ORGANIC LAWN CARE

A Guide to Lawn Maintenance and Pest Management for North Carolina

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ORGANIC LAWN CARE

The Keys

Select the right location for the lawn. Do not plant a lawn on a steep slope or in a poorly drained or very shady location.

Prepare the site by following soil test recommendations, adding organic matter to very sandy or very heavy clay soils, and insuring good drainage.

Select the right grass for the location. Grasses vary widely in color, texture, and density. Choose the one best suited to the region, intended use, and desired appearance.

Plant at the best time and choose the best planting method for the grass selected. Follow good management practices to prevent and minimize problems rather than trying to correct problems after they occur.

Develop an integrated pest management (IPM) program that emphasizes the correct identification of problems and pests and the use of cultural, manual, mechanical, and biological controls when necessary.

ORGANIC LAWNS: SOME CONSIDERATIONS

Lawns are more than attractive recreational spaces for homes and communities; they also serve many useful purposes. Lawns stabilize the soil and prevent erosion. They reduce runoff of rainwater and filter surface water before it recharges drinking water supplies. Like other landscape plants, lawns absorb sound and reduce air pollution in our increasingly urban landscape.

Although the benefits of an established lawn are numerous, some lawn maintenance practices have environmental side effects that merit attention. Technology has provided effective and relatively inexpensive means for managing our lawns. Applications of small amounts of chemicals can often reduce pest populations in a short time with little effort. With proper cultural management, use of some chemical pesticides can provide more thorough and longer-lasting pest control than strictly non-chemical methods. However, environmental effects of applying chemical pesticides and fertilizers are still being evaluated, and many people enjoy a sense of security when they use a non-chemical approach to lawn management.

Natural or “organic” methods of lawn care can provide more than just a sense of protecting the environment. Organic lawn care emphasizes selection of the right grass for the location and good management to maintain a healthy lawn. If you adopt an organic lawn care strategy, you will not need to store potentially dangerous chemical pesticides around the home, and you will not have to find safe ways of disposing of empty containers. If you use organic fertilizers and biological and cultural pest management instead of pesticides, you will eliminate concerns about the effects of pesticide residues on people (especially children who play on grass), pets, birds, and other wildlife. Potential risk to applicators from exposure to pesticides is also reduced.

People who practice organic lawn care can be proud of their efforts to recycle resources by composting yard waste and using other available waste products in their lawns. An organic lawn can provide all of the benefits of a healthy lawn—without the use of synthetic chemicals. Establishing a healthy stand of grass is the best way to defend against pests. Many problems with weeds, diseases, and insects can be prevented or minimized by good planning and careful management.

ESTABLISHING A NEW LAWN

Plan Before Planting

Many of the most important steps toward a successful lawn are taken before any planting begins. Plan for easy maintenance and pleasing appearance. Grass will not grow well in very shady spots or in poorly drained areas, and it will be hard to maintain on steep slopes.

Select the right grass for the site. No one type of grass is best suited to all situations. The grass you choose to grow should be matched to the region and climate and suitable for the intended use and desired appearance. Some grasses are more resistant to diseases than others.

If possible, plant the lawn during the season best suited to the variety selected. Planting density should be adequate to establish a good stand, and the seeds may need watering to encourage emergence. After seedlings emerge, they will need to be watered, fertilized, and mowed to ensure early growth. These establishment practices can affect the growth and development of your lawn for many years to come.

Select the Right Grass

Planting an improved, adapted grass is one of the best ways to avoid pest problems. Both cool-season and warm-season grasses are grown in North Carolina, where environmental conditions vary greatly. The climate of the mountain counties is similar to that of the northeastern United States where cool-season grasses such as bluegrass are best adapted. The southeastern counties have a climate suitable for the warm-season grasses such as centipedegrass or bermudagrass. The transition zone in the central part of the state is often too cold in the winter for the warm-season grasses and too hot in the summer for the cool-season grasses to grow well. The micro-climates of sites in the transition zone should be considered in selecting a turfgrass for a particular lawn. The warm-season grasses are best adapted for lawns with sunny southwest exposures, while the cool-season grasses are best adapted for lawns with northern exposures. Evaluation of the climate or the exposure direction of the lawn will help determine the best type of turfgrass(es) to grow to avoid severe disease problems in the future.

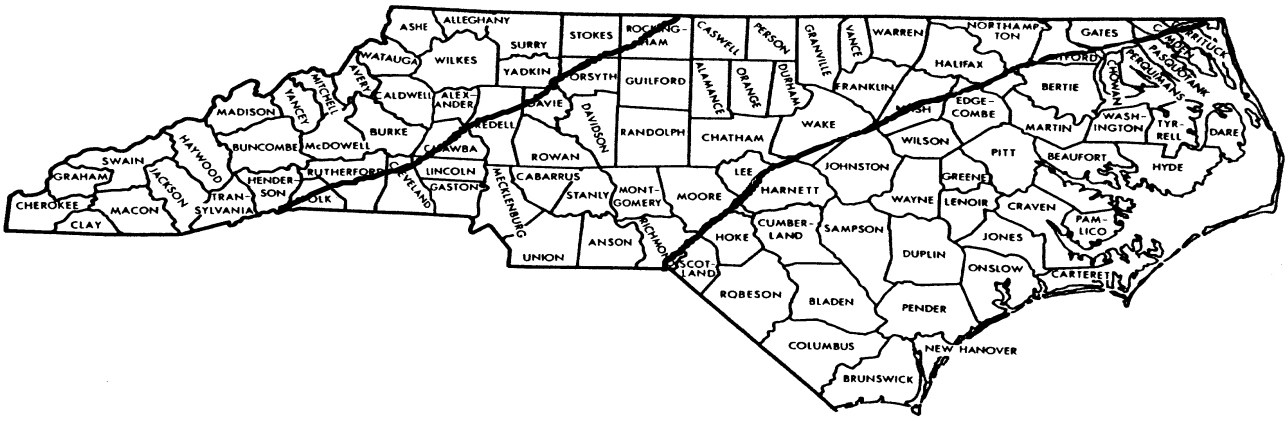
IPM Tip—Lawn Grass Mixtures

Selection of adapted and disease-resistant cultivars is the best method for disease control.

Use a mixture of several cultivars of cool-season grasses to reduce damage from diseases. A mixture of tall fescue cultivars or tall fescue mixed with Kentucky bluegrass will increase the resistance of the lawn as a whole to damage from common turfgrass diseases.

Warm-season grasses are generally not mixed.

In addition to regional climate factors, the characteristics of each site and your goals for it will determine which types of grass are appropriate. Choose an adapted grass that best meets



Western Region Piedmont Coastal Plain

Figure 1. Climatic regions in North Carolina.

your preference for color, density, and texture. Where heavy traffic is expected, use a tough, aggressive, wear-tolerant grass. Take into consideration the amount of time, effort, and money you are willing to put into maintenance. Grasses are best able to fend off pests when they are healthy and not struggling to survive in stressful environmental conditions.

Cool-season grasses grow best in the spring and fall and less actively in the summer. They stay reasonably green in the winter. Tall fescue, Kentucky bluegrass, fine fescue, and perennial ryegrass are common types of cool-season grasses. Warm-season grasses are slow to green up in the spring, grow well in the summer, and go dormant after the first heavy frost.

Table 1 gives information on the characteristics and requirements of various grasses grown in North Carolina. Study the chart to help select the appropriate grass for your region and the intended use of the lawn. The map in Figure 1 locates counties by region. Tables 2 and 3 give further information on characteristics and requirements of specific cultivars of cool- and warm-season grasses.

Plant at the Best Time

Planting times and rates are given in Table 4. **Cool-season grasses** are best seeded from mid-August to mid-October, depending on location. Seeding after these dates increases the chance of failure caused by cold injury. Spring seeding is often less satisfactory because seedlings do not have time to become well established before hot weather begins.

If spring seeding is necessary, do it as early as possible to take advantage of cool weather and the absence of weeds. Remember, many weeds grow best during this time of year, too. Seeding cool-season grasses after March generally results in a need to reseed the following fall.

Annual ryegrass can be used as a temporary cover until fall. However, it is better to seed the desired cool-season grasses and renovate in the fall. This may require the assistance of a professional. Install cool-season grass sod at any time during the cooler portions of the growing season when the ground is not frozen.

Warm-season grasses may be seeded or planted vegetatively (by sprigs or plugs) from March through July. Best results are usually obtained by planting dormant sprigs in March. Vegetative planting material can be obtained from a local sod producer. To avoid winter injury problems, plant before late summer so the turf can become well established before winter. Warm-season grasses can be planted from March through September with a reasonable chance of success as long as the temperature in the upper four inches of soil is above 55 degrees F. Sod will not produce roots unless the soil temperature stays above 55 degrees F for several weeks.

Table 1. Characteristics of Principal Lawn Grasses Grown in North Carolina.

Lawn grass	Adaptation					Appearance		Preferred Planting season	Rate of establishment[a]	Maintenance		
	Shade	Heat	Cold	Drought	Wear	Color	Texture			Cutting height (inches)	Fertilizer 1,000 sq. ft (lbs. N/year)	Mowing Frequency[b]
Western Region												
Kentucky bluegrass	G	F	VG	G	G	med-dark	medium	Fall	medium	1.5 to 2.5	2.5 to 4	medium
Kentucky bluegrass/ Fine fescue*	G	F	VG	G	F	med-dark	fine-med	Fall	medium	1.5 to 2.5	2.5 to 3	medium
Kentucky bluegrass/ Tall fescue*	G	G	VG	VG	VG	med-dark	med-coarse	Fall	fast	2.5 to 3.5	2.5 to 3	high
Kentucky bluegrass/ Tall fescue/fine fescue	VG	G	VG	VG	VG	med-dark	med-coarse	Fall	fast	2.5 to 3.5	2.5 to 3	high
Kentucky bluegrass/ Perennial ryegrass	G	F	VG	G	VG	med-dark	medium	Fall	fast	2 to 3	2.5 to 3	med-high
Tall fescue*	G	G	VG	VG	VG	medium	med-coarse	Fall	fast	2.5 to 3.5	2.5 to 3	high
Piedmont Region												
Bermudagrass (common)*	VP	VG	VP	E	E	medium	medium	Sp/Su	fast	0.75 to 1	4.5	med-high
Bermudagrass (hybrid)	VP	VG	P	E	E	light-dark	fine	Sp/Su	medium	0.75	5 to 6	high
Bahiagrass*	G	G	P	E	G	med-dark	coarse	Sp/Su	medium	2 to 3	1	high
Centipedegrass*	G	G	P	G	P	light	coarse	Sp/Su	slow	1	0.5	low
Kentucky bluegrass/ Tall fescue*	G	G	VG	VG	VG	med-dark	med-coarse	Fall	fast	2.5 to 3.5	1.5 to 3	high
Kentucky bluegrass/ Tall fescue/fine fescue*	VG	G	VG	VG	VG	med-dark	med-coarse	Fall	fast	2.5 to 3.5	1.5 to 3	high
St. Augustinegrass*	VG	VG	P	G	P	med-dark	coarse	Sp/Su	medium	2 to 3	2.5 to 3	high
Zoysiagrass	G	VG	F-G	E	G	med-dark	fine-med	Sp/Su	very slow	0.75 to 1	1.5	low-med
Coastal Plain												
Bermudagrass (common)*	VP	VG	VP	E	E	medium	medium	Sp/Su	fast	0.75 to 1	4.5	med-hgh
Bermudagrass (hybrid)	VP	VG	P	E	E	light-dark	fine	Sp/Su	medium	0.75	5 to 6	very high
Bahiagrass*	G	VG	P	E	E	med-dark	coarse	Sp/Su	medium	2 to 3	1	high
Centipedegrass*	G	G	P	G	P	light	coarse	Sp/Su	slow	1	0.5	low
St. Augustinegrass*	VG	VG	P	G	P	med-dark	coarse	Sp/Su	medium	2 to 3	2.5	med-high
Tall fescue*	G	G	VG	VG	VG	medium	coarse	Fall	fast	2.5 to 3.5	2.5 to 3	high
Zoysiagrass*	G	VG	F-G	E	G	med-dark	fine-med	Sp/Su	very slow	0.75 to 1	1.5	low-med

Key: E = Excellent; VG = Very Good; G = Good; F = Fair; P = Poor; VP=Very Poor.
*Can be seeded.
[a] Establishment rate is dictated by planting dates, seeding and planting rate, intensity of culture, and environment.
[b]Mowing frequency is dictated by season, intensity of managment, and use.

Note: Some improved cultivars are better adapted and more pleasing in appearance than the comparison rating provided for a given lawn grass. Check with county Cooperative Extension Centers concerning specific cultivars.

Table 2. Cool-season Grasses.

Grass	Performance in North Carolina		
	Very Good	Good	Fair
Tall fescue	Bonanza* Phoenix* Taurus* Thoroughbred Trident	Adventure Apache* Aquara Arid* Astro* Avanti Barnone Brookston Carefree Cochise Crossfire Emperor Falcon* Finelawn 1* Finelawn 5GL* Houndog* Jaguar II Jaguar* Maverick Maverick II Mesa Murietta Mustang Olympic II Olympic* Rebel II* Rebel Jr. Rebel* Richmond Shenandoah* Shortstop Sundance Tip Titan* Wrangler	Amigo Aztec Bonsai* Chesapeake Chieftan Guardian Ky 31* Monarch* Pacer* Silverado Trailblazer Tribute Twilight* Willamette* Winchester*
Kentucky bluegrass	A34# Aspen Blacksburg Bristol# Classic Coventry Kelly Monopoly Nassua Parade Ram I# Rugby Somerset Suffolk Trenton Wabash	Abbey Able-1 Amazon America# Aquila Asset Baron Challenger Chateau* Cheri Cynthia Eclipse Estate Georgetown# Glade*# Gnome Haga Huntsville* Ikone Joy Julia Kenblue* Merit* Midnight# Mystic# Princeton Sydsport# Tendos Victa	Merion
Fine fescue	Aurora* Scaldis Spartan	Flyer Longfellow Reliant* Shadow SR3000 Valda* Victory Waldina	Atlanta Banner Biljart Boreal Center Ceres Checker Enjoy Ensylva Highlight Jamestown Koket Mary Pennlawn* Ruby Waldorf
Perennial ryegrass	Allaire* Barrage Birdie II Competitor Dillon Fiesta II Lindsay Omega II Patriot II Pennant* Prelude Saturn SR 4100 Vintage 2DF	Barry Caliente Charger Citation II Dasher II Dimension Diplomat Goalie Manhattan II Nova Ovation Palmer Ranger Regency Repell SR 4000	Barcredo Belle Blazer Brenda Commander Cowboy Delray Derby* Gator* Manhattan* Pennfine* Regal* Rodeo Sheriff Tara Yorktown II

*Cultivars readily available in North Carolina. #Shade-tolerant cultivars

Table 3. Warm-Season Cultivars.

Grass	Cultivars	Comments
Bermudagrass	Common Guymon Sahara	Perform in similar ways. Can be seeded.
	TifwayHybrids. Tifway II	Require frequent mowing with a reel-type mower. Must be vegetatively planted.
	Midiron Vamont	Cold tolerant. Better suited to western piedmont than other bermudagrass cultivars.
	Tifdwarf Tifgreen Tifgreen II	Not recommended for home use because of high management requirements.
	Cheyenne Eclipse Sonesta Sundevil Tropica	Performance unknown.
Zoysiagrass	Emerald Meyer (Z-52, Amazoy)	Readily available. Fine texture. Use reel-type mower. Emerald has finer texture. Meyer most cold tolerant.
	El-Toro	Limited availability. Quick to establish from plugs. Use reel or rotary mower. Cold tolerance unknown.
	Belair Cashmire Midwest Sunburst Z-26 Zenith	Performance unknown. Can be seeded.
	Sunrise	Can be seeded. Performance unknown. Coarse texture.
St.Augustinegrass	Raleigh Raleigh S	Cold tolerant. Seeded. Performance unknown.
	Common Delmar Floralawn Floratam Jade Seville	May not have sufficient cold tolerance.

Note: Because the release and evaluation of turfgrass cultivars change rapidly, contact county Cooperative Extension Centers for the latest information on grass characteristics and selection.

Table 4. Dates and Rates to Plant Cool-and Warm-Season Grasses.

Lawn Grass	Planting Date[a]	Planting Rate/1,000 sq ft		
		Seeds[b]	Space Planting[c]	Broadcasting[c]
Western Region				
Kentucky bluegrass	Aug 15 to Sep 1	1.5 to 2	——	——
Kentucky bluegrass/fine fescue	Aug 15 to Sep 1	1.5+1.5	——	——
Kentucky bluegrass/tall fescue	Aug 15 to Sep 1	1+5	——	——
Kentucky bluegrass/ tall fescue/fine fescue	Aug 15 to Sep. 1	1+5+1	——	——
Kentucky bluegrass/ perennial ryegrass	Aug 15 to Sep 1	1.5+1	——	——
Tall fescue	Aug 15 to Sep 1	6	——	——
Piedmont Region				
Bermudagrass(common)	Apr to July	1 to 2	0.75	3 to 10
Bermudagrass(hybrid)	Apr to July	——	0.75	3 to 10
Bahiagrass	March to June	5	——	——
Centipedegrass	March to July	0.25 to 0.50	1.0 to 2.0[d]	——
St. Augustinegrass	Apr to July	——	1.0	1
Kentucky bluegrass/tall fescue	Sept 1 to Sep 15	1 + 5	——	——
Kentucky bluegrass/tall fescue/ fine fescue	Aug 15 to Sep 1	1+5+1	——	——
Tall fescue	Sep 1 to Sep 15	6	——	——
Zoysiagrass	Apr to July	1 to 2	1.0 to 2.0[d]	3 to 10
Coastal Plain				
Bermudagrass(common)	Apr to July	1 to 2	0.75	3 to 10
Bermudagrass(hybrid)	March to July	——	0.75	3 to 10
Bahiagrass	March to June	5	——	——
Centipedegrass	March to July	0.25 to 0.50	1.0 to 2.0[d]	——
St. Augustinegrass	Apr to July	——	1.0	——
Tall fescue	Sep 15 to Oct 15	6	——	——
Zoysiagrass	March to July	1 to 2	1.0 to 2.0[d]	3 to 10

[a]Optimum date of planting. Seeding beyond these dates increases the chance of failure. Sod consisting of cool-season grasses can be installed at any time when the ground is not frozen. Warm-season grasses can be installed as long as soil temperature exceeds 55 degrees F.

[b]Pounds of seed per 1,000 sq ft.

[c]Bushels of sprigs per 1,000 sq ft. (1 sq yd of turf pulled apart is equivalent to 1 bushel of sprigs.)

[d]Often plugged using 3 sq yd of turf cut into 2-inch squares on 12-inch centers to plant 1,000 sq ft.

Prepare the Site

Another key to a successful organic lawn is careful preparation of the soil. A healthy lawn needs a rooting environment favorable to soil organisms and grass roots. In an organic lawn, weed control is best accomplished by following the steps listed below.

1. If topsoil from the original site is free of weeds, insist on saving it. If grading is needed, remove the topsoil (usually 4 to 8 inches) and stockpile it nearby. Topsoil brought in from other areas will bring weed seeds along with it. Covering topsoil with a dark plastic cover for several weeks will kill many plants, but may not kill all seeds.
2. Do not allow the builder to use the lawn site as a dumping ground. Paint, lumber, and concrete can be harmful to grasses.
3. Install tile drain in poorly drained areas. Get professional advice about the type of drain and installation.
4. Build protective walls to save trees if the final grade is to be appreciably higher than the present level.
5. Shape the underlying subsoil to the desired contour and redistribute topsoil uniformly above the subsoil. A one- to two-percent slope is needed for proper drainage away from buildings.
6. Water the area to enhance settling. Fill areas that settle unevenly to avoid standing water. Insist that any topsoil added to the site be weed free.

For heavy clay soils or very sandy soils, mix 1 to 2 cubic yards of organic matter (compost, peat moss, or leaf mulch) per 1,000 square feet into the top 6 to 8 inches of soil. Clay soils are prone to compaction and require frequent aerification.

When soil acidity or nutrient levels are too high or too low, plant growth and the action of beneficial soil microbes will be limited. On sites where trees have been growing for many years, the pH may be 4.0 or lower. Turfgrasses used in North Carolina are not native, and they grow best in soils with a pH near 6.5, except centipedegrass which prefers a pH near 5.5. A soil with pH of 5.5 is ten times more acidic than a soil with pH of 6.5!

The pH of the soil determines the availability of nutrients in the soil to plants. Because lime and phosphorus move very slowly through the soil, they should be incorporated to a depth of 6 to 8 inches before planting. Failure to adjust soil pH and phosphorus levels throughout the rooting zone prior to seeding can result in shallow rooting, poor drought tolerance, and inefficient uptake of nutrients. Overapplication of lime or nutrients can also inhibit plant growth, so it is important to apply the correct amount for your soil.

Even a well-adapted grass can suffer from disease if the soil has not been adequately prepared. Most of the soils in the state have a low pH and low phosphorus levels, especially if the area was wooded just before the lawn was planted. Soil tests should be taken from the site early enough to know how much lime and phosphorus should be incorporated before planting. The depth of incorporation of lime and phosphorus determines the depth of rooting of the grass. A deep and healthy root system results in a healthy plant that can better tolerate environmental stresses, including pests.

Test the soil before applying lime or fertilizer. The only way to determine whether the acidity (pH) and nutrient levels are adequate for the grass you plan to grow is to have a soil test analyzed by a reputable soil-testing laboratory. County Cooperative Extension Centers have sampling boxes and submission forms. Mail samples directly to the North Carolina Department of Agriculture Soil Test Laboratory (4300 Reedy Creek Rd. Raleigh, NC 27607). It may take several weeks (or longer in late winter and early spring) to receive results of a soil test, so plan ahead. The soil test will indicate the proper amount of lime and nutrients required per 1000 square feet for the type of grass you wish to grow (see Table 5).

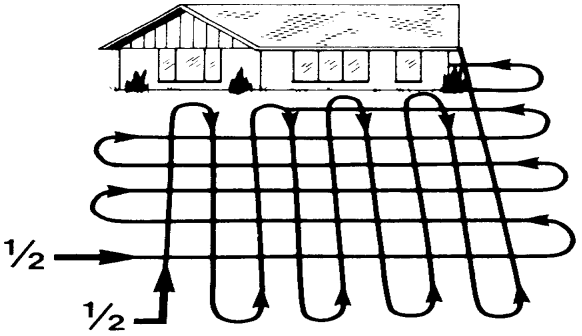


Figure 2.To insure uniform coverage when applying fertilizer or lime, apply half while moving back and forth in one direction and the other half while moving at a right angle to the first pass.

How To Prepare a Soil Sample

For new lawns, sample 10 to 12 locations to a depth of at least 4 inches (the depth you expect your tiller to reach). Take a uniform slice with a shovel from each location or use a soil-sampling tube. Combine these samples in a clean plastic bucket and mix thoroughly. About one cup of soil from the combined sample is needed for analysis. For a site with uniform soils, only one combined sample may be needed. If the soil varies greatly in color or texture, additional combined samples should be taken from each distinct soil area.

For established lawns, the recommended sampling depth is three inches. This shallower sampling depth will detect problems in the rooting zone more quickly than a deeper sample.

Rake the site to establish a smooth and level final grade. Soil particles should be no larger than marble size, and pea-gravel size is even better. Hand raking is the best way to level the soil and work out hills and hollows. Allow time for rain or watering to settle the soil, then roll lightly to firm the soil before seeding. Before seeding, hand rake again to break up the crusty surface. Protect water quality by sweeping any fertilizer off paved surfaces and back onto the turf area.

IPM Tip—Limit Nitrogen

To decrease susceptibility of lawn grasses to pests and environmental stress, avoid high nitrogen fertilization of cool-season grasses in the late spring or summer. Likewise, avoid high nitrogen fertilization of warm-season grasses in the fall or winter.

Planting Methods

Lawns can be established by seeding or vegetatively planting. Buying poor-quality plants or seed often results in less-than-satisfactory performance by the turf, pest problems, and general disappointment by the lawn owner. Selection is especially important when establishing a lawn. Read the information on the seed tag carefully, and make sure you purchase seed with no noxious weed seed and low levels of other crop seed. One way to be sure you have seed or planting material that is true to type, free of noxious weed seed, and contains low levels of other crop seed is to purchase *Certified Seed* or *Sod*. "Certified" indicates the seed or plants have met certain standards to assure high quality and low levels of contaminants.

Seeding is usually the most economical method of establishing grasses. Both rotary and drop-type spreaders work well. Apply half of the seed in one direction and the other half moving at right angles to the first pass. Lightly cover the seed by hand raking or dragging with a mat or chain link fence. Roll the

Table 5. Fertilizer Recommendations for New Lawns.

During Site Preparation

Materials to use	Amounts to apply*	Comments
Lime	Follow soil test recommendations.	Apply uniformly with a rotary or drop-type spreader. Apply half of the fertilizer in one direction, and the second half at right angles to the first pass. Incorporate the lime and nutrients into the top 6 to 8 inches of the soil using a rototiller.
Phosphorus (P_2O_5)		
Potassium (K_2O)		
Nitrogen	For a new lawn apply 1 pound of nitrogen (N) per 1000 square feet.	Soil tests do not routinely analyze for soil N.

*Note: Organic fertilizers with a guaranteed analysis will have three numbers on the label. These numbers represent the content in percent of nitrogen (N%), phosphate (phosphorus as P_2O_5%), and potash (potassium as K_2O%) contained in the fertilizer. Thus, a 50-pound bag of composted manure with an analysis of 4-4-2 would contain 2 pounds of N (50x 0.04 =2.0), 2 pounds of P_2O_5, and 1 pound of K_2O. In this example, 50 pounds of the composted manure should be applied to each 1000 square feet of area to be treated.

Surface Application at Time of Planting

Materials to use	Amounts to apply	Comments
starter-type fertilizer (ratio of 1-2-2)	0.5 pounds of nitrogen per 1,000 square feet.	Apply to the soil surface at the time of seeding.

Follow-up Application
(when new seedlings are between 1 and 2 inches high—approximately three weeks after they emerge).

Materials to use	Amount to apply	Comments
complete fertilizer (N-P-K) (ratio of 3-1-2 or 4-1-2)	.5 to 1 lb nitrogen per 1,000 sq ft. These rates are equivalent to 10 lbs 5-10-10 or 10-10-10.	Organic sources such as composted manures can be safely used, but will usually supply higher levels of P and K per unit of N.

For faster spread of vegetatively planted warm-season grasses, add 0.5 to 1 pound of nitrogen per 1,000 square feet every three to four weeks during the growing season until grass covers the soil completely.

soil lightly to firm the surface and provide good seed-to-soil contact.

Mulch grass seed with weed-free straw, hay, or a commercial mulch. Use one bale per 1,000 square feet for warm-season grasses and one to two bales for cool-season grasses. This will help conserve moisture, control erosion, and reduce surface crusting until establishment. Once mulch is in place, stabilize it by rolling or watering. Twine netting can be used if the site is very windy. If applied evenly and lightly, these materials need not be removed.

Vegetative planting is necessary for those grasses for which seed is not available. When this method is used, keep the plant material fresh and moist from removal site to planting area. Protect it from direct sun. Once it is installed, keep it moist until established. Fertilize with 0.5 to 1 pound of nitrogen per 1,000 square feet every one to three weeks for fastest spread. Times and rates for planting vegetative grasses are given in Table 4. Several methods of vegetative planting useful in lawn areas are described below.

Space planting is the planting of separate shoots or sprigs (runners, cuttings, or stolons) at regular spacings. This labor-intensive method is best used for planting small areas. Spacing is determined by how fast the grass will spread, how fast you want it to cover, and how much material is available. The closer the spacing the faster the lawn will establish.

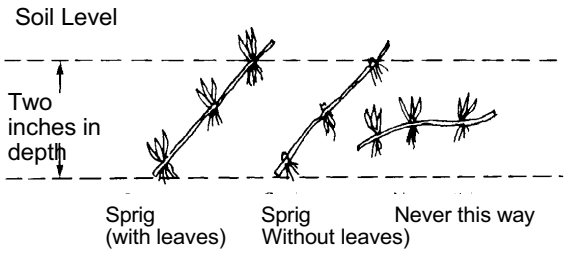


Figure 3. In space planting, always leave some part of the sprig above the ground.

Broadcasting is the uniform distribution of sprigs (cut stems) over the entire area. After sprigs are thrown or dropped onto the surface, the sprigs are pressed into the top 0.5 to 1 inch of soil by hand. Large areas planted with bermudagrass or zoysiagrass sprigs require a minimum of 3 to 5 bushels of sprigs per 1,000 square feet; and 5 to 10 bushels for extremely fast cover. St. Augustinegrass is seldom established through broadcasting because the stems are too sensitive.

Plugging is planting individual pieces (2 inches or larger) of sod on 6-inch or 1-foot centers. This is an excellent way to introduce a better-adapted lawn grass into an existing lawn in an effort to replace the existing grass by crowding it out. Make sure edges of plugs are covered with soil. Zoysiagrass, St. Augustinegrass, and centipedegrass are often planted by plugging.

Sodding uses strips of grass from one site to establish an 'instant' lawn on another site. Install sod as soon as possible after it has been harvested to prevent injury. Sod should be installed within 24 hours of delivery. Plan to unstack and unroll the sod if it cannot be laid within 48 hours. While installing, keep stacks of sod in the shade to lessen the chance of heat buildup. Soil should be moist (but not overly wet) before laying sod. Irrigate the soil several days before delivery to settle the topsoil and provide necessary moisture. Start sodding from a straight edge (driveway or sidewalk) and butt strips together, staggering the joints in a brick-like pattern. Avoid stretching sod. Use a knife or sharp spade to trim to fit irregularly shaped areas. Lay sod lengthwise across the face of slopes and stake the pieces to prevent slippage. After the sod has been placed, press the sod with a roller to ensure good sod-to-soil contact. Then begin watering.

IPM Tip—Planting and Seeding Rates

Proper seeding and planting rates will help to control disease damage. As an example, in the case of tall fescue, a high seeding rate (10 or more pounds per 1000 square feet) will usually result in rapid greening of the lawn in the fall, but poor survival the following summer. Many small seedlings do not develop deep root systems and are more susceptible to drought stress and diseases such as brown patch

Lower seeding rates (4 to 6 pounds per 1000 square feet) result in slower greening of the lawn in the fall, but also in better developed plants that are more likely to survive disease and drought stresses the following summer.

Watering

To prevent seeds, seedlings, and new grass from drying out and to prevent soil from eroding, keep the top 0.5 inch of the soil moist. This may require light watering two to three times a day for 15 to 20 days. After the third mowing, water to a depth of 6 to 8 inches about once a week or when needed.

Bluegrass takes 7 to 14 days longer to germinate than other cool-season grasses. As the seedlings grow and root, water less often but for longer periods. For mixtures containing bluegrass, do not make the mistake of decreasing water as soon as the seedlings appear. Germination of Kentucky bluegrass may take as long as 3 weeks so continue watering until the bluegrass seedlings emerge.

Mowing

The frequency of mowing is governed by the amount of growth, which is dependent on temperature, fertility, moisture conditions, season, and the natural growth rate of the grass. The suggested heights of cut for different species are given in Table 1. In home lawns, do not remove more than half the total height of the leaf surface.

1. Use a mower with a sharp blade.
2. Begin mowing as soon as the grass is 50 percent higher than the desired height. (Measure from the base of the plant at the soil surface.) For example, mow tall fescue back to 3 inches when it reaches 4.5 inches.
3. Mow only when the soil and plants are dry to reduce the risk of spreading disease and injuring the turf.
4. Allow clippings to remain on the lawn. They can reduce the need for fertilizer by 20 to 30 percent.

Fertilizing

1. Fertilize the new seedlings approximately 3 weeks after they emerge using a complete fertilizer (N-P-K) that provides about 1 pound of nitrogen per 1,000 square feet. A fertilizer with a 3-1-2 or 4-1-2 analysis is preferable. Organic sources such as composted manures can be used safely, but will usually supply higher levels of P and K per unit of N. (See Table 7 for information on available organic fertilizer products.)
2. Apply fertilizer uniformly with a rotary or drop-type spreader.
3. For faster spread of vegetatively planted warm-season grasses, add 0.5 to 1 pound of nitrogen per 1,000 square feet every 4 to 6 weeks during the growing season until grass covers the soil completely.
4. To decrease susceptibility of lawn grasses to pests and environmental stress, **do not apply** high amounts of nitrogen in fertilizer to **cool-season** grasses in the late spring or summer and **do not apply** high amounts of nitrogen in fertilizer to **warm-season** grasses in the fall or winter.

Pests in New Lawns

Weeds. Broadleaf weeds are common in new plantings. However, many weeds will be controlled by taking proper care of the topsoil before seeding, by maintaining optimum growing conditions for the grass species, and by mowing at the proper height after establishing the lawn. Weed control in sodded lawns is best done through inspection of the sod before laying. The complete coverage and quick establishment of sod generally prevents weeds from becoming established. In organic lawns, hand-pulling is the preferred method of weed removal.

Diseases. Seedling diseases are best controlled by establishing the grasses properly and not mulching too heavily. Turfgrass diseases often appear following heavy nitrogen fertilization or periods of prolonged wetness, or both. In organic lawns where chemical fungicides are not used, good management is the best way to avoid or minimize disease. Compost and organic fertilizer have also been shown to minimize certain turfgrass diseases.

1. Select a disease-tolerant grass adapted to your region.
2. Do not overwater or overfertilize.
3. Reduce shade and improve drainage.
4. Mow at the highest recommended height using a sharp blade.
5. Mow when the grass is dry.
6. Remove large clumps of clippings (or spread them evenly in a thin layer).

If disease does become established, removing the effects without using chemical fungicides is difficult. Often, the grass will survive the disease and eventu-

ally return to a healthy appearance. If the grass does not survive, renovation of the area will be necessary.

Insects. Insects are seldom a problem in new lawns because bare soil or soil covered by sparse vegetation usually is not an adequate food source to support insect populations. Ants, however, are a notable exception. Fire ants can be transported in sod (usually in warm-season grasses) and other ants live in areas of bare soil.

MAINTAINING AN ESTABLISHED LAWN

Keys

Uniform application of nutrients throughout the top 6 to 8 inches of the root zone is very important! Unless the entire potential root zone has a consistent pH and adequate nutrients and is sufficiently porous, grass roots will struggle to occupy this zone and may die during periods of stress. Applications to the surface have little effect beyond the top 2 or 3 inches, while grass roots may extend more than 8 inches into the soil.

Trees and shrubs may need to be pruned to reduce shade and improve air movement. Shade and reduced air movement cause the relative humidity and moisture levels to remain high for long periods of time, promoting conditions favorable for disease. Eventually, either the trees or the grass may need to be removed, since it is difficult to maintain a good lawn in the shade.

How to Establish Summer Dormancy

During dry weather turfgrasses should generally be watered once per week with about 1 inch of water. Avoid frequent, light irrigations that keep the foliage wet and provide favorable conditions for development of disease.

If you do not plan to water throughout the summer, lawns can be allowed to go dormant. To ease a lush, actively growing lawn into dormancy, water deeply and infrequently, mow high, and do not overfertilize with nitrogen. In the absence of rain, water dormant lawns every 3 weeks to prevent turf loss from heat and drying. Do not be alarmed by brown, withered leaves; they are normal signs of dormancy. Turfgrasses are able to withstand prolonged periods of drought.

(Note: **Do not regularly water established cool-season grasses during the summer unless you plan to do so all summer.** Many lawns are lost by discontinuing irrigation in mid-summer.)

By the time a lawn has grown enough to require three mowings, you can consider it established. As shoot and root growth mature to this point, the plant is better able to fend for itself and the amount of daily care and attention needed will decrease. You can now focus on maintaining a healthy stand of grass through proper mowing, timely watering and fertilization, and effective pest control. In addition, you may need to aerify, remove thatch, and overseed parts of your lawn.

With time, some areas of the lawn may deteriorate and require renovation. It may be worthwhile checking to see if rocks under failed areas are preventing root penetration. Renovation involves more than normal maintenance or spot renovation. Additional soil preparation and reseeding may be needed to restore healthy growth.

Watering

Improper watering of lawns results in waste of water, added cost, and unhealthy grass plants.

1. Water only when lawns show signs of moisture stress. A dark, bluish-gray color; footprints that remain in the grass for some time after walking through it; and wilted, folded, or curled leaves are indications that the lawn needs water. Unless the turf is being allowed to go dormant, a delay in watering at first signs of wilt can result in permanent damage to grass plants.

2. Adjust any automatic irrigation system to supplement rainfall so that the lawn is not overwatered.
3. Water in the early morning to reduce the risk of disease, water loss through evaporation, and uneven water distribution due to wind. Also, the demand for water by industry and municipalities is usually low at this time.
4. Water established lawns to a depth of 6 to 8 inches to encourage deep rooting. Usually, this can be accomplished by applying 1 inch of water per week. Cans or a rain gauge can be used to determine how much water is being delivered in a certain period of time. It takes 640 gallons of water to apply 1 inch of water to 1,000 square feet of lawn.
5. Match watering technique with soil type and site slope. Apply water to clay soils until runoff is about to occur; wait 30 minutes for the water to be absorbed; and rewater until the desired depth or amount is achieved. This same technique can be used for slopes and compacted soils. Few lawns established on clay soils can absorb more than 0.5 inch of water per hour. Sandy soils require more frequent watering; 0.5 inch of water every third day is usually sufficient.

IPM Tip—Mowing

Maintaining the proper mowing height helps in controlling damage from disease. Most diseases will be less severe in taller grass. Also, turfgrasses should be mowed when the foliage is dry. Mowing when the grass is wet can spread the disease-causing organisms from infected leaves to healthy ones more rapidly.

Mowing

Equipment. A reel mower is preferred for grasses such as zoysiagrass, and hybrid bermudagrass. On other grasses, either a rotary or reel mower will be satisfactory. The cleanest cut and best mowing are obtained when the mower blades are sharp. Dull mower blades reduce lawn quality by tearing the grass instead of cutting cleanly, creating many ragged leaf ends that quickly wither and bleach and provide easy ports of entry for disease. Using a sharp mower is especially important for grasses that are difficult to mow, such as zoysiagrass, bahiagrass, and certain types of perennial ryegrass cultivars. A properly sharpened and balanced mower blade will also reduce mower vibration, lengthen mower life, and reduce fuel consumption by as much as 22 percent.

Frequency. To maintain a high quality lawn, mow often enough that less than 40 percent of the leaf height is removed with each mowing. The frequency of mowing is determined by the desired grass height and by the amount of growth. Growth rate depends on temperature, fertility, moisture, sunlight, and the natural growth rate of the grass. In most instances, this may amount to bi-weekly or weekly mowing. Suggested mowing heights are presented in Table 1. If the lawn gets too high during wet periods, wait until the grass is dry and then raise the mowing height to mow no more than one-third of the leaf. Gradually return to the proper height of cut by mowing more frequently (wait 1 or 2 days between mowings), but at gradually lower heights until the proper height is achieved.

Fertilizing

Most organic fertilizers contain between 3 and 10 percent nitrogen. However, this nitrogen is usually slow to release as it is typically tied up in complex organic molecules. The nitrogen is released as soil microbes break down the molecules for food and as the molecules slowly dissolve in water. It is called 'slow-release' because it may take several weeks or even months to become available to the plant. As such, growth response by the grass plants may be gradual over a period of 1 to 2 months. Therefore, when fertilizing with organic fertilizers, expect slower greening in the spring, and extended growth in the fall if temperatures remain adequate for growth. Extended dry or cold periods may delay release of nitrogen from organic fertilizers.

To maintain pH in the range of 6.0 to 6.5 (5.5 for centipedegrass) and to prevent nutrient deficiencies, the soil should be tested every 2 to 3 years. For established lawns, the recommended sampling depth is 3 inches. Lime may be put on any time during the year. However, winter is often the best time of year to lime since there is less traffic, gentle winter rains minimize runoff, and alternate freezing and thawing help incorporate lime into the soil.

Table 6. Suggested Maintenance Fertilization Rates of Nitrogen (N) for Established Lawns.[a]

Grass	Month[b]												Pounds N/1000 sq. ft/year
	J	F	M	A	M	J	J	A	S	O	N	D	
Bahiagrass					0.5		0.5						1
Bermudagrass (common)[c]					1	1	1	1	0.5				4.5
Bermudagrass (hybrid)[c]				0.5	0.5 to 1	0.5 to 1	1	1	0.5				5 to 6
Centipedegrass [c d]						0.5							0.5
Tall Fescue		0.5 to 1							1		1		2.5 to 3
Kentucky bluegrass		0.5 to 1							1		1		2.5 to 3
Ky. bluegrass/ fine fescue		0.5 to1							1		1		2.5 to 3
Ky. bluegrass/ tall fescue		0.5 to 1							1		1		2.5 to 3
Ky. bluegrass/ perennial ryegrass		0.5 to 1							1		1		2.5 to 3
St. Augustinegrass[c]				0.5	0.5	1	0.5						2.5
Zoysiagrass c				0.5		0.5		0.5					1.5

Notes:

a. All rates are pounds of nitrogen per 1000 square feet. Multiply the rate by 43.5 to convert to acres. Follow table suggestions in the absence of soil test recommendations. Except on centipedegrass, use a complete (N-P-K) fertilizer that has a 3-1-2 or 4-1-2 analysis. Fertilize established centipedegrass using a low phosphorus, high potassium fertilizer with an analysis approaching 1-1-2 or 1-1-3. Fertilizers without phosphorus are preferred if soils supporting centipedegrass show moderate to high levels of phosphorus.

b. Dates suggested are for the central piedmont of North Carolina. In the western part of the state, dates may be 1 to 2 weeks later in the spring and earlier in the fall; in the eastern part, plan on 1 to 2 weeks earlier in the spring and later in the fall.

c. In the absence of soil test recommendations, in August apply about 1 pound of potassium per 1,000 square feet to bermudagrass, centipedegrass, St. Augustinegrass, and zoysiagrass.

d. Centipedegrass should be fertilized very lightly after establishment. An additional fertilization in August may enhance centipedegrass performance in coastal locations. Do not use any phosphorus on centipedegrass after establishment.

Table 7. Organic Fertility Sources.*

Nutrient	Product	Source(s)	Comments
Nitrogen (N) Natural Organic	Fertilizers municipal	sludge,composted turkey litter, animal proteins, bone meal, wheat germ	Complete N-P-K fertilizer; also supplies micronutrients.
		seaweed, kelp extracts	Source of N, Fe, and some micronutrients; often mixed with organic matter sources.
	Sodium nitrate (aka Chilean nitrate)	mined	Very quickly available source of N; overapplication may lead to leaching! Irrigate following application to avoid burn.
Phosphorous (P)	bone meal	pulverized poultry bones	More readily available P; dust, may be hard to apply.
	rock phosphate	mined	Little plant-available phosphorous except in super (0-20-0) or triple super (0-46-0) phosphate forms.
Potassium (K)	wood ash	home	up to 4% elemental K; also an excellent source of lime and may raise pH of soil
	compost	home	Up to 1% elemental K potassium sulfate mined naturally occurring; 0-0-52 analysis.
Iron (Fe)	humates	mined extractions	Sources of various nutrients including iron.
Calcium	calcium sulfate	mined gypsum, dolomitic(with Mg) or calcitic limestone	Source of Ca (and Mg if dolomitic); used to lower pH.

*Notes about using natural organic fertilizers.

Because organic fertilizers have low analyses (relatively low amounts of nutrients per weight of the product), split applications may be necessary with some products to supply the proper amount of nutrients without covering the lawn with a heavy layer of fertilizer.

Complete-analysis natural organic fertilizers may also provide:

- Organic matter as a carbon source for soil organisms.
- Micronutrients essential for plant growth.
- Disease suppression. (Applications of some organic fertilizers have suppressed dollarspot and brown patch in cool season grasses.)
- Reduced potential for nitrate leaching to the groundwater.
- Low potential for fertilizer burn.

Nitrogen (N) requirements cannot be determined by a soil test. Use Table 6 for determining amount and timing of nitrogen applications. To decrease susceptibility of turf to pests and environmental stress, do not apply high nitrogen fertilizer to cool-season grasses in the late spring or summer or to warm-season grasses in the fall or winter.

The number of organic fertilizers available is increasing in response to a growing demand. Organic fertilizers, as defined in this publication, come from animal, plant, or mineral sources and contain no chemically formulated additives. They are commonly made of livestock waste, municipal waste, bone meal, dried blood, manures, vegetable meals, feather meal, fish scraps, and crushed minerals. Some products claim to be 'organically-based' and 'natural-based', with man-made chemical formulations of either nutrients or pesticides added. Careful inspection of the label is the best way to determine the organic status of the product. Table 7 gives more information on organic sources of fertilizers.

Timing. In order to keep grass healthy so that it can withstand weeds, insects and diseases, it is important to fertilize the plants when environmental conditions are right for their optimum growth. A soil pH in the range of 6.0 to 6.5, adequate moisture and oxygen, and temperatures above 50 to 55°F favor microbial activity and enhance nutrient release. Do not fertilize when the grass is not growing and cannot take up the nutrients. Nutrients not used by the grass will be available to weeds and stimulating shoot growth at the wrong time increases susceptibility to disease. See Table 6 for suggested fertilization scheduling for different grasses in North Carolina.

Aerifying

Soils that are subject to heavy traffic are prone to compaction. Compacted soils reduce drainage, increase runoff, and inhibit root growth. Aerifying helps to alleviate compaction.

1. Use a device that removes soil cores and be sure to aerify after a soaking rain or irrigation to insure that the soil is penetrated to a depth of 2 to 3 inches.
2. Chop the cores and, if possible, distribute them by dragging with something like a chain-link fence.
3. Aerify when the lawn is actively growing so that it can recover from any injury. It is best to core cool-season grasses in the fall. Coring cool-season turf in the spring may unnecessarily promote weed growth. Core warm-season turf in the late spring or early summer.
4. Some lawn care and landscape companies offer coring service if rental equipment is not available.

Dethatching

Sod-forming grasses such as Kentucky bluegrass, bermudagrass, zoysiagrass, St. Augustinegrass, and centipedegrass have a tendency to build a thatch layer when they are heavily fertilized and watered. When thatch exceeds 0.5 inch, lawns should be dethatched. Thatch can be reduced by using any one of various tools that may be available to you.

1. Make several light power rakings instead of trying to remove too much debris at one time.
2. Small accumulations of thatch (less than 0.75 inch), can be removed from warm-season grasses by mowing as low as possible at the time of spring green-up and then raking.
3. Use 3-inch blade spacing on a power rake to avoid injury to centipedegrass and St. Augustinegrass.
4. Some lawn care and landscape companies have specialized equipment and offer power-raking service.

How to Make Use of Clippings

Many homeowners remove lawn clippings because they think that the clippings add to the buildup of thatch, which can be harmful to the lawn. Actually, thatch is made up of roots, stems, and the lower portions of leaves that are below the mower blade. Frequent mowing, mowing when the grass is dry, and proper fertilization are the best ways to reduce thatch buildup. Clippings contribute very little to thatch. They decompose quickly and release valuable nutrients—reducing fertilizer needed by as much as 20 to 30 percent.

After prolonged periods of wetness, long clippings may shade or smother the grass. In this case, rake and remove the clippings. Collected clippings can be used as mulch around trees and shrubs or added to compost.

INTEGRATED PEST MANAGEMENT & ORGANIC LAWN CARE

Integrated Pest Management (IPM) is an important component of any lawn care program. IPM can be defined as a system of keeping lawn pests at non-damaging levels by maintaining healthy plants, correctly identifying pests through regular "scouting," determining action thresholds, evaluating all possible control options and implementing selected controls. Controls used to prevent or remedy unacceptable pest activity or damage include biological, chemical, cultural, manual, and mechanical. An organic lawn care program will make use of all of these except chemical control options.

Weeds

A healthy, dense lawn is an indication of good cultural and fertility practices and is the best defense against weed problems. A lawn that is mowed at the proper height, fertilized at the correct rates and times, and irrigated efficiently will minimize infestation by weeds. Weeds in a lawn usually indicate a lack of proper growing conditions for the grass. Table 8 describes weeds associated with various problem conditions.

If an area is heavily shaded, on a steep grade, or in a depression prone to wetness, the turfgrass cannot effectively compete against weeds that are better adapted to these conditions. If these conditions exist, consider other landscape options for the area or plan to focus more resources caring for these areas.

When weeds occur in small numbers, use a spade or trowel to remove the entire plant, including the roots, to prevent regrowth. In areas of heavy weed infestation, the entire area may need to be treated and renovated. Sheets of black plastic will block sunlight and water, while raising temperatures in the soil. Covering an area for 7 to 10 days will kill most weeds. Sometimes existing turfgrass will survive. Also, a thick layer of compost or mulch can adequately kill weeds, but be careful not to introduce new weeds with the compost.

Insects

The best defense against insect damage is a healthy lawn. Healthy grass plants with deep roots will withstand insect damage better than plants weakened by environmental stresses. Insects survive by eating leaves and roots found in the thatch layer. Thatch buildup can be minimized by using a sharp blade to mow, mowing at the proper height, and watering and fertilizing at the right rate and time. These practices will limit favorable conditions for insect habitation.

Not all insects are pests, and a healthy lawn may very well have active insect populations that cause no damage. Learn to identify the few insects that may cause damage. Every 7 to 10 days inspect the turf for insect damage. Pests are most likely to be abundant at the boundary between a damaged area and healthy grass. Identify any problem

Table 8. Weeds Associated With Various Lawn Management Problems.

Condition	Indicator Weeds
Dry soil	prostrate spurge, black medic, yellow woodsorrel, goosegrass, annual lespedeza, birdsfoot trefoil, prostrate knotweed, bracted plantain
Wet soil	moneywort, annual bluegrass, alligatorweed, pearlwort, moss, liverwort, rushes, sedges
Compacted soils	annual bluegrass, annual sedge, annual lespedeza, broadleaf plantain, corn speed well, goosegrass, prostrate knotweed, prostrate spurge
Low nitrogen	birdsfoot trefoil, black medic, broomsedge, clovers, common speedwell, hawkweed, moss, white clover, crabgrass
Excess nitrogen	annual bluegrass, chickweed, moss, ryegrass
Infrequent mowing	bull thistle, burdock, chicory, smooth bedstraw, sweet clover, teasel, wild carrot
Close/frequent mowing	annual bluegrass, chickweeds, moss, pearlwort, thymeleaf speedwell, crabgrass

correctly before applying a treatment. Techniques for searching for insects (scouting methods) vary with different pests. Contact your county's Cooperative Extension Center for help.

Many insect problems can be treated in spots, and the entire lawn seldom needs treatment.

Billbugs. Billbugs feed on stems of grass plants by puncturing stems, crowns, and leaves. Grass will turn brown in patches, and is easier to pull up than healthy turfgrass. Adults are active in late March to early April. Tiny, legless grubs, with the rear end wider than the head, appear in June and July.

Chinch Bugs. Chinch bugs suck juice out of the grass plant. Adults, small black-and-white bugs, are active in late March to early April. Red-bodied, first-generation nymphs usually are present in May. Damage will usually appear in summer. St. Augustine-grass will first turn yellow, then brown to white.

Scouting Method: Cut both ends out of a large metal can and insert it in the turf in an area where the grass is yellowed and declining. Most of the can should remain above ground. Fill the can with water. Wait 5 minutes for the chinch bugs to float to the top of the water. Examine three or four places in the suspected area. Parting the grass to observe the soil surface for chinch bugs also works.

Fall Armyworms, Cutworms and Other Caterpillars. Look for an area that attracts birds to feed, dead patches of grass, and/or caterpillars feeding on leaves. Direct damage will appear as closely chewed areas.

Scouting Method: Mark off an area 1 square yard in a location of suspected infestation. Mix 2 fluid ounces of liquid dishwashing soap in 4 gallons of water and drench the area with the solution. Insects will emerge to the grass surface. Kneel to observe the area closely. Insects will return to the soil in 5 or 10 minutes. If no insects are found, examine other suspected areas.

Green June Beetle Grubs, Japanese Beetle Grubs, other White Grubs. Green June Beetle—look for finger-sized holes in grub mounds. White grubs—look for loose grass and patches of turfgrass that won't turn green. White grubs are C-shaped larva with brown heads and three pairs of legs.

Scouting Method: At the edge of an area of discolored turf, use a spade to cut three sides of a 1-square-foot piece of sod about 3 inches deep. Pull or pry the sod back like a flap. Use your fingers to sift through the soil and roots. Examine roots for chewed remnants and check the soil for grubs.

Mole crickets. In the spring, look for tunneled areas and loose grass. In the summer, look for loose, patchy areas of thinning grass. In the late summer, bare areas will appear.

Scouting Method: Mark off a 1-square-yard area where you suspect infestation. Drench the area with a solution of 2 fluid ounces of liquid dishwashing soap in 4 gallons of water. Insects will come to the grass surface for 5 or 10 minutes. If no insects are found, examine other suspected areas. This technique works best from late June to early September.

Sod Webworms. Look for brown areas in closely mowed areas. Damage may resemble symptoms of diseases such as dollar spot. Scouting Method: Mark off 1 square yard in a location of suspected infestation. Drench the areas with a solution of 2 fluid ounces of liquid dishwashing soap in 4 gallons of water. Web-worms will come to the grass surface. Kneel to observe the area closely. Insects will return to the soil in 5 or 10 minutes. If no

Top: Green June beetle larva. Center: Green June beetle. Bottom: Japanese beetle grubs.

insects are found, examine other suspected areas.

Fire Ants. Look for mounds, or lines of ant hills containing several sizes of workers (ants). Fire ant stings are painful and may cause allergic reactions, do not touch or irritate fire ants.

Ground Pearls. Look for yellowing, and then dead turf. Ground pearls are most common in centipedegrass. There may be no specific symptoms. In April through July, look for 1/16- to 1/8-inch long pink wrinkled creatures in the root zone or on the soil. In the summer or winter, look for 1/8-inch long pearly cysts in the soil, up to 8 to 10 inches deep.

Table 9. Some Organic Insect-Control Strategies.

Control Method and Products	Insects Targeted	Comments
Good management		Turf more tolerant of damage
Healthy, dense stand of turfgrass	ants, wasps, bees	Reduces ants, wasps, bees
Resistant varieties of grass	chinch bugs	Limited varieties available.
Endophyte-enhanced turfgrass	armyworms, cutworms, billbugs, chinch bugs, sod webworm	Only affects surface-feeding insects; available only in cool season turfgrasses (tall fescue, perennial ryegrass.
Bacillus thurigiensis (Bt) bacteria	armyworms, cutworms, sod webworm	Slow-acting, narrow spectrum of insects affected.
Bacillus popilliae (Milky spore) bacteria	white grubs	Limited availability; benefits remain unclear.
Beauveria bassiana (fungus); Metarhizium anisopliae (fungus)	chinch bugs, mole crickets, various caterpillars, white grubs	Naturally-occurring, limited commercial production; effectiveness not well-documented.
Clamshell pieces	armyworms, cutworms	Limited availability; benefits remain unclear.
Entomogenous nematodes (Steinernema carpocapsae, S. Glaseri, Heterorhabditis bacteriophora)	armyworms, cutworms, billbugs, green June beetle grubs, white grubs, fleas, mole crickets, sod webworms	Numerous products for different pests; specific conditions must be met for successful use.
Insecticidal soaps and oils	armyworms, cutworms, sod webworms	Only soaps have a role in turfgrass; effective on some caterpillars.
Azadirachtin (neem seed extract)	armyworms, cutworms, sod webworms	Controls caterpillars; growth regulator; must be applied to small worms
Diatomaceous earth	armyworms, cutworms	Acts as a dessicant; effectiveness questionable in moist environment.
Traps	white grubs	Various products available for adult stages (e.g. Japanese Beetles). Have not been demonstrated to be effective for reducing subsequent larval infestations.
Minimize thatch	all pests	Reduces likelihood of an infestation; improves efficacy of control strategies.

Diseases

Prevention is the best strategy for disease control in organic lawns. Disease occurs only when susceptible plants, disease-causing organisms (pathogens) and favorable environmental conditions are all present. Selecting grass that is adapted to the region, preparing a well-drained, sunny site, and keeping the grass healthy are the best strategies for preventing disease.

Even a well-adapted grass can suffer from disease if the soil has not been adequately prepared. Most of the soils in North Carolina have a low pH and low phosphorus levels, especially if the area was wooded just before the lawn was planted.

Soil tests should be taken from the site early enough to find out how much lime and phosphorus should be incorporated before planting. The depth of incorporation of the lime and phosphorus determines the depth of rooting of the turfgrasses. A deep and healthy root system results in a healthy plant that can better tolerate environmental stresses, including disease.

Cool-season grasses grow better in the fall, which coincides with unfavorable conditions for disease. Fungi that cause many turfgrass diseases are less active during cooler temperatures.

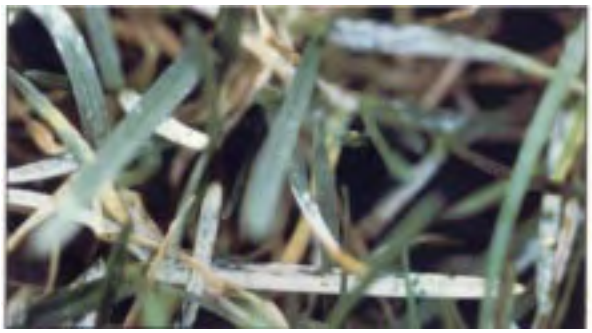
Fertilization. Some disease is likely to occur in all lawns at some time during the year, but a good fertilizer program can reduce the amount of damage. Fertilizer applications should be based on recommendations for the specific type of grass and on soil test results. Correct timing of fertilizer applications is important. High rates of nitrogen in the summer on tall fescue will increase the severity of brown patch. Tall fescue should be fertilized in the fall, winter, and spring, but not during the summer. A lighter green color in the summer may be less acceptable to the homeowner, but it is usually preferred to an infestation of brown patch.

Watering. During dry weather, turfgrasses should generally be watered once each week with about 1 inch of water. Avoid frequent, light irrigations that keep the foliage wet and provide favorable conditions for development of disease.

Mowing. Maintaining the proper mowing height helps in controlling damage from disease. Most diseases will be less severe in longer grass. Also, turfgrasses should be mowed when the foliage is dry. Mowing when the grass is wet can spread the disease-causing organisms from infected to healthy leaves more rapidly.

Brown patch on tall fescue.

Slime mold.



Powdery mildew.

Red “threads.”

Leafspot.

Table 10. Diseases of Cool-season Grasses.

Disease	Grasses	Symptoms	Management Strategies
Brown Patch	Fescue Ryegrass Bluegrass	Circular brown patches up to 3 feet in diameter develop during hot, wet weather. Infected leaves become dark, wilt and die quickly when the disease is active. The whole patch eventually becomes brownish-tan.	Adjust soil pH to 6 to 6.5 and avoid excessive fertilization with nitrogen in late spring or summer. Avoid prolonged leaf wetness by minimizing shade, watering early during the day, and providing good soil drainage. Water deeply but infrequently. Use of some organic fertilizers and composts may decrease disease severity.
Dollar Spot	Bluegrass Ryegrass	Straw-colored patches 2 to 6 inches in diameter usually develop under cool, cloudy conditions. Light tan lesions with reddish-brown margins develop on individual leaves. Use the most resistant cultivars available.	Adequate fertilization will help overcome the disease. Water deeply but infrequently and avoid late afternoon and evening watering. Collect and compost clippings when symptoms are present.
Fairy Rings	All	Large arcs or rings consisting of very green grass, dead grass, mushrooms, puffballs, or a combination of these.	Remove organic matter (stumps, waste lumber) from soil before planting. Power rake to remove thatch when it exceeds 0.5 inch. Remove soil cores, spike or force water into affected areas to allow nutrient and water penetration. Avoid over-fertilization in an attempt to mask the green ring. Rototilling and replanting may eliminate fairy rings
Leaf Spot	All	Dark, circular or oval lesions on leaves and stems. Some lesions become red, purple or tan with dark margins. Grass appears yellow and turns brown when the disease is severe, resulting in a thinning of the lawn.	Use resistant cultivars. Avoid excessive fertilization and close mowing in late spring and summer. Water deeply but infrequently and avoid prolonged leaf wetness.
Powdery Mildew	Bluegrass	White to gray powdery growth on infected leaves. Heavily infected leaves turn yellow and die. Symptoms are prevalent in shaded areas.	Plant shade tolerant cultivars. Improve light penetration and air movement by pruning, removal, or careful placement of trees and shrubs. Water deeply but infrequently and avoid prolonged leaf wetness. Raise mowing height.
Red Thread	All	Circular or irregular, bleached or reddish patches from 6 to 12 inches in diameter develop in cool-moist weather. Red threads radiate from the tips of dead leaves.	Fertilize lawn adequately to help overcome disease. Water deeply but infrequently. Collect and compost clippings when disease is present. Prune trees and nearby vegetation to improve air movement.
Rust	Fescue Bluegrass Ryegrass	Small yellow specks on leaves and stems develop into orange or red pustules. Heavily infected bluegrass and ryegrass lawns may have an orange or reddish hue. Heavily infected turf may become thin.	Plant resistant cultivars. Insure adequate fertilization and collect clippings when symptoms exist.
Slime Mold	All	White, gray, powdery fruiting bodies cover leaves in patches 6 to 12 inches in diameter during warm-wet weather.	Remove by brushing, mowing or washing the turf. Slime molds are not considered harmful.
Southern Blight	Bluegrass Ryegrass	Circular or crescent yellow-to-dead areas up to 3 feet in diameter. Tuft of green (frog-eye) in ring of dead gras is common. Weeds such as clover are also killed in spots. Tiny tan-to-brown seed-like bodies are usually present at outer edge of ring.	Fertilize and irrigate lawn properly. Power rake to remove thatch when it exceeds 0.5 inch.

Source: *Diseases of Cool Season Grasses*, AG-36, North Carolina Cooperative Extension Service, 8/92.

Table 11. Diseases of Warm-season Grasses.

Disease	Grasses	Symptoms	Management Strategies
Brown Patch	Bermudagrass St.Augustine-grass	Circular brown areas up to 20 feet in diameter that develop during cool, wet weather in the spring or fall. Leaves wilt and die, resulting in large brownish-tan areas. Often present in bermudagrass at time of spring greenup.	Provide good drainage and avoid excesive nitrogen fertilization. The lawn usually recovers in warm, dry weather.
Centipede Decline	Centipede-grass	Circular dead areas appear in the spring and continue to enlarge during the summer. Grass at edge of areas may yellow, wilt, and die during stress periods.	Maintain soil pH between 5 and 5.5 and avoid excessive rates of nitrogen (0.5 lb. of N per 1000 square feet per year recommended) and phosphorus. Provide adequate potassium in summer and fall. Maintain the lawn at a 1-inch mowing height and apply iron to foliage if yellow. Avoid drought stress. If nematodes are causing the decline, irrigate as needed or select another type of grass.
Dollar Spot	Centipede-grass Bermudagrass Zoysiagrass	Straw-colored patches 2 to 6 inches in diameter develop in late summer. Light tan lesions with reddish-brown margins develop across leaves.	Adequate fertilizer will help the grass over-come this disease. Irrigate lawn as needed to avoid drought stress.
Fairy Rings	All Large arcs or	rings of very green grass, dead grass, mushrooms, puffballs, or a combination of these symptoms.	Remove organic matter (stumps, waste lumber) from soil before planting. Power rake to remove thatch when it exceeds 0.5 inch. Remove soil cores, spike or force water into affected areas to allow nutrient and water penetration. Avoid over-fertilization in an attempt to mask the green ring. Rototilling and replanting may eliminate fairy rings
Gray Leaf Spot	St.Augustine-grass	Oval or circular tan lesions that are bordered by purple to brown margins develop in warm, wet weather. Leaves wither and die if many lesions develop, giving the lawn a brownish color.	Avoid excessive fertilization with nitrogen when warm, humid weather is expected. Avoid late afternoon and evening watering. Prune trees and undergrowth to improve air movement and light intensity.
Leafspot	Bermudagrass	Dark, circular, or oval-shaped lesions develop on blades and stems. Some lesions become red, purple, or tan with dark margins. Lawn appears yellow to brown if the disease is severe and grass becomes thin.	Fertilize properly and avoid close mowing in late spring and summer. Keep mower blades sharp. Water deeply but infrequently and avoid prolonged leaf wetness.
Rust	Zoysiagrass	Small yellow specks on leaves and stems that develop into orange or red pustules. Heavily infected lawns take on orange or reddish hue and become thin and weak. Rust is most often a problem in lawns with too much shade.	Give adequate fertilizer and collect clippings when symptoms exist. Reduce shade and maintain good soil moisture.
Slime Mold	All	White, gray, powdery fruiting bodies that cover leaves in patches 6 to 12 inches in diameter during warm, wet weather. Fungus usally disappears during dry weather.	Remove by brushing, mowing, or washing the turf. Slime molds are not considered harmful.

Continued on next page

Table 11. Diseases of Warm-season Grasses (continued).

Disease	Grasses	Symptoms	Management Strategies
Spring Dead Spot	Bermudagrass	Dead spots appear in the spring as grass resumes growth, usually after lawn is at least 3- to-5 years old. Spots expand for 3 to 4 years, often developing into rings, and then disappear. Infected areas recover slowly and weeds frequently invade these areas during the summer.	Avoid excessive nitrogen fertilization and do not apply nitrogen after late August. Raise mowing height and ensure adequate potassium in the fall. Reduce thatch by aerifying and pulverizing soil cores.
Nematodes (sting)	All	Lawn becomes thin and does not grow well following fertilization and irrigation. This occurs most often in sandy soils. Roots are shallow and may be killed. Have soil samples examined by the NCDA to determine if nematodes are a problem.	Plant the best-adapted grasses and ensure adequate fertilization and irrigation to help overcome nematode damage.

Source: *Diseases of Warm Season Grasses*, AG-360, North Carolina Cooperative Extension Service, 4/94.

Table 12. Organic Disease Control Methods and Products.

Control Method	Product/Strategies	Comments
Cultural	Properly adapted species; proper site preparation, fertilization, irrigation, and mowing practices.	(See individual disease for more specific information.)
Composts	Many available. Municipal yard waste is available in some communities.	Some commercially available composts may be enhanced with added microbial organisms as biocontrol agents.
Organic Fertilizers	Many available.	High organic content influences activity of both favorable and unfavorable microorganisms. Biocontrol is achieved through increased presence and activity of favorable agents.
Bacterial and Non-pathogenic Fungal Control Agents	Not widely commercially available.	Research has shown effective control of disease (brown patch and pythium in particular) is possible with non-pathogenic organisms. Presently, practical applications lack consistency in performance.

RENOVATING AN ESTABLISHED LAWN

Lawn renovation refers to any procedure beyond normal maintenance required to upgrade an existing lawn. Renovation generally takes place on a small scale in isolated areas of the lawn. Bare spots larger than 4 inches in diameter should be replanted. Deterioration of the entire lawn may require re-establishment. A deteriorated lawn is often a symptom of some underlying problem. Some of the major causes of lawn deterioration include:

- planting a grass that is poorly adapted to the site.
- overwatering, overfertilizating, mowing too low.
- poor drainage, heavy shade, compacted soil.
- improper nutrient balance or low pH.
- excessive thatch buildup.

Before renovating, identify and correct the problems that may have caused the deterioration. Otherwise, renovation will be an ongoing process.

Soil Preparation

To achieve good germination and fast establishment, remove weeds and prepare the soil before overseeding. Do a soil test in the area to be renovated, and follow recommendations for nutrients and pH. If total renovation of an area is needed because of severe damage or takeover by weeds, cover the area with a black plastic sheet for 7 to 10 days to kill most plants, including weeds. Those not killed will have to be manually removed as they appear. In bare areas, loosen the top 4 to 6 inches of the soil with a rake, hoe, shovel, or roto-tiller. Fill in low areas and smooth the surface so clods are smaller than marbles. If the area is to be reseeded, add compost before tilling to enhance water retention and speed germination. It is also possible to renovate small areas by coring and reseeding.

1. Remove as much extra vegetation as possible from the area to be overseeded. Use a rake to remove thatch, weeds, and leaves. (It is important to remove the roots of weeds too, to prevent the weed from regenerating and reappearing later.) Weeds with underground shoots are harder to control, and may need to be tilled under. Making several passes with a power rake is usually the best choice for cleaning up large areas.
2. Apply a complete (N-P-K) fertilizer to the soil. In small areas, hand application is acceptable. In larger areas, use a rotary or drop-type spreader to insure uniform distribution.
3. Use a rake to loosen the soil between existing plants as much as possible. If the soil is very dry, moisten the soil to improve penetration by the rake. In large areas, use a core aerifier to bring the soil to the surface.After aerifying, let the plugs dry, then pulverize with a power rake or by dragging a chain-link fence.
4. See Table 4 for correct seeding rates. To insure uniform coverage of seed, use a rotary or drop-type spreader, applying half of the seed in one direction, and the other half at a right angle to the first pass.
5. Keep the overseeded areas moist by sprinkling lightly several times a day. As seedlings grow, water less often, but more deeply, to promote deep rooting.

Timing

Late summer to early fall is the best time to renovate cool-season lawns. Seedlings can survive the heat and drought stresses of summer better if they can establish themselves the previous fall and winter. Warm-season lawns are best renovated in late spring to early summer. Attempts to upgrade existing lawns when conditions do not favor good growth are unlikely to succeed.

Replanting

Seeding is recommended for grasses with bunch-type or slowly spreading growth habits. These include tall fescue, Kentucky bluegrass, ryegrass, bahiagrass, and fine fescue. See Table 4 for correct seeding rates. To insure uniform coverage, use a rotary or drop-type spreader, applying half of the seed in one direction and the other half at a right angle to the first pass. Incorporate seed into the top one-eighth inch of the soil by lightly pulling a leaf rake over loosened soil or by running a vertical slicer over areas that have been aerified by coring. Adding a light covering of weed-free straw will help to protect the seeds from wind and also help retain heat and moisture.

Plugging can be used for those grasses such as

bermudagrass, zoysiagrass, and centipedegrass that spread laterally. Place plugs on either 6-inch or 12-inch centers, depending on the desired establishment speed. Use a plugging device to remove plugs of soil from bare areas, and switch them with plugs collected from healthy areas.

Broadcasting large areas (15,000 square feet or more) is often reserved for bermudagrass. Rototill the recommended amount of fertilizer and lime as indicated by soil test results. Spread sprigs over the surface using rates provided in Table 4. Press the sprigs into the top 0.5 to 1 inch of soil. Roll the area to firm the soil and insure good sprig-to-soil contact.

Care After Planting

Keep renovated areas moist with light sprinklings several times a day. As the seedlings, plugs, or sprigs grow, decrease the frequency of waterings while increasing the duration to promote deep rooting. After the third mowing, water to a depth of 6 inches.

Mow the areas as you normally would, using a sharp blade. Keep weeds pulled or cut very short until desirable grasses have germinated and the desired mowing height is achieved. This will reduce the competition for new seedlings.

To enhance establishment, fertilize the new seedlings of cool-season grasses. A complete (N-P-K) fertilizer that provides about 1 pound of nitrogen per 1,000 square feet should be applied approximately 3 weeks after seedlings emerge. An organic fertilizer, which will release nitrogen and other nutrients more slowly, needs to be applied at time of planting.

Warm-season grasses can be fertilized every 4 weeks until coverage by grass is complete. Use a complete (N-P-K) form of fertilizer that provides about 1 pound of nitrogen per 1,000 square feet. Every 2 weeks, apply a nitrogen-only (N) fertilizer that provides about 0.5 pound of nitrogen per 1,000 square feet may help warm-season grasses fill in more quickly. Keep unnecessary traffic off the area until reestablished to prevent damage to the seedlings.

Overseeding Warm-Season Grasses

In warm-season (usually bermudagrass) lawns, overseeding with annual or perennial ryegrass will help to maintain a green color and protect the dormant warm-season turfgrass during the cooler months. Occasionally zoysiagrass and centipedegrass are also overseeded. It is important that the warm-season lawn be lush and healthy before overseeding so that it can withstand the rather harsh cultural practices and competition from cool-season turfgrass associated with overseeding.

Timing. Overseeding should take place in late fall, 2 or 3 weeks before the expected first frost or when the soil temperature drops below 75 degrees F. In the piedmont area, this is usually September 15 through October 1. Plan on 1 to 2 weeks earlier in the western part of the state, and 1 to 2 weeks later in the eastern part of the state.

The transition back to warm-season turf will begin in the spring when night air temperatures begin to reach 60 degrees F, and the warm-season grass begins to break dormancy. Regular maintenance practices for the warm-season grass, competition from the warm-season grass, warm temperatures, and disease should eventually force the overseeded species out of the lawn in the spring. However, overseeding for several consecutive years may result in gradual decline of the warm-season lawn and increase in the cool-season species. Therefore, it is important to establish a healthy warm-season lawn before considering overseeding.

1. Prepare for overseeding by closely mowing the warm-season grass.
2. Thin the turf, especially hybrid bermudagrass, with a power rake to improve seed placement near the soil. Centipedegrass and zoysiagrass are slow to recover from injury, so only lightly rake the surface on these lawns. Remove the clippings and raised thatch.
3. Apply a complete format (N-P-K) fertilizer with a ratio of 1-2-2 based on 0.25 pounds of nitrogen per 1000 square feet. Do not stimulate continued growth of the warm-season grass by applying too much fertilizer or applying fertilizer too early. Use a rotary or drop-type spreader to insure uniform application.
4. Choose a seed species. Annual and perennial ryegrasses are the major overseeding species. They are both quick to establish and relatively inexpensive. Newer varieties of perennial ryegrass are more heat- and disease-tolerant and may be more difficult to remove in the spring than annual ryegrass or older varieties of perennial ryegrass. Consult the

county Cooperative Extension Service for recommended overseeding varieties.

5. Use a rotary or drop spreader to apply the seed at 5 to 10 pounds per 1000 square feet. Higher rates will produce denser and lusher lawns, but will leave more plants to remove in the spring.
6. Topdress the lawn with a light layer of sand or compost to improve seed-to-soil contact.
7. Water two to three times daily until the seedlings begin to emerge. Apply enough water to moisten the surface, but not enough to cause movement of the seed. As the seedlings emerge, water only once per day. Once the seedlings are established, water only when necessary to supplement rainfall.
8. Begin mowing 2 to 3 weeks after emergence. Do not remove more than one-third of the leaf blade in any one mowing. Maintain a mowing height of 1.5 to 3 inches.
9. Fertilize every 4 to 6 weeks with 0.5 pounds of nitrogen.
10. In the spring, when night air temperatures are regularly above 60 degrees F, mow the overseeded grass closely (1 to 1.5 inches) to reduce competition and promote growth of the warm-season grass.
11. Do not fertilize until the warm-season grass has returned to its green color.

SUMMARY

Remember that the key to successful organic lawn care is to prevent problems instead of to treat them after they appear. If you choose a sunny, well-drained site, protect and prepare the soil following recommendations, select a grass that will grow well in your area and wear well for the uses intended, and then water, fertilize and mow on schedule and inspect the lawn frequently to spot any problems early, your organic lawn should be a success.

It is also important to remember that just because a product is labelled as organic or comes from a natural source does not mean that it poses no threat to the environment or to people, pets, and wildlife. To prevent water pollution from organic fertilizers, follow recommended rates for application and sweep fertilizers off paved surfaces. Nitrogen and nutrients from any source, organic or otherwise, should be kept out of streams and other waters.

Some organic pesticides are quite toxic and should be stored in a locked or secure place. If you use such products, always read and follow product labels. The “organic” products on the market change each year. No brand names are listed in this publication because new products become available each year and others are taken off the market or are not available in every location.

Consult your local Cooperative Extension Center for current information.

Appendix 1— COMPOSTING

Yard waste has been banned from public landfills in North Carolina since 1993. A beneficial and easy way to make use of yard waste is to turn it into compost. Typically sources of compost include yard waste (grass clippings, fallen leaves, wood chips), and animal manures. Composted materials are incorporated into soil to improve conditions for plant growth.

Wood chips and grass clippings can be also used without composting as mulch around the bases of trees and shrubbery or in landscape areas. Clippings from grass that has been treated with any pesticide should not be used as mulch —they could damage plants. Effective mulch will help retain moisture in the soil and help prevent erosion of bare soil. Do not mix materials that have not been composted into the topsoil before seeding a lawn and do not use fresh compost as a topdressing fertilizer for an established lawn. Fresh compost could kill grass and will tie up nitrogen in the soil.

Compost as Mulch and Fertilizer

Properly cured compost may be used as a mulch or as an excellent source of organic matter for a lawn, whether incorporated in the topsoil before seeding or applied as a topdressing on an established lawn. To incorporate before seeding, use a rototiller or mix with the topsoil before spreading. One cubic yard of compost will cover approximately 108 square feet when applied to a depth of 3 inches, or 216 square feet at a depth of 2 inches, or 324 square feet at a depth of 1 inch. As a rule of thunb, spread compost no more than one third the depth of the rototiller. For instance, a 1-inch layer of compost should be tilled at 3-inches deep. Two or more passes with the tiller will help insure uniform distribution of compost and break up larger pieces of soil and compost.

To apply compost as a topdressing over a large area, use a rotary or drop spreader if the compost materials will pass through the openings in the spreader. If the compost material is too large or irregular, spread the compost by raking out piles of compost placed evenly throughout the lawn. Apply no more compost than will cover half of the height of the grass. Applying a thick layer of compost that covers the grass will block sunlight and decrease growth. It may also interfere with mowing.

Benefits of Compost in Soil

When used as a soil conditioner or in place of topsoil, properly cured compost is better than high quality topsoil. Rocks and sticks are often screened out of compost, and many weed seeds are killed by the high temperatures of the composting process. The consistency of compost is often very uniform so that it may be handled more easily than more inconsistent topsoils. A well-cured compost looks dark, crumbles in the hand, has uniform particles no larger than one-half inch in diameter, and has a pleasant odor.

Compost offers many advantages over topsoil. It has:

- higher nutrient content;
- higher amount of organic matter;
- better nutrient- and water-holding capacity;
- neutral reaction;
- disease-control potential.

The nutrients held in organic compounds by dead plant matter are slowly made available as the organic matter decomposes. Once applied to the soil, properly cured compost releases these nutrients through further microbial activity and decomposition. The complex organic compounds in the compost provide structure to sandy or heavy clay soils.

In addition to the nutrients it provides, compost improves the ability of the soil to retain nutrients added through fertilization. Improved structure also increases water holding in sandy soils and water infiltration in heavy clay soils. High levels of organic matter increase microbial activity which helps to decrease thatch levels, release nutrients held in the soil, and control certain pathogens that cause disease in turfgrasses.

Other Compost Sources

Yard waste is only one source for compost. It may, however, also be the most readily available source. Another good source is animal manure. Before using sources from outside your own yard, find out all you can about pH level, salinity levels, nutrient value, heavy metal content, and stability or maturity. Content of animal waste can be analyzed. High levels of acidity or salinity can cause severe problems in your lawn. High levels of unwanted nutrients or heavy metals can be harmful to the lawn

or to the lawn owner. An unstable compost will not perform on the lawn as a mature compost will, so further curing may be necessary before application to an established lawn.

Other Soil Conditioners

Do not overlook the benefits of earthworms. They aerate and fertilize the soil and destroy thatch.

Other non-chemical products are available as soil conditioners. These products can be used to improve the soil's physical or biological characteristics or both. Humate, diatomaceous earth, calcined clay, and greensand are examples of soil conditioners. (Products affecting primarily the chemical properties of the soil are considered as fertilizers in this publication). These products vary greatly between brands, and their effects have not all been evaluated scientifically. Before using any of these products, find out about their pH level, salinity level, nutrient value, heavy metal content, and organic stability. Also, some may contain chemical additives or may have been chemically altered so that they do not fit the definition of "organic" used here.

How to Make Compost

1. Place excess grass clippings, pulled weeds, fallen leaves, vegetable parings—basically anything that was growing—in a pile. The pile should be no less than 3 feet x 3 feet x 3 feet and no more than 5 feet x 5 feet x 5 feet. Meat scraps, bones, fatty foods, and pet feces should not be composted. Place the pile in a convenient but inconspicuous place. Use a wooden or wire fence, plastic tarp, or compost bin to contain the pile, if necessary.

2. Try to maintain equal amounts of green and brown materials (grass clippings and dead leaves) by mixing the materials within the pile. Adding materials in layers is acceptable, but will result in compost that cures more slowly. Too much nitrogen (too many grass clippings) will cause fast but incomplete decomposition. Too little nitrogen (too many fallen leaves) will cause very slow decomposition.

3. Chopping or breaking the pieces into small pieces will increase the rate of compost maturity. Larger, less uniform materials will require more time to decompose.

4. Allow pile to stand for several days. Temperatures inside the pile should gradually increase to 130 to 150 degrees F. As the temperature increases, microbial activity increases, breaking down the organic materials. Temperatures get high enough to kill many disease-causing organisms and weed seeds. The hotter the pile, the faster the composting.

5. Maintain an adequate amount of moisture in the pile. The materials in the pile should remain about as damp as a wrung-out sponge. Add water if it is too dry, or cover the pile if it is too moist.

6. Maintain an adequate amount of air in the pile. Mix in larger materials like stems and leaves with fine materials like grass clippings to insure enough air movement in the pile.

7. For faster composts: Check the temperature regularly. When the heat decreases substantially (after 5 to 10 days), turn the pile, mixing it so that the outer edges are placed closer to the center where the most microbial activity takes place. This should be repeated to insure a homogenous compost, free of weed seed and plant pathogens. After 4 to 8 weeks, depending on environmental conditions, the compost should be ready for use in the lawn.

8. For slower composts: As yard waste is collected, add it to the compost pile. Layering different wastes will improve uniformity and chopping or shredding will further enhance uniformity and rate of decomposition. Adding materials to an existing compost pile will extend the composting time to 6 months to 2 years for complete maturation of the original composted materials.

Appendix 2 — CALIBRATING SPREADERS

Rotary spreaders cover a wider area faster than drop spreaders, require less effort to push, and have better ground clearance. Drop spreaders have more uniform patterns, lower drift potential, and a more precise control of pattern edges than rotary spreaders. They are preferred for smaller, more contained areas of turf.

Calibrate the spreader under conditions similar to those of the actual operation. Ground speed, rate, and pattern settings, operator, wind speed and direction, terrain, termperature, humidity, and product applied should all be similar to the expected application. Different spreaders, even from the same manufacturer, should be calibrated individually. Variations in characteristics of the impeller (paddle or spinner) such as diameter, speed (gear ratio), concavity (flat or concave), height above ground, fin shape, angle, and surface will affect the calibration.

Calibrate the spreader individually for different products. Characteristics of the product to be applied, such as particle shape, size, uniformity, density, critical relative humidity (the level of humidity at which the particle becomes sticky), and surface friction all affect distribution.

Different operators require individual calibrations. The walking speed, handle height, and pattern of travel are controlled by the operator.

Wind speed and direction, surface slope, temperature and relative humidity affect distribution. When conditions interfere with application of the product in a uniform manner, it is a good idea to delay application.

(Note: All collection pans used to calibrate a spreader must be the same size. Square pans 1 to 2 square feet, and 2- to 4-inches deep are recommended. To prevent material from bouncing out of the pans, place pads or baffles inside them).

How to Calibrate a Rotary Spreader

1. Place collection pans in a line perpendicular to the travel direction of the spreader. Use at least 10 pans to cover the full width of the pattern. Large spreaders may need 20 to 30 pans.
2. Make several passes in the same direction over the pans. Make sure the spreader is open before reaching the pans and remember to walk at the same speed each time.
3. Collect and weigh the material in each pan on an accurate scale.
4. A desirable pattern is one that places the highest amount of material in the center and evenly decreasing amounts towards each side of the pattern. Unlike the drop spreader, some overlap of the pattern will be required to achieve a uniform distribution of the material. It is often recommended that the distance between spreader passes be adjusted so that the material is thrown back as far as the wheel marks from the last spreader pass. It is important that equal amounts of material be applied to the left and right side of the spreader. Skewing of the spreader to one side may be corrected by repositioning the pattern adjustment control if the spreader has one, or restricting the discharge ports.
5. The width of turf covered by each pass of the spreader is determined by finding the trays on the left and right that are equal to one-half of the amount in the center tray.
6. Use the weight of material collected from the pan in the center in the equation below:

$$\text{Weight of material per 1000 square feet} = 1000 \times \frac{\text{weight of material in center tray}}{\text{area of pan} \times \text{number of pans} \times \text{number of passes}}$$

7. If the proper rate is not achieved, change the spreader setting or the number of passes. Repeat the process until the spreader is applying the material at the proper rate.

How to Calibrate a Drop Spreader

Pan Method

Push the spreader over a line of identical pans and collect and weigh the material. Measure the area of an individual pan and then use the following formulat to determine the application rate:

$$\text{Weight of material per 1000 square feet} = 1000 \times \frac{\text{weight of material collected}}{\text{area of pan} \times \text{number of pans} \times \text{number of passes}}$$

Sweep and Weigh Method

Push the spreader over a clean, smooth surface of a known distance and collect the material. Determine the application rate through the following formula:

$$\text{Weight of material per 1000 square feet} = 1000 \times \frac{\text{weight of material collected}}{\text{spreader width x distance}}$$

Catch-Pan Method

Attach a catch pan to the bottom of the drop spreader. Establish a known distance. Push the spreader over the known distance, opening the hopper at the starting point and closing at the finish point. The application rate is determined with the formula:

$$\text{Weight of material per 1000 square feet} = 1000 \times \frac{\text{weight of material collected}}{\text{spreader width x distance}}$$

Whatever method is used, make enough passes or travel enough distance so that enough material is collected to be weighed accurately. Change the opening in the spreader to adjust the rate. Repeat the calibration until the correct rate is achieved.

Spreader Operation

1. Make sure the lever is closed before filling the hopper of the spreader.
2. Make sure the screen filter is in place to prevent clogging.
3. Push the spreader, do not pull.
4. Start walking and reach the calibrated speed before opening the lever to release the material; close the lever before slowing, turning, or stopping.
5. Hold the handle at the same height used in calibration. The impeller should be level.
6. Walk in straight lines. Use reference points such as spreader wheel marks or footprints.
7. Do not spread while turning. Generally, only one wheel drives the impeller. Continuing to spread while turning will cause the impeller to change speed, altering the distribution pattern.
8. Keep material dry to prevent caking and clogging of the spreader ports.

Spreader Maintenance

1. Wash the spreader after each day's use to avoid buildup around ports and on the impeller. Water is adequate for cleaning water-soluble products. Dry completely to prevent rusting.
2. Store the spreader empty, in a cool, dry place.
3. Lubricate as specified by the owner's manual.