, and we plant bermudagrass. The lawn does well for several years, but then we notice the grass is thinning out and weeds are invading. The problem is the trees have grown enough to shade the bermudagrass. The option is to cut the trees to allow light to penetrate or to shift to a more shade-tolerant grass.

The second major reason turf does not thrive is soil compaction. As we walk on, drive our vehicles across, mow with our riding lawn mowers, and have our children play games on our lawn, the large pores in the soil are destroyed. This slows the rate at which water and air move through the soil and acts as a barrier to root growth. You can solve this problem through aeration or by physically disrupting the compacted layer with a plow. To check for a compacted layer, insert a knife or screwdriver blade 6 inches into the soil. If you feel significant resistance, you probably have a compacted layer.

Lawns thin out for several other reasons. Drought stress thins out the desirable species, and disease pressure causes the lawn to thin. Insects will kill the turf. After the turfgrass is gone, weeds move in. The presence of a great number of weeds is a sign the turfgrass is not thriving.

Before you can make the lawn succeed, you need to find the cause of its decline. Weed growth is a result, not a cause. Killing the weeds will not cause the grass to grow. You must discover if the turf needs nutrients, water, protection from pests, better drained soil, or whatever it lacks to grow a successful lawn.

Establishing Winter Lawns

Sometimes the occasion arises when it is just too late in the fall for the establishment of the desired turf species. Many people do not appreciate the brown color of the warm-season grasses during the winter months and prefer to have something green. The ryegrasses are well suited to take care of these two problems.

There are two types of ryegrass grown for lawns in Mississippi. Annual ryegrass (*Lolium multiflorum*) is commonly grown in Mississippi as a forage for winter grazing. It also is referred to as Italian ryegrass.

Annual ryegrass is quick to germinate and is often used to overseed the warm-season grasses. The warm-season turf is sometimes vertically mowed lightly to allow the ryegrass seed to get good soil contact, but the seed is often just spread on top of the established turf and watered in.

Annual ryegrass is lighter green and coarser than perennial ryegrass. It also is less heat-tolerant than perennial. This could be an advantage for overseeding since ryegrass should disappear before it interferes with the growth of the warm-season grass.

Perennial ryegrass (*Lolium perenne*) is one of the major turfgrasses in the northern United States. It does not act as a perennial in Mississippi, however. It is used in the same way as annual ryegrass—to establish temporary lawns and to overseed warm-season grasses. Perennial ryegrass is finer leaved and darker green than annual and is the preferred grass for overseeding athletic fields.

Planting time is important in ryegrass establishment. Seed planted after the dates in the table may not have time to grow into plants that can survive freezing temperatures. Seeding rate is also important. The ryegrasses are bunch grasses, so not planting enough seed produces a thin, clumpy turf.

Seed perennial ryegrass at 8 to 10 pounds of seed per 1,000 square feet; seed annual ryegrass at 10 to 12 pounds. After seeding, remember that ryegrass is a living turf just like the warm-season ones. It requires fertilizing, watering, mowing, and other care to produce the desired effect.

Table 7. Planting dates for temporary winter lawn grasses (seeding only).

Grasses	Gulf Coast Zone 8b	South and Central Zones 7b and 8a	North Zone 7a
perennial ryegrass	10/15–11/30	10/1–11/15	9/15–11/1
Italian ryegrass (annual ryegrass)	10/15–11/30	10/1–11/15	9/1–11/1

Manage Your Lawn

The quality of turf depends on color, density, and absence of insects and disease. Color has long been overrated as a standard for a quality lawn. In many cases, a normal high-quality color should not be dark green. This is the case with centipedegrass and carpetgrass, both of which are naturally yellow-green. Overfertilizing to get a dark green color generally leads to problems. Sod density and absence of insects and diseases are just as important as turf color.

Certain maintenance requirements are necessary for quality lawns. Basic chores for having a quality lawn include proper fertilizing, watering, mowing, and controlling weeds, diseases, and pests.

Fertilization

Turfgrasses must be properly fertilized to stay the right color, thickness, and health. Also, a well-fed grass recovers more quickly from stress and is more aggressive against weeds. As with all living things, proper nutrition is important to prevent diseases and insects. The lawn grasses discussed in this publication have different fertilization requirements, depending on the type of soils you have and the climate zone where you live.

Fertilization programs. A fertilization program begins with soil testing, which tells the status of nutrients in your soil. Recommendations then can be made specifically for your lawn. If you have taken soil samples before planting, refer to the report for the recommendation needed to correct your soil problems.

If you have not taken soil samples, ask your county Extension agent for soil sampling boxes and an instruction sheet. Send soil samples to the Soil Testing Laboratory at Mississippi State University for analysis. There is a small fee. Be sure to indicate what kind of grass you will be using for your lawn.

Fertilizer and lime recommendations will be made for your own grass and soil needs. Results and recommendations will be returned directly to you from the Soil Testing Lab. If you have any questions about the report, feel free to contact your Extension agent.

Once you have corrected the early soil nutrition problems according to the recommendations from the Soil Testing Lab, you can follow the suggested fertilization programs shown in this publication. These programs suggest certain nutrients and when to apply them.

Soil testing should then become routine for managing the home lawn. A sample taken once every 3 years is ideal. This periodic sampling is necessary because of the changing conditions of soil chemistry.

Liming. When soil tests indicate the need for lime, be sure to follow the recommendations carefully. Two common sources of lime are calcitic lime (ground agricultural lime) and dolomitic lime (dolomite). You can apply lime any time in the year, but you should apply no more than 50 pounds per 1,000 square feet to actively growing turf.

Several applications may be necessary to apply the total amount recommended by the soil test report. For example, if the soil test report recommends 100 pounds of lime per 1,000 square feet, you should split the amount into two applications, each using 50 pounds per 1,000 square feet.

Soil acidity varies according to soil type. A soil test shows the soil acidity level, commonly referred to as "soil pH." The degree of soil acidity is indicated by pH numbers ranging from 1 (very acid) to 14 (alkaline).

Maintaining a proper pH for your lawn grass is important, because soil pH determines how the soil nutrients are used. Fertilizers work much better when you keep the proper pH.

Table 8. Acceptable pH ranges for turfgrasses.

Grass	Acidity	pH
centipedegrass	very acid to acid	4.5–6
carpetgrass	very acid to acid	5–6
fescue bermudagrass zoysiagrass	acid	5.5–6.5
Kentucky bluegrass ryegrass St. Augustinegrass	acid to neutral	6–7.5

Nutrients Are Needed

The major nutrients needed for quality lawns are nitrogen, phosphorus, potassium, and iron. All are needed for quality turf, but some are more important than others.

Grasses use **nitrogen** more than any other nutrient. Bermudagrass and zoysiagrass require large amounts of nitrogen during the growing season. Others, including centipedegrass, carpetgrass, and creeping red fescue, require only small amounts of nitrogen for best growth. In all cases, however, you must add nitrogen by proper fertilization.

Some soils in Mississippi indicate a need for **phosphorus**. However, many soils will have enough phosphorus for most lawn grasses. Soil testing can identify the existing levels of phosphorus in your soil. Don't add phosphorus unless the soil test shows the need.

Potassium is also called potash. Most soils in Mississippi need it. Potassium is important for proper maturity of turfgrasses. In addition, it helps prevent winter injury and susceptibility to disease.

An important nutrient often overlooked is iron, which is necessary for proper growth and color. In soils with a high pH, iron is often lacking (turf looks yellow-green, similar to lack of nitrogen). Centipedegrass, St. Augustinegrass, and carpetgrass are most affected by iron deficiencies. You can correct an iron deficiency with granular or foliar fertilizer products. Popular materials to add include iron sulfate, chelated iron, and specialty fertilizers with iron. Use each of these according to label directions.

Turfgrasses use various amounts of the different nutrients. Nitrogen is used in the greatest quantity, followed by potassium and phosphorus. Turfgrass research scientists are in general agreement that turfgrasses prefer a 3-1-2 ratio (nitrogen-phosphorus-potassium). This ratio is commonly used in fertilizer recommendations. After the basic soil deficiencies identified by soil testing have been corrected, the 3-1-2 ratio is ideal for most maintenance programs. Often the last application (winter fertilizers) is higher in K than N or at least nearer to a 1-0-1 ratio.

When should you start fertilizing your lawn? This perennial question has been complicated in recent years by data that do not support some long-held beliefs. There are two trains of thought:

1. "What is best for the turfgrass plant?" Ideally, you should not apply the fertilizer until the turfgrass is actively growing and can readily use the nutrients. Arguments that support this theory include not encouraging weed growth, reducing loss of nutrients to erosion, and not encouraging rapid, succulent growth that is easily damaged by cold.
2. "What is best for the lawn?" Fertilizing before transition (from dormant to full growth) aids in weed control by causing the turfgrass to grow more rapidly and provide a quicker canopy to shade out weed growth. The lawn achieves a darker color and looks better sooner.

There is a problem with early fertilization if the weather gets into a repeated cycle of temperatures warm enough to start top growth, but too short in duration to allow the newly developed leaves to provide carbohydrates to the roots before the leaves are destroyed by cold. All of the carbohydrate stored from last year can be used, and the roots will die from lack of food. This has been quite rare in Mississippi.

Lawn-care providers have several options. Users of conventional, quick-release fertilizers have two options. The old, tried and true method is to wait 2 to 3 weeks after green-up to apply the first fertilizer. The grass plant will come through transition upon stored carbohydrate and residual nutrients from last year.

The second option is to fertilize lightly at the first signs of green-up. This provides additional nutrition for the plants quickly to crowd out weeds. This option makes it possible to use "weed and feed" formulations since the preemerge fertilizers need to be out before germination of the weed seeds. Homeowners can achieve an even distribution of preemerge weed control most easily with these herbicide-carrying fertilizers.

Slow-release nitrogen fertilizers offer the best of both worlds. The fertilizers are available over an extended period of time and will help prevent flushes of rapid growth but will supply additional nutrition for the turfgrass to get off to a rapid start. Slow-release sources, which are temperature dependent (urea formaldehyde, sulfur-coated urea), somewhat match fertilizer release with grass growth.

Winterizing Fertilizers

Late-season or "winterizing" fertilizer applications to warm-season turfgrasses in Mississippi are a controversial management practices. The discussion concerns the potential for winterkill, disease promotion, and the effect on total nonstructural carbohydrates (TNC) from late-season nitrogen applications. For high-maintenance turfgrasses (particularly bermudagrass), nitrogen and potassium are nutrients that are required in fairly large amounts during the growing season to provide good growth and quality.

A late-fall application of potassium has been a standard practice because research indicates that potassium promotes winter hardiness and disease resistance in turf. Although some research has indicated an increased vulnerability to winterkill and the promotion of winter diseases from late-season nitrogen applications, similar research studies have shown that late applications of nitrogen prolonged desirable color of Tifgreen bermudagrass into the fall, promoted its recovery in the spring, and had no direct correlation with susceptibility to winterkill.

Research trials conducted at Mississippi State University were designed to simulate a worst-case scenario in which bermudagrass would have an increased likelihood of winterkill resulting from late-season growth stimulation, particularly with a water-soluble nitrogen source. Applications of nitrogen alone or in combination with potassium improved fall turfgrass color through October and gave significantly higher spring turfgrass color ratings with little effect on rhizome TNC levels.

There was no indication that nitrogen fertilization increased bermudagrass winterkill potential. The data indicate that the winterkill phenomenon is probably the result of a combination of factors such as previous cultural and chemical management practices, the environment, or pathogens, and it cannot be attributed solely to late-season fertilization.

Regardless of the time of year, lush turf that is stimulated by excessive nitrogen may be more susceptible to certain diseases. However, properly fertilized turf will have a quicker recovery if it becomes diseased.

A dense, healthy turf is much less likely to have heavy weed populations. Also, people who maintain their lawns with relatively high fertility programs most likely also will maintain good disease and weed management programs.

Although this publication provides general guidelines for fertilization and timings of applications for different turf species in different zones of the state, it does not exclude additional winterizing fertilization to meet specific needs. Winterizing fertilizers are generally formulated to contain lower ratios of nitrogen to potassium, and often the nitrogen sources are not water soluble and are not readily available.

Base your turf fertilization program on soil test analysis, turf use requirements, and grower expectations. Time the application of winterizing fertilizer in the fall, when temperatures begin to moderate and days begin to shorten, but before the turf goes dormant.

Fertilizers: What To Know

Fertilizers come in different strengths. All fertilizers have three numbers on the label. These numbers indicate the kind and strength of fertilizer materials. The first number indicates the percent of nitrogen. The second number indicates the percent of phosphate. The third number indicates the percent of potassium (potash). Many kinds and strengths of fertilizer materials are available.

A mixed fertilizer has nitrogen (N), phosphorus (P), and potassium (K) combined. Other examples of mixed fertilizers are 24-4-12, 8-8-8, 20-5-10, 24-4-4, 5-10-5, and 13-13-13.

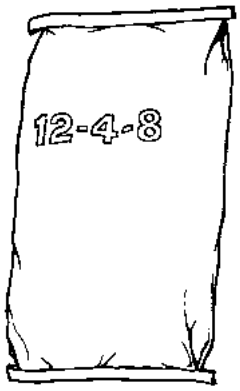

Figure 13. The numbers indicate the kind and strength of fertilizer materials in the bag. The example here is 12% nitrogen, 4% phosphorus, and 8% potassium.

In addition to mixed fertilizers, there are single-source fertilizer materials. These contain only one nutrient. Examples include 21-0-0, a nitrogen fertilizer called ammonium sulfate; 0-20-0, a phosphorus fertilizer called superphosphate; and 0-0-60, a potassium fertilizer called muriate of potash.

Not all fertilizers are the same strength. After determining your fertilization program for the year, choose the fertilizer materials compatible with the nutrients recommended for your lawn grass.

Your fertilizer program depends on three things:

1. Which grass you are growing.
2. Which zone you live in.
3. What kind of fertilizer is available.

Begin a fertilization program after you correct liming needs and soil deficiencies. The program shows the nutrient units needed per 1,000 square feet of lawn area for the entire growing season. The rates are based on a 3-1-2 (N-P-K) maintenance ratio.

Since fertilizers are not the same strength, you have to calculate the number of pounds of the fertilizer you plan to use to have the correct recommendation. This is easy to do using this formula:

Pounds of actual nutrients needed divided by percent strength of fertilizer material to be used × 100 = pounds of fertilizer material from the bag that must be applied to 1,000 square feet of lawn area during the entire growing season.

An example: You live in zone 8b and have a bermudagrass lawn. From Table 9, the recommended rate is 6 pounds of actual nitrogen per 1,000 square feet for the growing season. Let's suppose you wanted to use ammonium sulfate (21 percent nitrogen strength) as the fertilizer material. It is easy to calculate the amount of ammonium nitrate needed to supply a total of 6 pounds of actual nitrogen by using the formula:

$$(6 \div 21) \times 100 = 28.57 \text{ lb.}$$

Therefore, nearly 29 pounds of ammonium sulfate (21 percent nitrogen strength) will be needed to supply the 6 pounds of actual nitrogen needed per 1,000 square feet of lawn area for the entire growing season. This 29 pounds should be split into six equal applications as suggested in Table 9. You, therefore, need to apply 5 pounds of ammonium sulfate per 1,000 square feet each of the six times you apply fertilizer to the lawn.

Example: You have a St. Augustinegrass lawn and live in zone 8a. The table recommends you use 2 pounds actual nitrogen per 1,000 square feet per growing season. Assume you want to use a 24-4-12 fertilizer material. Use the formula to determine how many pounds of fertilizer material are needed to supply the 2 pounds of actual nitrogen needed for the entire growing season.

$$(2 \div 24^*) \times 100 = 8.33 \text{ lb.}$$

*Note: Use the largest number of a mixed fertilizer in the formula.

Table 9. Fertilizer programs for turfgrasses.*

Type of grass	Where you live	Recommended amount of actual nutrient for soils testing medium in phosphorus and potassium.**			No. of applications	Optimum dates of application
hybrid bermudagrass	Zone 7a	3 nitrogen	1 phosphate	2 potash	3	5/15, 6/15, 8/15
	Zone 7b	4 nitrogen	1 phosphate	3 potash	4	5/1, 6/1, 8/1, 9/1
	Zone 8a	4 nitrogen	1 phosphate	3 potash	4	4/15, 5/15, 6/15, 8/15
	Zone 8b	6 nitrogen	2 phosphate	4 potash	6	4/1, 5/1, 6/1, 7/1, 8/1, 9/1
seeded bermudagrass	Zone 7a	3 nitrogen	1 phosphate	2 potash	3	5/15, 6/15, 8/15
	Zone 7b	3 nitrogen	1 phosphate	2 potash	3	5/1, 6/1, 8/1
	Zone 8a	3 nitrogen	1 phosphate	2 potash	3	4/15, 5/15, 6/15
	Zone 8b	4 nitrogen	1 phosphate	3 potash	4	4/1, 5/1, 6/1, 8/1
zoysiagrass	Zone 7a	3 nitrogen	1 phosphate	2 potash	3	5/15, 6/15, 8/15
	Zone 7b	4 nitrogen	1 phosphate	3 potash	4	5/1, 6/1, 7/1, 8/1
	Zone 8a	4 nitrogen	1 phosphate	3 potash	4	4/15, 5/15, 6/15, 8/15
	Zone 8b	6 nitrogen	2 phosphate	4 potash	6	4/1, 5/1, 6/1, 7/1, 8/1, 9/1
St. Augustinegrass	Zone 7a	Not recommended for turf in this zone				
	Zone 7b	2 nitrogen	1 phosphate	2 potash	2	5/1, 6/1
	Zone 8a	2 nitrogen	1 phosphate	2 potash	2	4/15, 8/15
	Zone 8b	3 nitrogen	1 phosphate	2 potash	3	4/1, 6/1, 8/15
centipedegrass	Zone 7a	Not recommended for turf in this zone				
	Zone 7b	1 nitrogen	0 phosphate	1 potash	1	5/1
	Zone 8a	1 nitrogen	0 phosphate	1 potash	1	4/15
	Zone 8b	2 nitrogen	0 phosphate	2 potash	2	4/1, 8/1
carpetgrass	Zone 7a	Not recommended for turf in this zone				
	Zone 7b	Not recommended for turf in this zone				
	Zone 8a	1 nitrogen	0 phosphate	1 potash	1	4/15
	Zone 8b	2 nitrogen	0 phosphate	2 potash	2	4/1, 8/1
Kentucky bluegrass	Zone 7a only	4 nitrogen	1 phosphate	3 potash	4	9/15, 10/15, 3/15, 4/15
tall fescue grass	Zone 7a	3 nitrogen	1 phosphate	2 potash	3	9/15, 3/1, 4/1
	Zone 7b	2 nitrogen	1 phosphate	2 potash	2	9/15, 3/1
creeping red fescue	Zone 7a only	1 nitrogren	0 phosphate	1 potash	1	9/15

*This chart does not include any winterizing fertilizer recommendations that are optional based on soil test analysis, turf use requirements, and grower expectations.

**Given in pounds per 1,000 square feet for entire season (split amount into number of applications).

Mowing

Mowing is necessary for a quality turfgrass. Mow frequently and at the proper height. The frequency and height of cut depend on the type of turfgrass, fertilization program, and the amount of rainfall.

The frequency of mowing depends on the growth rate of the turfgrass. The best rule of thumb is to mow enough that you never remove more than one-third of the leaf area per mowing. A common mistake is to allow the turf to become overgrown before mowing; this stresses the grass by removing too much of the foliage at one time.

When you mow turfgrass properly, it is not necessary to remove clippings for the health of the lawn. The only time you need to remove clippings for the grass's sake is when they are so heavy that the uncut grass is not visible; then remove the clippings to allow the sun to hit the grass. Clippings are an excellent source of slow-release nutrients to the turf. If you remove clippings for aesthetic purposes, consider placing them in a compost pile rather than the trash.

Special Types of Mowing

After many years of high maintenance, some lawn grasses develop a spongy layer of stem and grass residue called "thatch." All lawns have a little thatch, but when thatch layers reach more than 1 inch deep, they should be removed. Excess thatch is a haven for diseases and insects. In addition, heavy thatch layers interfere with proper watering, weed control, and fertilization programs.

Thatch accumulates most often on grasses that are heavy fertilizer users. Bermudagrasses and zoysiagrasses are notorious for developing thatch layers when overfertilized. In addition, St. Augustinegrass and centipedegrass develop thatch over a period of many years. When thatch has accumulated, you should dethatch your lawn. The most practical way to dethatch warm-season grasses is to rent a mower especially designed for dethatching. This mower has vertical blades that thin the grass and throw out the thatch buildup of stems and leaves. The operation usually leaves quite a mess of debris that you should remove from the lawn area.

The best time to dethatch is after the lawn has greened up and you have had to mow the turfgrass at least three times. The grass needs to have at least a month after dethatching to reestablish itself and renew the energy stored in its below-ground portion.

Don't dethatch during the spring transition or green-up period. However, once the grass has come through spring transition and is actively growing, a lawn can be dethatched in the active growing season and up until September 1. Don't dethatch warm-season grasses in late fall or early winter.

If you think your lawn needs dethatching, you need to find a vertical mower. Nurseries, garden centers, and rental stores usually have vertical mowers for rent with advanced notice.

Table 10. Recommended cutting heights.

Turfgrass	Inches
bermudagrass	½–1½
St. Augustinegrass	2½–3
centipedegrass	1½–2
zoysiagrass	1–1½
tall fescue	2–3 winter; 3–4 summer
Kentucky bluegrass	1½–2 winter; 2–3 summer
carpetgrass	1–2
creeping red fescue	2–2½ summer

General Rules for Mowing Turfgrass

1. Be sure the mower blade is sharp. This saves wear and tear on the engine and also prevents damage to the turfgrass.
2. Don't let lawn grasses become overgrown before mowing. Follow recommended mowing heights and frequency of mowing to avoid removing more than one-third of the leaf area.
3. Before mowing, always walk over the lawn area in search of rocks, wire, and other debris that could be a hazard to the operator or bystanders.
4. Wear safety equipment recommended by the manufacturer of your mowing equipment.
5. Always check the oil level before starting the engine.
6. Always adjust the mowing height of the equipment before starting the engine.
7. In general, mow coarse-textured grasses higher than finer-textured grasses.
8. Mow grasses grown in the shade one-half inch higher than the recommended cutting heights.
9. Grass clippings make excellent additions to the compost pile.
10. Avoid using grass clippings as a mulch, since the grass seed and weed seed may contaminate the planting area in flower beds, shrub beds, and vegetable gardens. When added to the compost pile, however, these materials generally decompose and can be used later for soil amendments and mulching.

Control Weeds

To maintain an attractive lawn, you have to learn to manage weeds. Weed control in a lawn begins with a healthy,

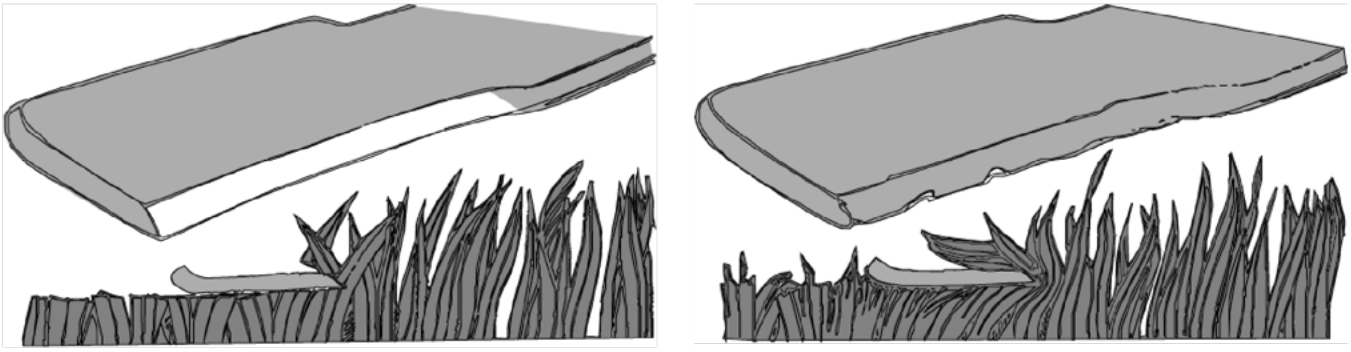

Figure 14. Sharp blades cut the grass evenly; dull blades break and tear it, leaving a ragged lawn.

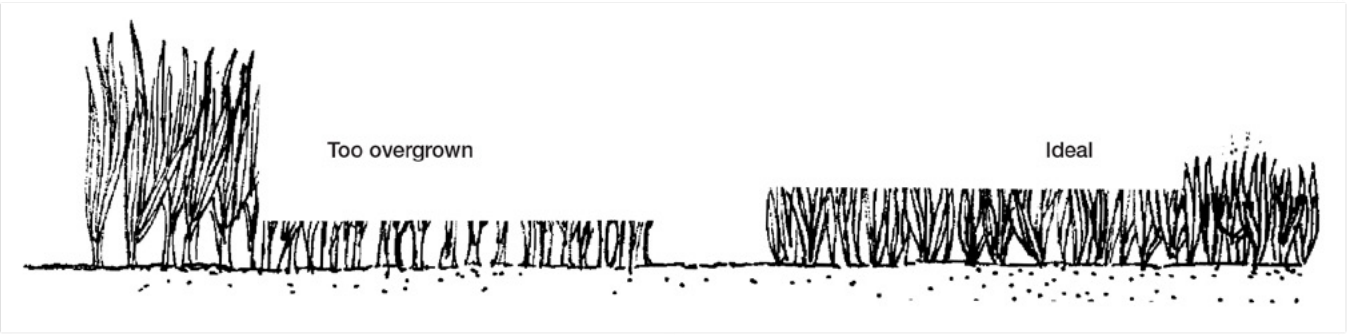

Figure 15. Don't let lawn grasses become overgrown before mowing.

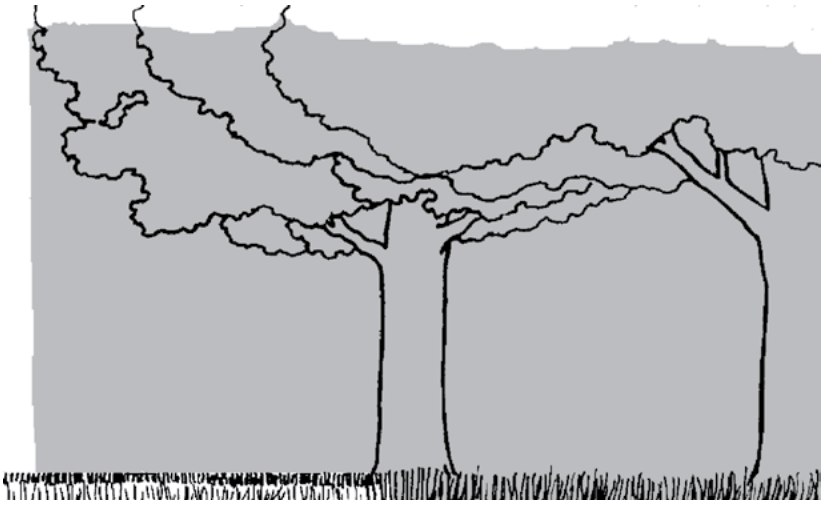

Figure 16. Shaded grass should be ½ inch higher than normal.

vigorous, dense stand of turf. Healthy turf helps control weeds by growing to fill bare areas, shading the soil surface, and shading newly emerged weed seedlings. Without sunlight, many weed seedlings cannot survive. An attractive, weed-free lawn can bring a sense of satisfaction and accomplishment to the homeowner.

Weed Identification

Weed identification is the first step toward chemical control. The pest must be correctly identified before a herbicide to control it can be selected or recommended. County Extension agents can assist you with weed identification. Several inexpensive identification guides are available at most bookstores. Most of these guides contain color photographs as well as written descriptions.

Lawn weeds can be grouped into one of three broad classes: grasses, sedges, or broadleafs. Grasses and sedges are similar with their long, narrow leaves and parallel veins. Grasses, however, have solid nodes (joints) and hollow internodes, and sedges do not. Sedges also have leaves arranged in threes. Hence, a cross-section of a sedge stem appears

triangular. Broadleaf weeds have showy flowers and leaf veins in a net arrangement.

Weeds can be further classified into three broad categories based on their life cycles.

Annuals are those weeds that produce seeds within 1 year after emergence. Those that emerge in the spring, grow through the summer, and produce seeds in the fall are called summer annuals. Examples of summer annuals are crabgrass, goosegrass, spurge, knotweed, and annual lespedeza. Weeds that emerge in the fall, grow in the winter, and produce seeds in the late spring are called winter annuals. Examples of winter annual weeds are henbit, chickweed, and annual bluegrass.

Biennial weeds require 2 years to produce seeds. These weeds emerge and grow the first year, overwinter as a dormant rosette of leaves, resume growth, and produce seeds the second year. Wild carrot and common mullein are examples of biennial weeds.

Perennial weeds emerge, grow, and produce some structure that enables the plant to overwinter and resume growth year after year. These plants typically reproduce by vegetative mechanisms as well as seeds. Common examples are bermudagrass, bahiagrass, dallisgrass, Florida betony, Virginia buttonweed, wild garlic, and nutsedge.

Perennial weeds reproduce by several vegetative structures. Bermudagrass produces rhizomes, or underground stems, capable of rooting and producing new plants at each node. Bermudagrass also produces stolons that are similar to rhizomes but are above the soil surface rather than below. Yellow and purple nutsedges produce tubers (or underground storage organs) capable of producing new plants. A potato is an example of a tuber. Wild onion and garlic produce bulbs or underground vertical stems encased in fleshy leaves. The other mechanism of vegetative reproduction is creeping roots or roots modified for food storage and reproduction. This reproductive mechanism is used by Virginia buttonweed.

Control

Most of the recommended turf-production practices, although not solely intended as weed control methods, do help control weeds. All production practices that promote healthy turf also help reduce weed establishment. This includes use of soil tests to maintain recommended pH, timely addition of recommended rates of fertilizer, controlled irrigation during periods of limited rainfall, insects and disease management, and proper mowing.

Although these practices are considered standard agronomic production tips, they can also help control weeds. As environmentalists, we must manage the turf to use its competitive ability to help control weeds.

Bare soil is a prime area for weed invasion. Bare areas should be reseeded, plugged, or left for adjacent grass to grow into. Areas reseeded or left void should be covered with mulch, such as grain straw, until turf fills the area.

Regardless of how well you manage the turf, weed seeds germinate and seedlings emerge. You should rely on other control methods when this occurs.

Some scattered, individual weeds (wild garlic, for example) can be removed by hand. However, hand removal is a tedious and time-consuming process. Herbicides that will reduce the time required to control weeds are available.

Chemical Weed Control

Herbicides can be divided into two groups: selective and nonselective.

Selective herbicides injure some plants but not others. For example, 2,4-D controls many broadleaf weeds, but does not injure bermudagrass. If, however, you use an excessive rate on a sensitive hybrid bermudagrass, injury will probably occur. Warning: Selective herbicides may become nonselective if you use more than the label recommends. Use caution to apply the rate stated on the product label.

Nonselective herbicides control or injure all plants that are contacted with the spray solution. These herbicides are useful to control all vegetation before lawn renovation or to control emerged weeds in driveways, sidewalks, and patios. Roundup is an example of a nonselective herbicide.

Herbicides can also be classified by their method of application: preemergence and postemergence.

Preemergence herbicides are applied to the soil surface or turf canopy before weed emergence. These herbicides kill weeds before or soon after seedling emergence. Chemical weed control begins with a preemergence herbicide application. If you do not use a preemergence herbicide, weed control becomes a defensive tactic. Apply preemergence herbicides from February to mid-March to control summer annual weeds.

For winter annual weeds, apply after mid-August and before September 1. Individuals in the southern part of the state should apply preemergence herbicides at the beginning of this time and those in the northern part of the state at the end of this period for summer annuals, and reverse these timings for winter annuals.

All preemergence herbicides must move into the upper portion of the soil to control weeds. Herbicides not washed into the soil are decomposed by ultraviolet sunlight or lost as vapors. Some herbicides are more susceptible to decomposition than others. Therefore, the length of time varies that a herbicide can stay on the soil surface before moving into the soil and still provide acceptable weed control. However, the sooner after application the herbicide is washed into the soil, the better the weed control will be. Rainfall will move these materials into the soil, but if rainfall is not forecast within 1 or 2 days after you apply a preemergence herbicide, you should water a half-inch to move the herbicide into the soil.

Postemergence herbicides are applied after weed seedling emergence (no application window is stated). Carefully examine your lawn for the invasion of weed seedlings that were not controlled by the preemergence herbicide.

Postemergence herbicides are most effective if applied to seedlings less than 3 inches tall. Wait until most weeds are 2 to 4 inches tall. Since weed seedling emergence occurs for several weeks, more than one application is needed to control weeds the entire season.

Herbicides are available in several formulations: emulsifiable concentrate (EC or E), water dispersible (WDG, D, DF), flowable (F, AS, LF), soluble concentrate (S), soluble powder (SP), or microencapsulated (M or ME). These formulations are mixed with water and sprayed onto the turf canopy or weeds. All formulations contain inert ingredients in addition to the active herbicide ingredient (active ingredient or ai). They also contain emulsifiers, surfactants, wetting agents, or antifoaming agents that help keep the active ingredient suspended in water and enhance plant uptake. All herbicide labels state the amount of active ingredient and amount of inert ingredients in the container. Knowledge of this information can help you make economical herbicide purchases.

Other herbicides are available in granular formulations (G). The granules are applied directly to the turf or soil surface. Granular materials may be less difficult to apply but are more expensive per unit of active ingredient than the sprayable formulations. Many herbicides are available in sprayable or granular form.

Activity of most postemergence herbicides is enhanced with addition of an adjuvant (or surfactant). Some herbicides require use of surfactant. Adjuvants facilitate herbicide movement into the leaf. Many types of adjuvants are available, and the concentration of active ingredient varies among brands. For most turf herbicide applications, a nonionic surfactant with at least 85 percent active ingredient is sufficient.

The adjuvant rate to add to the tank is stated on the herbicide label. Most, however, recommend 0.25 percent based on the volume of the spray tank (indicated v/v). If, for example, the volume of a spray tank is 1 gallon (or 128 ounces), and the label recommends addition of 0.25 percent (v/v) surfactant, 0.3 ounces surfactant should be added to the spray tank.

Some individuals suggest household detergents can be substituted for surfactant. This is not recommended for several reasons. Household detergents do not contain as much surface-active ingredient per unit volume as do agricultural surfactants. The amount of surface active ingredient per unit volume varies among brands of detergents. Hence, their use is more costly than use of agricultural surfactant. Detergents foam excessively, can form scums that affect sprayer performance, and can interfere with herbicide activity. Remember to purchase a good agricultural surfactant, if the label recommends its use, to save money.

Herbicide Selection

Many preemergence and postemergence herbicides are labeled for use in Mississippi lawns. A visit to the local cooperative dealer or garden center confirms this statement. Don't purchase a herbicide without serious consideration. Determine the type of turf in your lawn and the weeds that are present or anticipated. Then determine which herbicide(s) will provide the best control of the weeds in your turf.

Some weeds are more easily controlled with preemergence herbicides than with postemergence herbicides. For this reason, a combination of preemergence and postemergence herbicides may be necessary for year-round weed management in most lawns.

Turfs vary in their sensitivity to herbicides. Table 11 contains a listing of turfgrass tolerance to herbicides. Consult this table before you make the final herbicide selection. Tables 12 and 13 list weed response to preemergence and postemergence herbicides. These tables are useful to determine which herbicide(s) best controls the weeds present.

Not all herbicides listed in the tables are labeled for home lawns. Many of the products listed will injure desirable, broadleaf plants such as trees, shrubs, flowers, and vegetables. Use caution when applying these materials to turf near these plants. Remember, before using any pesticide, read and follow directions and precautions stated on the label.

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Table 11. Turfgrass tolerance to herbicides.

Herbicide	Common bermuda	Hybrid bermuda	Centipede	St. Augustine	Zoysia
2,4-D	Yes	Yes	Yes	S	Yes
2,4-D + 2,4-DP	Yes	Yes	Yes	S	Yes
2,4-D + dicamba	Yes	Yes	Yes	S	Yes
2,4-D + MCPP	Yes	Yes	Yes	S	Yes
2,4-D + MCPP + dicamba	Yes	Yes	Yes	Y/N[1]	Yes
2,4-D + MCPP + dicamba + carfentrazone	Yes	Yes	Y/N	Y/N	Yes
2,4-D + clopyralid + dicamba	Yes	Yes	No	No	Yes
asulam	–	Yes	–	Yes	–
atrazine	Yes	Y/N	Yes	Yes	Yes
benefin	Yes	Yes	Yes	Yes	Yes
benefin + oryzalin	Yes	Yes	Yes	Yes	Yes
bensulide	Yes	Yes	Yes	Yes	Yes
bentazon	Yes	Yes	Yes	Yes	Yes
bromoxynil	Yes	Yes	–	Yes	Yes
bentazon + atrazine	Yes	Yes	Yes	Yes	Yes
carfentrazone	Yes	–	Yes	Yes	Yes
chlorsulfuron	Yes	Yes	–	–	–
clopyralid	Yes	Yes	Yes	Yes	Yes
clopyralid + triclopyr	Yes	Yes	–	–	–
CMA	Yes	Yes	S	S	Yes
dicamba	Yes	Yes	Yes	Yes	Yes
diclofop	Yes	Yes	–	–	–
dithiopyr	Yes	Yes	Yes	Yes	Yes
DCPA	Yes	Yes	Yes	Yes	Yes

Herbicide	Common bermuda	Hybrid bermuda	Centipede	St. Augustine	Zoysia
DSMA	Yes	Yes	S	S	Yes
fenarimol	Yes	Yes	–	–	–
fenoxaprop	S	S	S	S	Yes
flazasulfuron	Yes	Yes	Y/N	S	Yes
fluazifop	S	S	S	S	Yes
foramsulfuron	Yes	Yes	–	–	–
halosulfuron	Yes	Yes	Yes	Yes	Yes
imazaquin	Yes	Yes	Yes	Yes	Yes
isoxaben	Yes	Yes	Yes	Yes	Yes
MCPP	Yes	Yes	Yes	Yes	Yes
mesotrione	S	S	Yes	Y/N	S
metolachlor	Yes	Yes	Yes	–	Yes
metribuzin	Yes	Yes	–	–	–
metsulfuron	Yes	Yes	Yes	Yes	Yes
MSMA	Yes	Yes	S	S	Yes
MSMA + metribuzin	Yes	Yes	–	–	–
oryzalin	Yes	Yes	No	Yes	Yes
oxadiazon	Yes	Yes	Yes	Yes	Yes
pendimethalin	Yes	Yes	Yes	Yes	Yes
pronamide	Yes	Yes	Yes	Yes	Yes
prodiamine	Yes	Yes	Yes	Yes	Yes
rimsulfuron	Yes	Yes	–	–	–
sethoxydim	S	S	Yes	S	S
simazine	Yes	Yes	Yes	Yes	Yes
sulfentrazone	Yes	Yes	Yes	Y/N	Y/N
sulfosulfuron	Yes	Yes	Yes	Yes	Yes
trifloxysulfuron	Yes	Yes	–	–	Yes

[1]Use products only with a 0.5:1:0.1 ratio of 2,4-D, MCPP, and dicamba on St. Augustinegrass. **S** indicates susceptible; herbicide known to severely damage or kill turfgrass. **Y/N** indicates intermediate, use with caution, or at reduced rates. Consult label for product use instructions and restrictions before considering use. **Yes** indicates tolerant when applied according to label directions. – indicates not labeled or data not available. Consult labels for approved adjuvants. Weed resistance to recommended use rates of certain herbicides has been documented in Mississippi.

Table 12. Estimated preemergence control.

Weeds	atrazine	benefin	bensulide	benefin + oryzalin	benefin + trifluralin	dithiopyr	fenarimol	isoxaben	metolachlor	oryzalin	oxadiazon	oxadiazon + prodiamine	pendimethalin	prodiamine	pronamide	simazine
annual bluegrass	G	G	G	G	G	E	E	N	–	E	G	–	E	E	E	E
bahiagrass	–	G	G	G	–	–	–	–	–	G	G	–	G	–	–	–
buttercup	N	N	N	N	–	–	N	–	–	N	F	–	N	–	–	N
carpetweed	–	G	G	G	–	–	N	F	–	G	E	–	N	–	–	E
chamberbitter	G	–	–	–	–	–	–	G	–	–	G	–	–	G	–	G
chickweed	E	N	F	F	G	–	N	E	–	G	F	–	G	–	F	E
clovers	G	N	N	N	–	–	N	G	–	N	N	–	N	–	–	F
crabgrass	F	G	E	E	G	E	N	N	G	E	G	E	E	E	–	F
dallisgrass	–	G	G	G	–	–	N	N	–	G	–	–	G	–	–	–
dandelion	–	N	N	N	–	–	N	G	–	N	N	–	N	–	–	F
dichondra	E	N	N	N	–	–	N	–	–	N	N	–	N	–	–	N
Florida betony	E	N	N	N	–	–	N	–	–	N	N	–	N	–	–	–
Florida pusley	E	N	F	F	–	–	N	F	–	N	–	–	N	–	–	G
goosegrass	F	F	F	F	G	G	N	–	–	G	E	E	G	E	–	N
ground ivy	N	N	N	N	–	–	N	–	–	N	G	–	N	–	–	G
henbit	–	N	N	N	–	–	N	G	–	N	G	–	N	–	–	E
knotweed	G	N	F	F	G	–	N	G	–	F	–	–	N	–	–	G
lawnburweed	G	N	N	N	–	–	N	–	–	N	F	–	N	–	–	E
lespedeza	G	N	N	N	–	–	N	–	–	N	–	–	N	–	–	F
pennywort	–	N	N	N	–	–	N	G	–	N	–	–	N	–	–	N
plantain	–	N	N	N	–	–	N	G	–	N	N	–	N	–	–	F
prostrate spurge	–	N	N	N	–	–	N	F	–	N	G	–	F	–	–	G
sandbur	F	G	G	G	–	–	N	–	–	G	G	–	G	–	N	–
sherpherdspurse	–	N	N	N	–	–	N	E	–	N	G	–	N	–	–	E
speedwell	E	N	N	N	–	–	N	G	–	N	G	–	N	–	–	F
Virginia buttonweed	–	N	N	N	–	–	N	–	–	N	G	–	N	–	–	G
wood sorrel	G	N	N	N	–	–	N	G	–	F	G	–	F	–	–	G

E = Excellent, **G** = Good, **F** = Fair, **N** = No control, **–** = Data not available.

Table 13. Estimated postemergence control.

Weeds	asulam	atrazine	bentazon	chlorsulfuron	clopyralid	clopyralid + triclopyr	2, 4-D	2, 4-D + mecoprop	2, 4-D + dicamba	2, 4-D + mecoprop + dicamba	2, 4-D + mecoprop dicamba + carfentrazone	diclofop	dicamba	diquat	foram sulfuron	fenoxaprop	flazasulfuron	fluazifop	glyphosate	halosulfuron	imazaquin	mecoprop	mesotrione	metribuzin	metsulfuron	MSMA, DSMA, & CMA	MSMA + metribuzin	pronamide	quinclorac	rimsulfuron	sethoxydim	simazine	sulfentrazone	sulfosulfuron	trifloxysulfuron
annual bluegrass	–	E	N	N	N	N	N	N	N	N	N	–	N	G	E	N	F	–	E	N	N	N	N	G	N	N	N	E	–	E	F	E	N	G	E
bahiagrass	–	N	–	–	N	N	N	N	N	N	N	N	N	–	N	G	–	–	E	N	N	N	–	N	E	F	F	N	–	–	G	N	N	N	F
buttercup	–	N	–	–	–	G	F	G	G	E	E	N	E	F	–	N	–	N	E	–	–	F	–	G	–	N	N	–	–	–	N	N	–	–	–
carpetweed	–	E	–	–	N	–	G	G	G	G	G	N	G	N	–	N	–	N	E	–	–	F	Y	N	N	N	G	–	–	–	N	E	–	–	–
chamberbitter	–	G	–	F	–	–	–	–	–	–	–	–	–	–	–	–	F	N	–	–	N	–	–	–	G	–	–	–	–	–	–	G	–	N	F
chickweed	G	E	–	–	–	E	F	G	G	E	E	N	E	G	–	N	E	N	E	–	G	G	–	G	G	N	N	F	–	G	N	E	–	E	E
clovers	–	G	–	N	E	E	N	G	E	E	E	N	E	P	N	N	G	N	E	–	N	E	–	N	G	N	N	–	–	–	N	G	F	N	G
crabgrass	G	F	N	–	N	N	N	N	N	N	N	–	N	N	–	E	G	G	E	–	–	N	G	N	N	E	E	N	G	N	G	F	–	N	–
dallisgrass	N	N	N	–	N	N	N	N	N	N	N	N	N	N	F	N	P	–	E	N	N	N	N	N	N	E	E	–	–	N	F	N	N	N	–
dandelion	–	F	–	G	–	E	E	E	E	E	E	N	G	N	N	N	F	N	E	N	F	F	–	N	G	N	N	–	–	–	N	F	–	F	E
dichondra	–	N	–	–	–	–	F	G	G	G	–	N	G	N	–	N	P	N	E	–	–	–	–	N	N	N	N	–	–	–	N	N	–	–	–
Florida betony	–	N	N	N	–	G	N	–	G	G	G	N	G	N	–	N	–	N	E	N	N	–	–	N	E	–	N	–	–	–	N	–	–	–	–
Florida pusley	–	N	–	–	–	–	N	N	–	–	–	N	–	N	–	N	–	N	E	–	–	N	–	–	G	N	N	–	–	–	N	N	–	–	–
goosegrass	F	N	N	–	N	N	N	N	N	N	N	E	N	N	G	G	P	–	E	–	–	N	G	N	N	F	E	N	–	N	F	N	G	N	–
ground ivy	–	G	–	–	–	–	G	–	–	–	–	N	–	N	–	N	–	N	E	–	–	–	–	G	G	N	G	–	–	–	N	N	–	–	–
henbit	–	E	–	–	–	E	F	G	G	E	E	N	E	G	E	N	E	N	E	–	F	F	–	G	G	N	N	–	–	E	N	E	–	E	E

Weeds	asulam	atrazine	bentazon	chlorsulfuron	clopyralid	clopyralid + triclopyr	2, 4-D	2, 4-D + mecoprop	2, 4-D + dicamba	2, 4-D + mecoprop + dicamba	2, 4-D + mecoprop dicamba + carfentrazone	diclofop	dicamba	diquat	foram sulfuron	fenoxaprop	flazasulfuron	fluazifop	glyphosate	halosulfuron	imazaquin	mecoprop	mesotrione	metribuzin	metsulfuron	MSMA, DSMA, & CMA	MSMA + metribuzin	pronamide	quinclorac	rimsulfuron	sethoxydim	simazine	sulfentrazone	sulfosulfuron	trifloxysulfuron
knotweed	–	G	–	–	G	–	F	G	G	G	–	N	E	N	–	N	–	N	E	–	–	G	–	N	E	N	N	–	–	–	N	G	–	–	N
kyllinga	–	–	–	N	N	N	N	N	N	N	N	N	N	–	N	N	–	N	E	F	F	N	–	–	N	–	–	–	–	–	N	N	E	E	G
lawnburweed	–	E	–	E	–	–	F	F	G	G	G	N	G	G	N	N	E	N	E	N	E	–	–	G	E	N	N	N	–	G	N	E	–	E	E
lespedeza	–	F	–	–	–	–	F	G	G	G	G	N	E	N	–	N	–	N	E	–	–	G	–	N	G	N	F	–	–	–	N	F	–	–	–
nutsedge, purple	N	N	N	–	N	N	N	N	N	N	N	N	N	N	–	N	F	N	G	E	E	N	–	N	N	F	F	N	–	–	N	N	G	E	E
nutsedge, yellow	N	N	E	–	N	N	N	N	N	–	N	N	N	N	–	N	F	N	G	E	E	N	–	N	N	F	F	N	–	–	N	N	G	E	E
path rush	–	–	–	N	–	–	G	–	–	G	–	–	N	–	–	N	P	N	E	–	N	–	–	–	N	–		–	–	–	–	–	–	N	–
pennywort	–	F	–	–	–	G	F	–	–	F	–	N	–	N	–	N	P	N	E	–	F	–	–	–	G	F	E	–	–	–	N	N	–	–	–
plantain	–	F	–	–	G	F	E	G	G	G	E	N	F	N	–	N	–	N	E	–	–	F	–	N	G	N	N	–	–	–	N	F	–	–	–
prostrate spurge	–	G	–	–	N	E	N	F	G	G	G	N	F	N	–	N	–	N	E	–	–	N	–	N	G	N	N	–	–	–	N	G	–	–	–
ryegrass	–	–	–	E	N	–	N	N	N	N	N	–	N	–	E	N	E	–	E	N	N	N	N	–	E	N	–	E	–	E	–	E	N	N	E
sandbur	–	–	–	–	N	N	N	N	N	N	N	–	N	N	N	–	–	–	E	–	–	N	–	N	N	G	E	N	–	–	F	–	–	–	–
shepherd-spurse	–	E	–	–	–	–	G	G	G	G	G	N	G	G	–	N	–	N	E	–	–	F	–	G	G	N	N	–	–	–	N	E	–	–	–
speedwell	–	–	–	–	G	–	N	F	F	F	F	N	N	G	–	N	P	N	E	–	N	N	–	N	N	N	N	–	–	–	N	–	–	N	–
tall fescue	N	N	N	F	N	N	N	N	N	N	N	N	N	N	–	–	G	N	G	N	N	N	N	N	N	N	N	N	–	–	F	N	N	F	G
torpedograss	N	N	N	–	N	N	N	N	N	N	N	N	N	N	N	–	P	N	N	N	N	N	–	N	N	N	N	N	G	–	N	N	–	N	G

Weeds	asulam	atrazine	bentazon	chlorsulfuron	clopyralid	clopyralid + triclopyr	2, 4-D	2, 4-D + mecoprop	2, 4-D + dicamba	2, 4-D + mecoprop + dicamba	2, 4-D + mecoprop dicamba + carfentrazone	diclofop	dicamba	diquat	foram sulfuron	fenoxaprop	flazasulfuron	fluazifop	glyphosate	halosulfuron	imazaquin	mecoprop	mesotrione	metribuzin	metsulfuron	MSMA, DSMA, & CMA	MSMA + metribuzin	pronamide	quinclorac	rimsulfuron	sethoxydim	simazine	sulfentrazone	sulfosulfuron	trifloxysulfuron
tufted lovegrass	–	N	–	N	N	N	N	N	N	N	N	N	N	–	N	G	P	G	E	N	N	N	E	N	N	N	N	–	N	N	N	N	G	N	N
Virginia buttonweed	–	N	–	G	–	F	N	F	G	G	G	N	F	N	–	N	P	N	E	–	N	N	–	N	F	N	N	–	–	–	N	N	–	N	–
wild garlic	–	N	–	–	N	F	F	F	F	F	F	N	F	N	F	N	P	N	G	–	E	N	–	N	F	N	N	N	–	E	N	N	F	N	E
wood sorrel	–	G	–	–	–	–	N	N	F	F	F	N	G	N	–	N	F	N	E	–	F	F	–	N	G	N	N	–	–	–	N	G	–	–	–

E = Excellent, **G** = Good, **F** = Fair, **N** = No control, **–** = Data not available.

Maintenance Calendar for Home Lawns

Winter *December 22–March 21*

Grassy winter annuals and broadleaf winter annuals in dormant turf become aggressive and rampant by early March. The seed (for next year's crop) matures in late winter and spring. Grassy winter annuals include annual bluegrass and little barley. Broadleaf winter annuals include henbit, wild mustard, common chickweed, saw thistle, pepperweed, Carolina geranium, buttercup, wild garlic, narrow vetch, shepherd's purse, and wild lettuce. Seed from last year's crop of summer weeds are present and will germinate in February and March.

Checklist

- To control existing winter weeds in the dormant lawn in January, February, and very early March: (a) Use a postemergence herbicide to kill existing weeds, and (b) keep your lawn mowed closely at recommended heights for your type of lawn grass. Most winter weeds cannot tolerate close mowing and will be stressed, damaged, or even killed by mowing heights used on warm-season lawns. (c) Plan to use a preemergence herbicide next fall to kill next year's crop. If you have allowed several winter weeds to mature and produce seed, you will certainly have the potential for a big weed crop next winter. Make notes and plans now.
- Do not fertilize lawns with warm-season grasses in January or February. Winter weeds are in "prime time." Warm-season turf is dormant, or nearly so. Fertilizer in these months only encourages rampant weed growth and seed production. Warm-season grasses are not yet actively growing and do not benefit from early spring applications of fertilizer.
- Plan to use a preemergence herbicide in late winter to control summer annuals that will be sprouting then.

Spring *March 22–June 21*

Winter annuals grow vigorously and become rampant. Seed production peaks in spring. See winter weeds mentioned above.

Desirable warm-season turfgrasses begin "spring transition" from dormancy to active growth. They are sensitive to certain herbicides and cultural conditions during "spring transition." Transition begins in March and continues through mid-April.

Summer annual weeds begin seed germination in early spring. Summer perennials begin regeneration from roots, stems, rhizomes, or tubers of established mother plants. Summer perennials also begin seed germination in spring.

Checklist

- Continue to mow the lawn at recommended heights for your particular type of lawn grass. Regular mowing helps control weeds.
- Fertilize the lawn to allow quick coverage. Always be sure the turfgrass, and not weeds, is responding to the nutrients by applying proper herbicides.
- Do not apply postemergence herbicides to warm-season turf during "spring transition." They can damage or hinder turfgrass in the early stage of active growth. Postemergence applications are safe beginning May 1 on the Gulf Coast and May 15 in central and north Mississippi. Lawns with severe thatch problems may need dethatching after the grass has gone through transition. Grasses prone to thatch include bermudagrass, zoysiagrass, and St. Augustinegrass.

Summer *June 22–September 21*

Summer annuals are at their peak. They can produce several generations of weed seedlings from now until frost. Spring seedlings have enough time to produce seed. These seeds immediately germinate into another generation. The cycle is repeated until frost in October and November. Some scattered seed of summer annuals will lie dormant through the winter months and sprout early next spring.

Grassy summer annuals include crabgrass, goosegrass, crowfoot, signalgrass, barnyardgrass, and foxtail. Broadleaf summer annuals include ragweed, spurge, pigweed, chickweed, lamb's quarter, bitterweed, yellow wood-sorrel, spiny amaranth, and beggar's lice.

Warm-season turfgrasses have the best opportunity for rapid growth and development. Encourage quality turf by proper maintenance suggested in this publication.

Winter weeds (grassy and broadleaf) begin their cycles in late summer. Winter annuals begin seed germination in early September. Seeds are present from last year's crop that matured in late winter and early spring of this year. The seed and sprouting seedlings are hard to see because they are below the leaves and stems of your lawn grass. Seeds continue to sprout during the fall, but some wait until late winter to sprout. In both cases, you won't see much growth of winter annuals until cool weather and winter rains arrive in late fall and early winter.

Grassy winter annuals include little barley and annual bluegrass. Broadleaf winter annuals include henbit, wild mustard, common chickweed, sow thistle, pepperweed, Carolina geranium, buttercup, wild garlic, narrow vetch, shepherd's purse, and wild lettuce.

Checklist

- Continue regular mowing at the recommended height for your particular lawn grass. Proper mowing promotes a dense quality turf cover that competes aggressively with weeds.
- Continue a proper fertilization program to encourage a quality turf cover.
- Be prepared to water as needed in hot weather. Summer is the prime time for promoting active growth of your warm-season grass. Take advantage of the ideal temperatures and provide water, fertilizer, and proper mowing at this time.
- Continue a postemergence herbicide program as needed to clean up existing summer weeds.
- Decide on a late-summer application of a preemergence herbicide to control winter weeds. Contact your local nursery and have the herbicide material on hand by late summer. Remember, timely application of preemergence herbicide is necessary for proper control.

Fall *September 22–December 21*

Warm-season lawn grasses grow more slowly with the cooler fall temperatures. However, moderate growth continues in September and early October in most areas of Mississippi. Dormancy begins with the first frost on all warm-season grasses except St. Augustinegrass, which sometimes does not become completely dormant in winter.

Active growth of winter annuals may be seen by December.

Checklist

- Continue regular mowing at recommended heights for bermudagrass, zoysiagrass, and carpetgrass. Raise mowing height to 3 inches on St. Augustinegrass to promote winter hardiness.
- Take a soil test to help you plan your fertilization program for next summer. Fall is the ideal time to apply lime if your soil test recommends it.

Control Diseases

Turfgrass damage should be diagnosed as soon as possible. Damage is often blamed on diseases or insects when climate, environmental conditions, or cultural practices are the real causes. Tree competition, cutting height, cutting frequency, herbicide damage, nutrient chlorosis, and soil compaction sometimes cause diseases to develop.

Diseases are usually more severe in lawns with a heavy thatch. Thatch is a layer of partially decomposed leaves, stems, and

roots at the soil surface. It builds up over several years and restricts the movement of air, water, and fertilizers into the soil. When thatch is heavy, roots are generally shallow, which increases damage from drought.

Following are brief descriptions of the most common diseases of warm-season grasses and some suggested control recommendations. For more complete descriptions of these diseases and updated chemical control recommendations, use rates, timing of applications, and other information, refer to other Extension turf disease publications and suggested chemical labels.

Always read and follow label directions, as many pesticides have restrictive use or application guidelines and can be applied only by professional applicators. Some of the fungicides listed are labeled only for golf courses, sod farms, industrial, or municipal turf areas, or to be applied only by professional applicators to residential lawns; therefore, they may not be used by homeowners.

Large Patch (Brown Patch)

The fungus responsible for large patch, commonly referred to as brown patch, attacks most species of grasses but is more serious on bentgrass, bluegrass, bermudagrass, centipedegrass, and St. Augustinegrass.

Large patch is prevalent in spring or fall. You will see brownish to gray irregular, circular areas a few inches to several feet in diameter. In certain grasses, a narrow, dark, smoke-colored ring may border the diseased area. These water-soaked or scalded spots spread rapidly, becoming large, brown areas.

Generally, large patch fungus attacks the base of leaf sheaths where they are joined to stolons. Leaves turn yellow in St. Augustinegrass and a reddish color in centipedegrass before dying. Uncontrolled, it can attack the roots and kill large areas of the lawn. Large patch is severe on St. Augustinegrass in the spring, especially at temperatures of 60 to 75°F. At temperatures of 80°F and above, and under low moisture conditions, the activity of the fungus decreases. Large patch can be caused by too much nitrogen fertilizer, watering late in the afternoon, and by thatch buildup.

Control: 1) Use recommended varieties and good cultural practices for watering, fertilizing, and mowing. 2) Control thatch. 3) Limit the amount of nitrogen fertilizer. 4) Refer to Tables 14 and 15 for recommended fungicides.

Gray Leaf Spot

Gray leaf spot usually attacks St. Augustinegrass, but it can also attack centipede. It is a summer disease caused by a fungus and is common in long periods of hot, humid weather. Newly sprigged or rapidly growing grass is more susceptible than well-established grass. Too much nitrogen fertilizer can make the disease more severe.

The disease causes irregular gray, dirty-yellow, or ash-colored spots with brown, purple, or water-soaked borders on leaf blades. Spots may be covered with gray mold in warm, humid weather. Lesions may occur on stems, spikes, and leaves. A yellow halo or general chlorosis may occur around some spots.

The disease is usually noticed first in shaded damp areas. In heavy areas, the grass may have a burned appearance. Seldom will this disease kill an entire lawn.

Fungus spores are spread by the wind, rain, irrigation water, and animals.

Control: Avoid excessive nitrogen (water-soluble) fertilization in summer. Water in the day so foliage will not stay wet overnight. Refer to Tables 14 and 15 for recommended fungicides.

Fairy Rings

Most fairy rings are caused by fleshy fungi such as mushrooms, toadstools, or puffballs. They occur wherever grass grows and in soil that is high in organic matter. The rings are usually marked by mushrooms or by a stimulated or depressed growth of vegetation.

There are three types of fairy rings. One produces a ring of dead grass each year and is visible for long periods of time. Another produces a dark-green ring. The third type is visible only when the fruiting bodies are produced and does not affect the grass.

The killing or dark-green reaction sometimes results from hydrogen cyanide (HCN) production, which in high concentrations is lethal to grass. Mushrooms may appear periodically. The soil is permeated by a white fungus growth (mycelium) and is usually very dry.

Fairy rings spread outward a few inches to a few feet per year. Where the grass cover is not uniform, the rings may not be completely circular. As the fungus spreads, it consumes a portion of the organic matter in the soil. The fungus prevents the penetration of water into the soil, and the grass is damaged or killed from drought.

Control: In developing your lawn, do not bury roots, stumps, branches, and other large pieces of organic debris. These provide a food source for these fungi. If the only effect of the fairy ring is a stimulation of growth in rings, fertilization usually takes care of the problem. Removing cores of soil (aerification) aids in water penetration.

Topdress holes with fresh soil free of organic matter. Some experts recommend removing the soil 18 inches on each side of the outer stimulated area 1 foot deep. In removing infested soil, do not spill it on adjacent healthy grass. Fill trench with fresh soil and reseed or resod. Chemical control is generally not very effective because the fungus grows so deeply into the soil, but refer to Tables 14 and 15 for labeled fungicides.

Dollar Spot

This common fungus disease occurs on several grass types but is most severe on bermudagrass. It attacks neglected turf or areas that are under moisture or nutritional stress caused by a lack of nitrogen.

Warm, humid weather and cool nights with heavy dew promote the disease. It kills the grass in small spots 2 to 3 inches in diameter. The spots may grow together into large areas. They appear first as small, circular, straw-colored spots of blighted turfgrass about the size of a silver dollar. Individual leaves develop lesions that have a bleached, straw-colored appearance, bounded by a tan to reddish-brown margin. A white, cotton-like fungal mycelium growth may be seen in early morning when dew is present.

Pieces of diseased plants are spread by mowers, sweepers, and other lawn equipment.

Control: 1) Maintain adequate moisture and nutrients. Maintain a high level of nitrogen when the disease is prevalent. 2) Prevent the buildup of thatch. 3) Do not water in late afternoon or evening. 4) Many strains of this fungus resist certain fungicides, so use several types of fungicides to control this disease. Alternate contact fungicides with systemic fungicides. Refer to Tables 14 and 15 for suggested fungicides.

Slime Molds

Slime molds cover above-ground plants with a dusty-gray, black, or dirty yellow mass. When you look closely, you see small, round balls scattered over the plant. If you rub these balls between your fingers, a minute, soot-like powder covers them. This powder is the spores of the fungus.

Slime molds normally live on the soil, where they feed on decaying organic matter. Slime molds do not feed on living plants. They use them for support during reproduction. They damage grass and other plants only by shading them from sunlight, causing the leaf blades to turn yellow. Slime molds occur in wet weather in spring, summer, and fall. They disappear rapidly as soon as it becomes dry.

Control: Control is usually not necessary. You can break up the masses by sweeping with a broom, spraying with a strong stream of water, or just dragging a hose over the affected area. In prolonged damp weather, you can apply any good contact turf fungicide to affected areas.

Melting Out or Leaf Blotch

Several fungi can cause melting out, or leaf blotch. Fungus spores produce abundantly and travel long distances by wind, water, and mowers. Infection by the wind-borne spores results in leaf spotting.

Symptoms are round or oblong spots parallel to the leaf blade. They are usually brown or purple and are more numerous near the collar area of the leaf blade. The leaf sheath turns brown and dies, resulting in death of the leaf blade. In severe cases, a sheath and crown rot kills the grass in patches. The grass may be badly thinned over the entire turf area.

Control: There are no resistant varieties. 1) Do not let grass stay wet. Irrigate early in the morning. 2) Keep the grass in good vigor. Do not apply high rates of water-soluble nitrogen fertilizers in the spring. 3) Raise mowing height during disease outbreak. 4) Remove and destroy clippings from affected lawns when mowing. 5) Apply recommended fungicides. Follow label instructions.

Nematodes

Nematodes are microscopic worm-like organisms that live in the soil and attack the roots. They are occasionally a problem in home lawns because they feed on turfgrass roots and cause a slow decline of the turf.

If you have a lot nematodes, they can cause a thinning out, stunting, and pale color of the grass, usually in patches. There are no absolute above-ground symptoms to confirm the presence of nematodes. The only way to determine if nematodes are a problem is to have a soil sample assayed by the Mississippi State University Extension Service's Nematode Assay Laboratory. You may get a Nematode Soil Sample Bag (Extension Form 591), Nematode Soil Sample Form (Extension Form 488), and instructions from your county Extension agent.

Control: Controlling nematodes in home lawns is different from nematode control in most other plants. There are no resistant varieties, you cannot use biological control, and there are no chemicals (nematicides) you can use in established home lawns because of the extreme toxicity of nematicides. You should use good cultural practices to keep

damage to a minimum. This includes mowing, watering, controlling insects and diseases, and fertilizing properly.

When bringing soil in to form a new lawn, first have it tested for nematodes. On an established lawn where nematodes are a problem, take a soil sample for fertility testing to the Extension Soil Testing Laboratory. Follow fertilizer and lime recommendations, and water to avoid drought stress.

Rust

People typically notice rust on cool-season turf species, such as fescues and ryegrass. But it also can attack warm-season species such as bermudagrass. Symptoms of rust appear as irregular areas or distinct patches of turf having a yellowing or orange color. Leaves will have tiny pustules or blisters on their surface that when ruptured release a powdery mass of spores.

An easy way to notice these is to wipe a white cloth across the lawn. The tiny spores will easily show up as an orange stain.

Turf stresses such as drought and nitrogen deficiency are associated with this disease, so good turf management will help control rust. Apply fungicides that are effective in managing rust.

Take-All Root Rot

This disease is caused by a fungus. It may be mistaken for chinch bug damage or drought symptoms.

Symptoms are circular to irregular in shape and may resemble symptoms of brown patch. Patches of diseased St. Augustinegrass or centipede at first appear yellowish-green and then die. As diseased stolons die, severe thinning occurs in areas of several feet to even entire lawns.

It is important to remember that this is a root disease and by the time leaf symptoms are noticeable, the root systems have already been severely damaged. Another key symptom is the ease of lifting stolons from the soil, since the roots are essentially gone.

You can lessen the disease by following cultural practices that reduce turf stresses. Eliminate excessive irrigation. Avoid applying high rates of lime, and maintain a soil pH of 5.5 to 6.0. Mow at recommended heights and intervals with a sharp blade. Avoid ammonium nitrate fertilizer, and use acidifying fertilizers such as ammonium sulfate or slow-release urea. Maintain recommended levels of potassium. Do not use root-inhibiting herbicides on infected lawns.

Few fungicides provide acceptable control, but sterol inhibitors such as myclobutanil or triadimefon may help, as well as a strobilurin fungicide such as trifloxystrobin or azoxystrobin.

Spring Dead Spot

Spring dead spot (SDS) is most prevalent in highly maintained bermudagrass lawns. Most other turfgrass diseases attack the foliage, but SDS does its damage below-ground. Therefore, SDS must be managed differently.

Infection occurs in late summer through fall while the grass is still growing, but symptoms go unnoticed until the next spring when the turf begins to break dormancy. As the turf goes dormant, the pathogen continues to attack the roots, causing root decay and increasing susceptibility to cold injury. The result is dead circular patches 6 inches to 3 feet in diameter that appear in the spring.

Preventive applications of trifloxystrobin or sterol fungicides, such as fenarimol, myclobutanil, or propiconazole, applied in early fall and again in the spring may help, but these treatments can become very expensive and may require a professional to apply. To best manage SDS, the goal is to maintain a strong, healthy below-ground turf structure. The first step is to alleviate adverse soil conditions. Reducing soil compaction with core aerification, improving poor drainage issues, and dethatching to keep thatch accumulations below 1 inch will help.

Soil chemical properties and nutrition are also important. Maintaining soil pH between 5.5 and 6.0 tends to help suppress SDS severity. Keeping potassium levels high, especially from a fall application, helps to reduce SDS and increase turf winter hardiness whereas late-season, high-nitrogen applications may enhance the disease.

Throughout the growing season, maintaining an optimum mowing height and avoiding other plant stresses (drought, traffic, pests, etc.) will also develop a stronger, healthier turf.

Anthracnose

This disease has become more prevalent in Mississippi recently, particularly in centipede lawns stressed from heavy thatch or soil compaction, but it can infest many warm- and cool-season turf species. General diagnostic symptoms are yellow to brown irregular patches of turf with leaf lesions that are yellow with black centers. Warm temperatures and extended leaf wetness enhance disease activity.

Control: Avoid late in the day irrigation that creates long overnight leaf wetness. Maintain a balanced fertility program that reduces growth flushes and thatch build-up.

Table 14. Turf fungicides. Locate the disease of interest and look down that column until you find a fungicide active ingredient that has activity against that disease. The disease resistance group is found in column 2. The re-entry period (usually in hours) appears in the final column. Refer to Table 15 to find brand name products.

Active ingredient	Resistance group (FRAC)*	Disease									Re-entry period (usually hrs)
		Anthracnose	Dollar spot	Fairy ring	Gray leafspot	Large (brown) patch	Leaf spot (bermudagrass), melting out, or crown rot	Rusts	Take-all or bermudagrass decline	Spring dead spot	
azoxystrobin	11	G–E**	P	G	F–G	E	G–E	E	F	P–F	4
bacillus licheniformis SB3086		L	GZ								
boscolid	7	NL	E	NL	NL	NL	NL	NL	NL	NL	dry
captan	M4	NL	NL	NL	L	L	L	NL	NL	NL	96
fludioxonil	12	F	NL	NL	L	L	G–E	NL	NL	NL	12
myclobutanil	3	L (C)	L (C)	NL	L (C)	F–G	P–F	G–E	L (C)	P–F **	24
PCNB, quintozene	14	NL	NL	NL	NL	G	F	NL	NL	NL	12
polyoxin D	19	L	NL	F–G	P–F	P–F	F–G	NL	NL	NL	4
propiconazole	3	L (C)	L (C)		L (C)	F–G (C)	P–F	NL	P	NL	24
pyraclostrobin	11	G–E	suppression only	F–G	E	G–E	G–E	L	F	NL	12
thiophanate-methyl	1		G–E		G–E		P	P	L	NL	12
thiram	M3	NL	P	NL	NL	NL	NL	NL	NL	NL	24
triadimefon	3	L	G–E	NL	F–G	G–E	F–G	G	P–F	F	12
trifloxystrobin	11	G–E	NL	NL	G	G	F–G	F–G	NL	NL	12

*E = excellent; F = fair; G = good; L = labeled but efficacy not known; L (C) = labeled, efficacy not known but the chemistry to which this active ingredient belongs may slow growth or cause some phytotoxicity of warm-season turfgrasses during warm weather; NL = not labeled; P = poor.

**Resistance or FRAC group indicates how the fungicide acts against the fungus. Unless the fungicide group begins with an "M," please rotate the use of different fungicide groups to prevent resistance to that fungicide. If possible, it is often a good idea to mix an "M" group fungicide with a numbered fungicide.

Table 15. Fungicide product trade names for residential lawns. *(Some may be applied to home lawns only by professional applicators.)*

Active ingredient	Comments
azoxystrobin	This active ingredient was derived from fungi. For professional use only, but may be used on home lawns. The Heritage label is the most common.
bacillus licheniformis SB 3086	Ecoguard; professional and homeowner use.
captan	Sold by various companies in both homeowner and professional formulations. All have Captan in the trade name.
myclobutanil	Myclobutanil is sold under the homeowner brand names Green Light Fung-Away Systemic Granules, Spectracide Immunox, and Schultz Fungicide Plus. Available in granular form as Fertilome F-Stop. Professionally sold as Eagle. Use to control spring dead spot in the fall often results in the best dormant ratings of all products, but not necessarily the best after spring green-up.
PCNB or quintozene	Homeowner trade names contain PCNB or Terraclor. Professionally available in diverse names.
polyoxin D	This active ingredient was derived from fungi. Sold mostly under the trade name Endorse.
propiconazole	Propiconazole may burn bermudagrass, especially under high summer temperatures. Newer formulations are said to be not as bad. Sold as Bonide Infuse Disease Control, Bonide Fung-onil Lawn and Garden Disease Control, Fertilome Liquid Systemic Fungicide, Honor Guard PPZ Turf and Ornamental Fungicide, and Ortho Lawn Disease Control Ready-Spray. Professionally marketed under the trade name Banner Maxx.
pyraclostrobin	Sold under the trade name Insignia. May be used on home lawns by homeowners, but must purchase the professional material.
thiophanate-methyl	Sold under the trade names Fertilome Halt Systemic Rose, Flower, Lawn Fungicide; Green Light Systemic Fungicide; Green Light Fung-Away ii Systemic Lawn Fungicide; and Southern Ag Thiomyl Turf and Ornamental Systemic Fungicide. Centipede grass is not on thiophanate-methyl labels. The most common commercial trade names are 3336 and Cavalier.
triadimefon	Sold as Bayleton; Bayer Advanced Fungus Control for Lawns (granular formulation); Bonide Fung-onil Lawn Disease Control; Green Light Fung-Away Systemic Lawn Spray Hose-End Concentrate (RTS); Hi-Yield Lawn Fungicide Granules Containing Bayleton; Southern Ag Bayleton - Systemic Fungicide for Turf & Ornamentals; and Southern Ag Bayleton-Turf Fungicide Granules.

Control Insects

The home lawn is an ideal environment for insects and related creatures. Some of these animals may be classified as pests, but many are harmless and some are beneficial. It is important to know the damaging ones from the nonpests. It is also important to be able to tell the difference between insect damage and other types of damage, such as disease, drought, or nutritional problems. The following sections provide brief discussions of the most common insect pests of home lawns and the damage they cause.

Fire Ants

Fire ants are the most common insect pests of home lawns. They occur in practically every lawn in the state, and even when a homeowner manages to eliminate all fire ant mounds in the lawn, they quickly return. This is because new fire ant colonies thrive especially well in areas where they do not compete with other fire ants. Although fire ants are persistent pests, there are steps that homeowners can take to maintain lawns that are relatively free of fire ants.

In terms of both cost and effort, the most effective thing you can do to control fire ants is make a broadcast application of fire ant bait at least once per season. Treatments are most effective if you apply them in the spring, but you can improve control by making additional treatments in midsummer and fall.

Broadcast applications are much more effective than applying bait treatments to individual mounds. This is because broadcast bait treatments also control newly formed colonies you can't see. Broadcast fire ant treatments are most effective when applied before large mounds are present.

When using baits, keep in mind they are meant to be slow acting, to allow time for them to be taken back to the colony and fed to the queen and immature brood. It may take a month or longer to see the full benefit of a bait treatment.

You can eliminate individual mounds that survive the bait treatments with dry mound treatments or liquid mound drenches. Liquid mound drenches provide almost immediate control, when you apply them properly, but they are messy and time-consuming. Dry mound treatments are much more convenient but can take several days to work.

Individual mound treatments are an effective way to eliminate large visible mounds, but they don't work against smaller colonies not yet visible. The best approach is to combine the use of granular baits and spot treatment of individual mounds.

Chinch Bugs

Chinch bugs damage St. Augustine lawns. Although you can occasionally find chinch bugs in other grasses, they rarely cause serious injury to anything other than St. Augustine. As the insects suck the plant juices, they also inject toxins that cause yellowish-brown patches to appear in lawns. These patches tend to enlarge gradually as chinch bugs expand their feeding area. If the feeding does not kill the grass, it recovers slowly and the damage lasts for a long time. Chinch bugs are sunshine-loving insects and seldom attack grass in shaded areas. Areas of St. Augustine lawns that suddenly become exposed to more sun, because of loss of shade trees, are especially susceptible to attack.

Adult chinch bugs are about one-fifth of an inch long and are black with white wings folded over their backs. Newly hatched nymphs are wingless and pink to bright red with a white band across their backs. Older nymphs are black with a white line across their backs.

Check St. Augustine lawns regularly in the warm months of the year by parting the grass in several locations and watching for these insects as they move into the thatch. Another way to check for chinch bugs is to cut the bottom from an opened fruit can, imbed it an inch or so deep in a green area next to damaged turf, and fill it with water. If chinch bugs are present, they float to the top after 5 to 10 minutes. Look closely. These insects are small.

Two-lined Spittlebugs

Two-lined spittlebugs have dark maroon wings with two bright red lines across each wing. Adults use their piercing-sucking mouthparts to suck sap from stems and leaves. The nymphs feed similarly but form their spittle masses deeper in the turf on the stems and stolons. The adults produce toxic saliva, which can cause significant injury to susceptible grasses. Initial symptoms include yellowing of the leaves, but heavy infestations can result in weak, unhealthy areas and even dead brown patches. Damaging infestations most commonly occur on centipede lawns.

Heavy infestations are favored by wet, rainy conditions or by lush, vigorously growing grass, and it is often the "prettiest centipede lawn in the neighborhood" that has the heaviest infestations. Lawns that are well fertilized, frequently watered, mowed fairly high, and suffer from excessive thatch are especially susceptible. Cultural practices play an important role in managing this pest. Taking steps to minimize thatch buildup, keeping grass mowed to the right height, and avoiding excessive water and fertilization can reduce the potential for problems.

This insect has two or three generations per year. Adults of the second generation begin emerging in August and September, and it is normally this second generation that causes the greatest damage to home lawns. Homeowners with susceptible lawns can prevent this problem by checking for spittle masses and treating promptly, if necessary, to prevent large numbers of second generation adults. This means you need to start checking for second generation spittlebug nymphs in July.

Scout lawns by parting turf and looking for the white frothy spittle masses. Heavily infested lawns sometimes have a squishy feel when you walk across them. Treat moderate to heavy infestations with a liquid spray of a recommended insecticide. Sprays are usually more effective than granules because granules tend to fall below the target zone. Hose-end sprayers are a convenient way to apply spittlebug treatments, and many home lawn insecticides are available in "ready to use" hose-end spray containers. Mow and water before treatment to improve control.

Fall Armyworms

Fall armyworms are mainly pests of bermudagrass lawns, and as their name implies, they are most common in late summer and fall. It is the larva, or caterpillar, stage that causes damage by eating the grass blades with their chewing mouthparts.

Fall armyworm larvae have three pairs of true legs just behind the head, as well as five pairs of "prolegs" along their abdomen. These pests can appear as early as late June in the southern portion of the state. During high outbreak years, fall armyworms may feed on centipedegrass or St. Augustinegrass, but this is rare.

Fall armyworm adults (moths) are active at night. Female moths deposit egg masses containing about 150 eggs on grass stems or leaves. Females can lay up to 1,000 eggs.

After hatching, the young larvae first feed as a group on the grass blades. The damage at this stage is slight and often goes unnoticed. But as the larvae grow, they require more food and can strip a lawn quickly. To prevent this, make regular lawn inspections, beginning in early summer.

Select locations at random throughout the lawn, and examine the grass by rubbing it briskly back and forth with your hand; then part the grass and examine the ground. If you see coiled light tan or green to nearly black caterpillars, you probably have fall armyworms. Control is much easier if you find worms early, when they are small. This also helps keep lawn damage to a minimum. Do not water turf after treating for fall armyworms, as this would wash the insecticide out of where the insects are feeding. Liquid sprays are generally more effective than granular treatments.

White Grubs

White grubs are the larvae of May beetles, June beetles, mask chafers, and other related beetles. A full-sized larva is about 1 inch long, has a brownish head, three pairs of legs, and rests in a characteristic "C" shape. White grubs feed below ground, pruning the roots and causing the grass to yellow. You can easily roll or lift severely damaged sod from the ground by hand. Damage is often most obvious when infested turf doesn't green up properly in the spring because of heavy feeding by large numbers of large, nearly mature grubs.

The adults vary in appearance, depending on species. June beetles are green, while May beetles are dark brown, and masked chafers are tan to brown. For most species, flights of adults occur early May through mid-June, and egg laying follows shortly. Because white grubs are easiest to control when small, the best time to apply white grub treatments is in mid- to late summer. Check for grubs by cutting several 1- to 2-foot square samples 2 to 3 inches deep and lifting out, or rolling back, the turf square to look for grubs.

Treatment is probably needed if you find an average of three to five grubs per square foot. When applying insecticides to control white grubs, water insecticides into the turf according to label directions. This leaches the insecticide into the zone where the grubs are feeding.

Mole Crickets

This insect is most common in the sandier coastal soils of south Mississippi. It is rarely a problem in the northern part of the state. Adult mole crickets are light brown, and the front legs are short with shovel-like feet that are well adapted for digging. The young, or nymphs, are similar to the adult except smaller. Damage is the result of nymphs and adults feeding on grass roots and tunneling through the turf, which also destroys roots and causes excessive drying.

These insects overwinter as partly grown nymphs, and damage is often most severe in the spring, because of heavy feeding and tunneling by large nymphs. Depending on species and location in the state, adult mole crickets fly, mate, and lay eggs from mid-March to late May. Newly hatched nymphs are present in June and early July. Even though damage is not obvious at this time, this is when treatment is most effective, because small nymphs are easiest to control.

To check for this insect, mix 1 ounce of liquid dishwashing soap in 2 gallons of water, and pour this solution slowly over about 4 square feet of turf. If mole crickets are present, they will crawl to the soil surface within just a few minutes. Be sure to follow label directions for pre- and post-treatment watering when treating for mole crickets. It is

usually necessary to water following treatment to leach the insecticide into the soil where the mole crickets live.

Snails and Slugs

These creatures do not damage turf, but they can be annoying. These pests, which are not insects, leave a trail of slime that appears as a silver trail when dry. They can damage bedding plants by feeding on young, tender leaves. Snails are about 1 inch long with spiral shells. Slugs vary in length from half an inch to 4 inches. They look like snails except they do not have the shells on their backs.

Snails and slugs are active at night. During the day, they can be found under mulch, in grass along sidewalks or patio edges, or under any object that may be in the lawn. Snails and slugs are best controlled with bait treatments specially formulated for these pests. When using baits, be sure to observe label precautions for use around pets and small children.

Sod Webworms

Sod webworms are the larval, or caterpillar, stage of a small night-flying moth. The moth is about ¾ inches long, cigar-shaped, and gray. It has two noticeable finger-like projections on the front of the head. You may see it during the day while mowing or walking across the lawn. The moth flies short distances in a zig-zag pattern before settling quickly back into the grass.

The webworm larvae generally feed at night and prefer areas that receive plenty of direct sunlight during the day. Problems seldom develop in shaded areas. During the day, the larvae may be found in small silken tunnels in grass thatch. They feed on grass blades next to these tunnels by clipping them off at the thatch line. Injury appears as small hand-sized brown patches. This insect attacks bermudagrass and zoysiagrass.

Ticks and Fleas

Ticks and fleas are carried into the lawn by dogs and cats. They are blood-feeders and will bite people, as well as pets. Ticks have an extremely high reproductive potential. For example, adult females of some species of ticks may lay as many as 3,000 to 5,000 eggs in 2 weeks. Eggs take about 35 to 40 days to hatch. After hatching, the young ticks climb up grass, shrubs, or sides of the house where they wait to climb onto a passing host.

Adult fleas feed on blood, while the larvae feed on bits of organic material or dried blood in and around pet bedding areas. This is why flea populations are normally highest near pet bedding or resting areas. High populations of fleas occasionally occur in and around home lawns.

Successful control of fleas and ticks requires controlling these pests on the pet, in any indoor areas frequented by the pet, and infested lawn areas the pet uses. Control of fleas and ticks on pets and inside homes is addressed in other Extension publications.

Treatments listed in this publication are only for use outdoors in the home lawn. Do not apply them to pets or use indoors unless the label specifically indicates such uses. When treating lawns to control fleas and/or ticks, pay particular attention to areas where pets spend time resting. Often this may not be in the lawn itself but in nearby areas such as under shrubs, porches, or houses.

Control

To control lawn pests, first properly identify the target pest; then select one of the insecticides from Table 16. Insecticides are listed by active ingredient rather than by brand name because many different brand names contain the same active ingredient. Also, brand names can be confusing, and buying insecticides based solely on brand name and what pest is pictured on the label can often lead to disappointing control.

Never purchase an insecticide without first considering the active ingredient and reading the label to determine if the product is labeled and appropriate for the intended use. Time spent reading and studying pesticide labels before making the purchase is time well spent.

Controlling lawn pests depends on getting the insecticide to the target pests. Be sure to consider this when planning an insecticide treatment, and be sure you have the necessary equipment to properly apply the product you are buying.

For pests such as white grubs and mole crickets, it is usually necessary to "water in" the insecticide after application. On the other hand, it is important to avoid watering and rainfall for a day or two when treating pests, like fall armyworms, that feed on grass blades above the soil. Be sure to read the pesticide label and follow the application directions carefully to ensure the desired result—safe, effective pest control.

For a more detailed description of lawn insects, insecticide rates, formulations, application timings, and more information, refer to Extension Publication 2331 *Control of Insect Pests In and Around the Home Lawn*.

Table 16. Lawn insect control guide.

Insect	Insecticide	Use rate[1]	Remarks
fire ants (bait treatments)	hydramethylnon (0.73%) {Amdro}	1–1.5 lb/acre	Apply baits as broadcast treatments in early spring, midsummer, and fall. Use an appropriate spreader that can apply the small amount of bait required. Avoid rainfall or irrigation for at least 24 hrs after application.
	fenoxycarb (1.0%) {Award}	1–1.5 lb/acre	
	pyriproxyfen (0.5%) {Distance}	1–1.5 lb/acre	
	methoprene (0.5%) {Extinguish}	1–1.5 lb/acre	
	abamectin (0.011%) {Ascend}	1 lb/acre	
	indoxacarb (0.045%) {Advion}	1.5 lb/acre	
fire ants (dry mound treatments)	acephate (75% SP)	1–2 tsp/mound	Do not disturb mound. Sprinkle dry product over and around mound as directed.
	cyfluthrin (1% dust)	1 tsp/mound	
	deltamethrin (0.05% dust)	1 tbsp/mound	
fire ants (mound drenches)	acephate (75% SP)	2 tsp/gal water	Use 1–2 gal of drench per mound, depending on size of mound. Do not disturb mound before drenching.
	carbaryl (22.5% conc.)	0.75 fl oz/gal water	
	permethrin (2.5% conc.)	0.67 fl oz/gal water	
fire ants (broadcast treatments)	fipronil (0.0103% granules) {Over'n Out}	2 lb/1000 sq ft	Water in after application. This is not a bait.
chinch bugs (liquid treatments)	carbaryl (22.5% conc.)	16 fl oz/1000 sq ft	Irrigate before application.
	cyfluthrin (0.75% liquid)	6 fl oz/1000 sq ft	Irrigate before and after application.
	lambda-cyhalothrin (0.5% conc.)	4 fl oz/1000 sq ft	Water lightly following application.
	permethrin (2.5% conc.)	6 fl oz/1000 sq ft	
	permethrin (38% conc.)	0.8 fl oz/1000 sq ft	
chinch bugs (granular treatments)	bifenthrin (1% granules)	2.4 lb/1000 sq ft	Irrigate after application.
	carbaryl (6.3% granules)	3 lb/1000 sq ft	
	lambda-cyhalothrin (0.04% granules)	3 lb/1000 sq ft	
	permethrin (0.5% granules)	3 lb/1000 sq ft	
spittlebugs (liquid treatments)	carbaryl (22.5% conc.)	3–6 fl oz/1000 sq ft	Mow and water before treating.
	cyfluthrin (0.75% liquid)	6 fl oz/1000 sq ft	
	lambda-cyhalothrin (0.5% conc.)	2 fl oz/1000 sq ft	
	permethrin (38% conc.)	0.8 fl oz/1000 sq ft	

Insect	Insecticide	Use rate[1]	Remarks
fall armyworms, sod webworms (liquid treatments)	carbaryl (Sevin 22.5%)	3–6 fl oz/1000 sq ft	Delay watering or mowing for 24 hrs.
	cyfluthrin (0.75% liquid)	6 fl oz/1000 sq ft	
	lambda-cyhalothrin (0.5% conc.)	2 fl oz/1000 sq ft	
	permethrin (38% conc.)	0.8 fl oz/1000 sq ft	
white grubs (liquid treatments)	carbaryl (22.5% conc.)	12 fl oz/1000 sq ft	Irrigate after application.
	imidacloprid (1.47% ready-to-spray)	6.4 fl oz/1000 sq ft	Apply according to label.
white grubs (granular treatments)	carbaryl (6.3% granules)	3 lb/1000 sq ft	Irrigate after application.
	halofenozide (1.33% granules)	0.75 lb/1000 sq ft	
	imidacloprid (0.2% granules)	2.87 lb/1000 sq ft	
	trichlorfon (6.2% granules)	3 lb/1000 sq ft	
mole crickets (liquid treatments)	lambda-cyhalothrin (0.5% conc.)	4 fl oz/1000 sq ft	Irrigate after application.
	cyfluthrin (0.75% conc.)	6 fl oz/1000 sq ft	
mole crickets (granular treatments)	bifenthrin (1% granules)	4.8 lb/1000 sq ft	Irrigate after application.
	imidacloprid (0.2% granules)	3.8 lb/1000 sq ft	
	lambda-cyhalothrin (0.04% granules)	3 lb/1000 sq ft	
	carbaryl (5% bait)	0.9 lb/1000 sq ft	
snails and slugs (liquid treatments)	metaldehyde (2% bait granules)	0.5 lb/1000 sq ft	Toxic to pets and wildlife. Follow label.
	iron phosphate (1% bait granules)	1 lb/1000 sq ft	
ticks and fleas (liquid treatments)	carbaryl (Sevin 22.5%)	3 fl oz/1000 sq ft	Apply as a broadcast treatment using a hose-end sprayer or other appropriate sprayer.
	cyfluthrin (0.75% liquid)	6 fl oz/1000 sq ft	
	permethrin (38% conc.)	0.8 fl oz/1000 sq ft	

[1]This information is for preliminary planning purposes only. Always read and follow product labels.
fl oz = fluid ounce; lb = pound; tsp = teaspoon; tbsp = tablespoon; gal = gallon; sq ft = square feet
Apply by mixing the desired amount of insecticide per 1,000 sq ft in at least 15 to 20 gal of water.

The information given here is for educational purposes only. References to commercial products, trade names, or suppliers are made with the understanding that no endorsement is implied and that no discrimination against other products or suppliers is intended.

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