Chapter 4

Turf Establishment and Renovation

Turfgrass maintenance problems often result from poor planning in the initial stages of establishment. Poor drainage, scalping and turf-susceptibility to environmental stresses may be the consequence of poor establishment techniques. To ensure a healthy turf and avoid later maintenance problems, begin with proper site preparation.

The primary objectives of soil preparation are:

- To provide a firm, smooth surface for rapid establishment
- To provide a rooting medium conducive to water infiltration, aeration and drainage.

The goal of proper site preparation is to create a firm foundation on which you can establish and maintain a high-quality turf with a minimum of difficulty.

The steps for preparing the site are the same whether you establish turf by seed or vegetative methods.

- **Clear the site.** Begin by removing any obstructions that may impede turf establishment and make future maintenance difficult. These include rocks, boulders, old building foundations, roots of dead trees, brush and weeds. When planted over shallow rock outcrops, boulders or old foundations, the turf will have a restricted root system, and it will continually suffer from drought stress. Either remove the obstructions or bury them at least 15 inches deep.

Trees can excessively shade a site. This may prevent good turf establishment and lead to turf thinning. Trees also may reduce air circulation and create an environment conducive to disease development. So selectively prune tree limbs to let in light and promote air movement before establishing turf.

Trees and turf also compete for nutrients and water. In some cases, you may have to remove trees that interfere with the turf and the site’s planned uses. If so, be sure to remove stumps. Don’t simply bury them. As they decompose, the soil will sink. Eventually, a depression will form at the site. Fairy-ring disease also is likely to develop on the excess organic debris.

If you don’t remove difficult-to-control weeds from the site before establishment, you can expect serious persistent problems in the turf. Propagules—seeds, rhizomes, stolons—let the weeds survive tillage and later infest turf. You’ll especially have problems from annual bluegrass seed, quackgrass rhizomes, bermudagrass stolons and nutsedge nutlets.

Non-selective, systemic herbicides or fumigants control growing weeds and propagules. Choose materials that control all vegetation on the site yet have a short soil residual, allowing you to plant soon after treatment.

*Glyphosate* is a non-selective systemic herbicide that the plant absorbs through its leaves then translocates to all other parts. To be sure that weeds have fully absorbed and translocated the herbicide to roots and propagules, it is best to wait a week after application before tilling the area. Soil microorganisms quickly deactivate glyphosate once it comes in contact with the soil so you can plant soon after treatment.

Fumigants are volatile materials that you apply to the soil in gaseous or liquid form. They kill all living organisms, including seeds and other propagules in the upper layer of soil.

- **Test the soil.** The best way to determine lime and fertilizer requirements is with a soil test. By testing the soil, you can avoid spending unnecessary time, labor and money on materials that the soil doesn’t need. You also avoid applying excessive amounts of lime and nutrients, which could be detrimental to the future turf.

- **Rough grade and install drainage and irrigation systems.** Rough grading involves removing the topsoil and contouring the subgrade. By smoothing out surface irregularities, such as steep slopes and depressions, you will greatly ease future maintenance. Steep slopes interfere with mowing and make applying fertilizer and pesticides difficult. Irrigation also is difficult on slopes. Water often runs off before it can infiltrate the surface. If steep slopes face south, turf can suffer from heat and drought stress.

When determining the contour, consider surface drainage. If the area will be heavily trafficked, such as an athletic field or golf course, contour the site so surface water can run off compacted areas. With athletic fields, add a 1-foot crown in the center. Golf-course fairways, tees and greens should slope toward roughs. Home sites should slope away from the house to keep water out of basements.

After contouring the subgrade, replace the topsoil, spreading it evenly over the site. Staking the area with markers showing the desired final elevation eases this operation. Topsoil settles after you spread it over the site. You can expect fine-textured soils to settle 5 to 10 percent. Coarse-textured soils won’t settle as much. When marking the stakes, take this settling into account and mark them above the final settling level.
A variety of seedbed-preparation equipment is available to help you get the job done on both large and small sites. Most are of three types:

- Tow-behinds
- Hitch-mounted units
- Fast-mounting systems for frame-mounted attachments.

Tow-behinds are attached to a draw bar that is bolted to a tractor frame. Hitch-mounted units use a tractor’s hydraulic 3-point-hitch system to lift them, so the operator controls the units’ functions and height. Fast-mounting systems usually take no more than 5 minutes to put in place.

The following equipment types fall into these categories:

- **Rock pickers.** You can rake top-side stones before planting, but it’s best to remove even small stones from the upper 4 inches of the root zone. These stones interfere with cultivation and damage machines. A stone-picking machine may handle the problem most effectively.

  Rock pickers are either ground- or PTO-driven and do a good job where rocks have been brought up to the surface. They operate best at 3 to 5 mph, and some models can pick rocks ranging from small stones to 200-pounders. Some can pick a ton of rock in 1 minute, so labor savings can be substantial.

- **Tractor rakes.** Tractor rakes are especially efficient on stony or sandy soils. They remove trash and are particularly good for minimizing surface irregularities and contouring the subgrade.

  By angling these rakes, you can lay down windrows of rocks or trash for later pickup with trucks or front-end loaders. You also can add wheel and scarifier attachments for heavier soil.

  Soils in the West and Midwest often are too heavy for a tractor rake alone, so you may need to use a box scraper or scarifier/scraper on the area first. Many manufacturers make tractor rakes.

- **Rear scraper blades.** Many of these blades, mounted on the rear of a tractor, include operator-activated tilt and angle controls. With the tractor in reverse, you can use the blade as a dozer. Rear blades use their own weight and the blade’s angle to dig.

- **Scarifiers.** Two types of scarifiers handle different jobs. A scarifier/scraper uses teeth to rip up hard-packed soil while bringing stones to the surface. You can later drag the stones using the scraper blade. The scraper blade also roughly levels areas and spreads topsoil. On many units, you can easily switch the scarifier to the scraper by using a lever that rotates the unit.

  A scarifier/clod breaker works on level ground that hasn’t been finish-graded. The leading edge has fixed teeth that break up compacted soil. A spiked roller bar follows and breaks clods turned up by the scarifier teeth. These units are best for light work and as preparation for final hand raking.

- **Box scrapers.** These attachments do an excellent job of breaking stones loose and leveling out an area’s high spots. Usually a welded brace keeps the box in a rigid position so the unit doesn’t rotate.

  Some box scrapers have a blade along the rear. The blade covers wheel tracks, while the box holds sand and soil being distributed over the area. Side shields on the blade trap scraped soil until the end of the pass, which controls soil placement. Optional scarifier teeth ahead of the blade can break up crusty soil.

- **Drags.** A drag can be anything from a railroad tie to a large pipe to a heavy mat. Used for final smoothing, they’re usually hauled behind a tractor. Manufactured drags may have scarifier teeth, leveling bars or drag chains to smooth a surface. Drags are effective only on the soil’s surface.

- **Harrows.** Some harrows look like chain-link fencing and are dragged behind a tractor. One side of a harrow has spikes that dig lightly into the soil. The other side is smooth and distributes soil side to side as it breaks up clods. It can remove light trash and cover seed, but it’s best use is for soil preparation.

- **Front-end loaders.** Seedbed-preparation attachments for front-end loaders have a dual advantage. They can work the soil bed and lift loads, so debris can be put into a truck.

  Their hydraulic down-pressure can dig or make shallow passes to remove topsoil before grading. Front-wheel drive on many models is an additional advantage.

When filling areas with large amounts of topsoil, add the soil in 12-inch-deep layers, rolling between each one to speed settling. If the subsoil is considerably different than the topsoil, mix 2 inches of fill with 2 inches of subsoil to create a transition zone.

Using soil amendments, modify topsoil that has a poor texture. Otherwise, the poor texture allows either compaction or poor nutrient and water retention.

Sandy soils don’t hold water or nutrients well. You can improve sandy soils by amending with organic materials or with calcined clay. These materials aid moisture retention and increase cation-exchange capacity, minimizing nutrient loss. Organic amendments such as peat and compost work well.

Because soil microbes break down organic matter, it is important to consider the stability of the material when choosing an organic amendment. Stable materials that resist decomposition will retain their soil-amending properties longer than materials that quickly decompose.

The carbon:nitrogen ratio (C:N) is an indicator of the material’s stability. The higher the C:N ratio, the more stable the material. However, you must ensure the soil has adequate amounts of nitrogen when amending with material having a high C:N ratio. Microbes use nitrogen as they break down carbon components in the organic matter. The higher the C:N ratio, the more nitrogen it takes to break down the material. If soil nitrogen is low, the turf could become deficient.

Peat is superior to other organic compounds because it is relatively stable and has a favorable C:N ratio. Reed-
sedge peat is the most stable peat and is the preferred organic material for turf establishment. Add peat to the soil at the rate of 10 to 20 percent of the total volume of the mixture.

You also can use coarse inorganic amendments for improving the structure of fine-textured, easily compacted soils. Sand is the most widely used inorganic amendment. Another material that is good for this purpose is calcined clay. Not only does it improve soil texture, it also increases cation-exchange capacity and water retention. Calcined clay costs more to use than sand. Isolite is another inorganic amendment that shows promise. Research indicates that it improves aeration in heavy soils and aids water retention.

Characteristics of a good coarse amendment include particle size, particle-size uniformity and durability of the material. The objective of using a coarse amendment is to create large pores in the soil. Sands that are too fine or that are composed of a wide range of particle sizes may actually impede water movement. Coarse amendments that are not durable break up under traffic and lose their beneficial characteristics. For this reason, avoid materials such as vermiculite, perlite and diatomite.

Because large pores are important in soil-water movement, you must add enough coarse amendment that individual particles bridge, or touch, each other. The amendment may need to make up as much as 80 to 90 percent of the volume of the soil mixture. Have the soil and amendment physically tested by a university or commercial soil-testing lab to determine the quality of the amendment and the native soil and to determine the amount of amendment to add.

- **Apply lime and fertilizer.** Referring to soil-test results, incorporate any necessary materials 4 to 6 inches deep. In the absence of a soil test, you can apply fertilizer using standard recommendations. However, remember that you may be applying materials that aren’t needed, wasting money and possibly creating detrimental conditions for the turf.

  Phosphorus is important to seedling rooting. Potassium increases turfgrass resistance to stresses. Lime will correct an acid soil. Basic fertilizers, such as 10-10-10 and 0-20-20, supply phosphorus and potassium without adding excessive nitrogen. Because these materials are not mobile and don’t readily move in the soil, it is best to incorporate them into the soil before establishing the turf. Disk or rotary till them 4 to 6 inches deep following rough grading.

- **Finish grading.** Finish grading will provide a smooth, firm seedbed free of obstructions. When the area has settled and the soil is moist—not too wet or too dry—it is ready for finish grading.

  Remove stones and other debris that may impede seedling emergence or interfere with future turf maintenance. If you have sufficient staff or the area is small, use hand rakes. Lightweight, broad aluminum or wooden rakes with closely spaced tines are best for removing small stones and smoothing the soil.

  To achieve a smooth firm surface, it is best to rake then roll, alternating procedures until footprinting on the soil surface is minimal. A water-ballast roller one-half to three-fourths full is easy to push and is heavy enough to firm the soil.

  For larger areas, use a cultipacker to firm and smooth the soil.

- **Apply starter fertilizers.** Starter fertilizers supply young, shallow-rooted seedlings with an initial source of nitrogen. A soluble nitrogen source is best because it is readily available to the seedlings. If you didn’t incorporate fertilizer in the soil during site preparation, you should use a complete fertilizer at this time.

  Apply starter fertilizer just before seeding or as you seed. Lightly rake the fertilizer into the upper 0.5 inch of the soil surface. Use 1 to 1.5 pounds of nitrogen per 1,000 square feet. If the turf doesn’t sufficiently grow or green up, you can supplement the initial application with 0.5 pound of nitrogen per 1,000 square feet when the seedlings reach 1.5 to 2 inches in height.

**BUY HIGH-QUALITY SEED**

High-quality turf starts with high-quality seed. High-quality seed is one of the most important prerequisites for the establishment of a persistent, weed-free, high-quality turf. Poor-quality seed may be contaminated with weed seed and undesirable turf species or varieties. It may have low purity and germination percentages. Using poor-quality seed can lead to persistent maintenance problems in the future and can waste all the time, effort and money you spend on soil preparation, fertilization, liming and seeding.

Because turfgrass species and varieties are adapted to different environmental conditions, have varying levels of disease susceptibility and perform differently under varying levels of cultural intensity, it always is best to refer to local recommendations from county or state extension specialists.

**Identifying seed.** Botanically speaking, the turfgrass seed is a caryopsis. It is composed of an embryo, endo-
sperm and the testa, or seed coat, which is fused to the ovary wall. The embryo is a rudimentary plant, and the endosperm provides energy reserves, allowing the embryo to grow until it can manufacture its own food by photosynthesis.

The turfgrass seed is not strictly a true seed. It is actually a floret. The floret includes the caryopsis enclosed by two floral bracts called the palea and the lemma (see Figure 1, page 23). At the base of the palea is a stem-like structure called the rachilla.

The seed of most major turfgrass species is easily identifiable through distinguishing marks on the seed. For example, seed size, shape, color, pubescence, awns, the number of nerves or veins running lengthwise on the lemma, and the shape of the rachilla can help you identify the species making up a turfgrass blend.

Seeds of species within the genera Agrostis (bentgrasses), Poa (bluegrasses) and Festuca (fescues) are similar. So while you can identify the genus, you can’t easily tell the species in a mix. You won’t know if you have Kentucky bluegrass or rough bluegrass, hard fescue or red fescue. It’s also extremely difficult to distinguish among the varieties of a particular species.

It is important to note that every rule has an exception. Seed harvesting, cleaning and packaging procedures can damage the distinguishing features of a seed. Thus, it’s best to look at several specimens before making a positive identification.

Labeling seed. Regulatory agencies on the federal and state levels monitor the seed industry and enforce standards for seed quality. The Federal Seed Act of 1939 regulates the sale, transportation and distribution of seed imported into the United States and seed that is transported across state lines. Individual states also have seed laws. Although seed laws vary from state to state, they all require that seed packages have a label attached and that their contents meet basic minimum-quality requirements.

Although all seed must bear a label, the label alone doesn’t guarantee the varietal purity of the seed in the package. Seed regulatory agencies inspect seed during production and after harvest, mixing and packaging. Seed that meets the specifications of the state agency receive an official certification tag—a guarantee of varietal purity.

Specifications differ from state to state, and seed that is certified in one state may not necessarily meet the certification specifications of another state. In addition, certification doesn’t guarantee the other components of seed quality on the label: purity or germination percentage.

The seed label must provide some basic information. With this information, you can tell what turfgrasses you are buying and the proportion of each species in the bag. Information on the bag should include:

- Name and address of the labeler
- Lot number
- Whether the turfgrass is fine- or coarse-textured
- The turf species and varieties listed in order, starting with the variety making up the largest portion of the mix
- The percent by weight of pure seed for each species and variety—the purity percentage (pure seed is the named species minus the amount of weed seed, inert matter, chaff and other crop seed)
- The germination percentage or percentage of viable seed
- Percent of other crop seed by weight
- Percent by weight of weed seed, including that of restricted noxious weeds
- Percent of inert matter by weight
- Number of restricted noxious weed seeds per ounce or pound
- Date on which the germination test was conducted.

The germination percentage that is listed on a label for a particular turfgrass seed reflects the germination capacity of the seed. Germination percentages are calculated from the number of seeds that germinate in a test sample.
Seed companies conduct germination tests on a seed lot every 9 months, and that date must be listed on the label.

Although companies take measures to reduce the amount of contaminants in a seed lot, contamination can occur. Inert matter is the percent by weight of any material in the seed lot that will not grow. It may include chaff, small stones, sand, pieces of seed, asphalt or other bulking agents. The cleaning process normally reduces the amount of inert matter. However, companies sometimes intentionally add it to “bulk up” the seed lot, making less-expensive seed.

There are two basic weed-seed categories: noxious and non-noxious. Noxious weeds are ones that, when established, are objectionable and difficult to control through normal practices. You can further divide noxious weeds into prohibited and restricted weeds. Prohibited noxious weeds are exceptionally difficult to control, and laws ban their inclusion in seed mixes. Restricted noxious weeds are permitted in turfgrass seed lots, but at specified low amounts. Weed problems differ across the country, and states have established their own lists of prohibited and restricted noxious weeds.

The label must state both the kind of noxious weeds and the number of weed seeds per pound. The label must also include a percentage by weight of all weed seed—noxious and non-noxious—present in the seed lot.

The label also must list any seed considered a crop seed that is in the seed lot in amounts greater than 5 percent of the mix. When crop seed makes up less than 5 percent of the mix, it will be listed in a general “other crop seed” category. All other crop seeds will be combined as a total percentage of the seed lot by weight.

In some cases, crop seed can cause serious, persistent problems for the future turf stand. Annual grasses and most broadleaf weeds are easily controllable. But it’s hard to control perennial grasses without killing the turf. Bentgrass, tall fescue, rough bluegrass and orchardgrass are crop seeds that are not compatible with Kentucky bluegrass. Even when present in amounts of less than 5 percent, such grasses will seriously detract from the quality of a Kentucky bluegrass turf.

**Seed calculations.** See “Appendix: Turf and Landscape Calculations” for seed calculations concerning seeding rate and pure-live seed, and determining the best buy for seed.

### SEED APPLICATION

Seeding is the least expensive and least labor-intensive means of propagating turfgrass. And it is the way most cool-season turfgrass species are established.

The best time to seed cool-season turfgrasses is in fall. You can seed in spring, but summer annual weeds, such as crabgrass, compete with and often over-run the emerging turfgrass seedlings. Also, summer weather can stress seedlings, causing stand losses.

When sowing seed, strive to evenly distribute it over the seedbed at the proper rate and provide good seed-to-soil contact. Several types of seeders are available to help you meet these goals. You can seed by hand, but it requires considerable skill and is not practical for large sites.

- **Broadcast spreaders** are appropriate for small or moderately sized areas. You can cover a wider area with these spreaders than you can with drop spreaders. However, wind can deflect seed coming out of broadcast spreaders, making it difficult to get a uniform distribution. Also they may not evenly distribute mixtures, as different-sized seed can spin out at different rates. Be careful when seeding the boundaries of an area to ensure seed doesn’t go beyond the area, thus wasting seed.
- **Drop-type spreaders** deliver seed through holes in the base of a hopper. The hopper has an agitator that helps force seed out of the holes. Seed placement is more accurate with drop spreaders than with broadcast spreaders. Wind is less of a problem. But it is easy to skip areas between application strips and to excessively overlap strips. The best use for drop spreaders is in small areas and along borders where you need accurate seed placement.
- **Disk-type seeders** have vertical blades that cut slits in the soil. Seed drops into the grooves from a hopper behind the blades. Disk seeders place seed in direct contact with soil so more seed germinates with these types of seeders than with drop or broadcast seeders. You normally use lower seeding rates with disk seeders than you use with broadcast spreaders.
- **Cultipacker seeders** are tractor-mounted units that not only uniformly distribute seed but also firm the seedbed after planting. The roller component is ridged to ensure proper seed placement. This equipment is appropriate for seeding large areas.
- **Hydraulic seeders** are essentially large-capacity sprayers with a single-nozzle delivery system. Through them, you can apply a mix of seed, mulch, fertilizer and other materials to slopes and areas where other seeding methods are impractical. Because this method doesn’t provide good seed-to-soil contact, it is critical that you mulch hydraulically seeded areas.

**Uniform application.** To ensure uniform application, make two passes over a site, the second one at right angles to the first. In this way, you can cover any skips you make with the first pass. Calibrate the spreader to deliver one-half the recommended seeding rate in each pass.

**Seed-to-soil contact.** If establishment is to occur, seed must be kept moist and have a place to anchor its
roots. Thus, good seed-to-soil contact is important for germination. Good seed-to-soil contact also prevents seed from drying too quickly and enables seedlings to root into soil more rapidly.

With broadcast and drop spreaders, you should lightly rake the seed into the upper 0.25 inch of soil then roll to firm the soil. You don’t need to do this with disk seeders or cultipacker seeders because they work seed into the soil as they go.

- **Mulching.** Mulch helps provide a favorable environment for germination and seedling development. It reduces moisture loss while seed germinates and begins to grow and shades seedlings, minimizing daily temperature increases. Mulch also helps stabilize the soil until seedlings have rooted.

  Many different mulches are available from which to choose. Straw mulch is most popular. It is easily obtainable and inexpensive. Take care to ensure that the straw is free of weed-seed, or you could have future weed problems.

  Apply straw by hand or with a mechanical blower. Evenly distribute it to get 50-percent soil coverage—1 bale per 1,000 square feet or 1.5 to 2 tons per acre.

  Generally, you can leave straw mulch on the seedling stand because it will decompose in a relatively short time.

  Wind often blows straw mulch. Tie it down with twine, crisscrossed over the site and staked down. Asphalt binder is often used to stabilize mulch on large areas. Apply it at the rate of 200 gallons per acre.

  Wood mulches such as wood cellulose fiber, wood shavings or excelsior are comparable to straw. Other wood mulches—sawdust, wood chips or bark mulch—can upset the soil C:N ratio and tie up much of the nitrogen in the soil. These materials also do a poor job of modifying the seedling microclimate.

  Apply wood cellulose fiber by hand or as a slurry through a hydraulic seeder. You can buy excelsior in 4-foot-wide rolls or as a loose material. Apply it by hand or with a mechanical mulching machine.

  Burlap, cheesecloth, jute netting or tobacco shade cloth are good mulches for slopes or other critical areas, such as in drainage swales or around irrigation heads. When laid out and staked along a slope or drainage swale, they effectively stabilize seed and minimize moisture loss. These materials are biodegradable, so you can leave them to decompose on the site.

  Elastomeric polymer emulsions form a thin rubbery layer over the seedbed. When you apply these materials in a low-pressure stream of water using a 9:1 proportioner, seed stabilization is good. With these materials, you judge the application rate by how well they cover the site. Be careful not to apply too much material as it could seal the surface and impede seedling germination.

- **Aftercare.** Because seedling turf is much more sensitive than mature turf, you must manage it differently. Seedlings don’t have the extensive root system of mature turf and can’t easily obtain water and nutrients. They are also more susceptible than mature turf to injury from disease, environmental stresses and herbicides.

  Proper irrigation is the most important management practice following seeding. If you don’t supply water once the seedlings begin germinating, the stand will be lost. Keep the upper 0.5 inch of soil moist during establishment. Irrigate lightly and frequently until the turf matures. If you haven’t mulched the area, water several times during the day to prevent drying.

  Excessive watering can be as damaging as infrequent watering, especially during warm weather. Pythium blight is a fungal disease that is active when warm, moist or humid conditions prevail. It is particularly lethal to seedling turf and turf that is succulent from excess nitrogen. The care you give young turf—frequent irrigation and starter fertilizer—promotes perfect conditions for the development of Pythium blight.

  Other diseases can attack seedling turf, including damping off, root rot and seed rot. These can kill plants before or right after they emerge. Thiram or captan will reduce injury from damping-off organisms.

  Mow the seedling stand when its height is one-third greater than the recommended mowing height for the species. For example, you normally maintain tall fescue at 2 to 4 inches high. So when seedlings are between 2.7 and 5.3 inches, mow them to the recommended height.

  An exception to the rule is close-cut creeping bentgrass. Begin mowing it at 0.5 inch, then gradually lower the cutting height as the turf matures.

  Take care not to uproot seedlings with the first couple of mowings. A well-sharpened mower blade can help here. To avoid making ruts in the seedbed, use a lightweight mower. Or mow only when the seedbed is relatively dry and firm.

  Apply nitrogen fertilizer 3 to 4 weeks after seedlings have emerged and have grown to 1 to 2 inches tall. Apply soluble nitrogen at 0.5 pound actual nitrogen per 1,000 square feet. If you use slowly available nitrogen, use a rate of 1 pound per 1,000 square feet.

  Herbicides that you can use on mature turf may damage seedlings. This is why it is so important to control as many weeds as possible before you establish the turf. Most herbicides require you to hold off on treatment until the turf has been mowed two to three times. Others have a much longer waiting period. Siduron is the only pre-emergence crabgrass herbicide that you can apply before seeding. Before applying any herbicide to
new turf, read the label carefully.

**SOD INSTALLATION**

A sodded area can be no better than the quality of the starting product. If sod is certified in your state, purchase certified sod containing varieties well-adapted to your area. A scheduled visit to prospective suppliers’ fields will acquaint you with growers and the quality of sod they produce long before you take delivery. Make sure your supplier does the following things before harvesting the sod:

- Maintains a uniform cut at appropriate heights for the individual turfgrass species.
- Allows no more than 0.5-inch of uncompressed thatch. To reduce the potential for heat buildup in stacked sod (which can lead to transplant failure), make sure the grower removes excessive clippings.
- Applies 0.25 to 0.75 pound of actual nitrogen per 1,000 square feet to improve color. (Avoid excessively fertilized sod, as indicated by dark-green, lush leaves. Sod fertilized with excessive nitrogen in particular leads to stress-susceptible turf with poor rooting potential. Sod in this condition has a greater tendency to heat on the pallet and is more susceptible to transplant failure.)

Although sod pieces come in various sizes, make sure the width does not vary by more than 0.5 inch to ensure installation ease and a uniform initial appearance. Make sure the sod is 1- to 0.75-inch thick, excluding thatch and leaf length. Thickly cut sod—1.5- to 2-inches thick—is sometimes used on specialty-use turf areas, such as athletic fields, to shorten the waiting time before the area is usable. However, for most turfgrass areas, thinly cut sod is easier to handle and roots more readily.

Test for sod strength by holding the sod by one end and observing whether it tears or loses its shape. Sod that falls apart easily may have been harvested too young or managed poorly. It is difficult to install and a high risk for successful establishment.

**Soil preparation.** Sod often fails to establish or perform well because no one bothered to correct deficiencies in the physical and chemical condition of the soil. Prepare soil as you would for a seedbed by first sending a soil sample for analysis by a reputable testing laboratory. This will help determine the amounts of nutrients needed to correct deficiencies. Also, follow the laboratory’s recommendations for correcting an acid or alkaline soil to pH 6.0 to 7.0.

When renovating existing turf, remove the old grass below the thatch layer rather than tilling it in. Treat difficult-to-control weeds with appropriate herbicides before adding amendments. To improve the water-retention properties and soil structure of sandy or heavy clay soils, add about 30 cubic feet of peat moss per 1,000 square feet. Apply 1 to 2 pounds of actual nitrogen per 1,000 square feet. Apply fertilizer, lime or other amendments recommended by the soil test, incorporating all amendments at least 6 inches into the soil. Rake the soil to a smooth, level finished grade and roll it to provide a firm planting bed.

Where high-quality topsoil is difficult to obtain or economically prohibitive, incorporate sand and organic matter to improve existing soil conditions.

**Schedule operations.** Schedule operations carefully and complete all soil preparation before sod delivery. Install sod immediately after delivery—within 12 hours of harvest in warm weather and 36 hours during cool weather. Yellow leaves and signs of mold and mildew indicate that the sod remained on pallets or stacks too long, has reduced vigor and will establish poorly. Do not accept sod that arrives on site in this condition.

**Supply adequate moisture.** Sod is living turf with a limited root system, so make sure the sod remains moist until a new root system develops. Water the soil lightly before you install the sod, or schedule soil preparation so the soil is still moist when you install it. For high-quality turf, you cannot get away with irrigating only after installation.

Irrigate again within 20 to 30 minutes of installing the first piece of sod. Thorough irrigation to a 6-inch depth immediately after installation should help maintain adequately moist sod.

Make sure all sod pieces are butted together tightly and do not overlap. Stagger the joints in each row the same way bricks are laid and use wooden stakes to hold sod in place on steep slopes. Roll sod to smooth the surface and to bring the bottom of the sod layer into intimate contact with the soil surface.

Until the root system begins to develop, irrigate often enough to keep the sod pad moist; this usually means irrigating 0.25 inch per day for the first week after installation. After a sufficient root system develops, reduce irrigation frequency and irrigate to a depth of 4 to 6 inches every 5 to 10 days.

Bermudagrass sod may root sufficiently within 3 to 5 days and quickly allow a reduction in irrigation frequency. However, Kentucky-bluegrass sod requires careful irrigation for 2 to 3 weeks to become successfully established during summer-stress periods. Mow the newly sodded area when the turf exhibits a 30- to 50-percent increase in vertical-shoot growth. For example, if you maintained the sod at a 2-inch cutting height before harvest, you should mow for the first time when the grass reaches a height of 2.75 to 3 inches.

Apply 0.5 to 1 pound of nitrogen per 1,000 square feet after 4 to 6 weeks if the grass begins to show signs of
Whenever possible, whenever it has dried, which may be two to three times daily in hot weather. If you can irrigate only once a day, do so at midday. Correct pH, salinity or sodic soil problems. Once you make the decision to renovate a lawn, submit representative soil samples to a reputable soil testing laboratory 3 to 4 weeks before you need results. The soil test will indicate whether the soil is acidic or alkaline, an important consideration because pH could have contributed to the original deterioration. Soil with a pH below 6.0 needs lime; alkaline soil with a pH above 7.4 needs an acidifying material such as sulfur. The soil test will indicate the specific rate of lime or acidifying material to apply. Correct soil pH at the time of soil cultivation, so the liming or acidifying material will move deeper into the soil.

Renovation

- Correct pH, salinity or sodic soil problems. Once you make the decision to renovate a lawn, submit representative soil samples to a reputable soil testing laboratory 3 to 4 weeks before you need results. The soil test will indicate whether the soil is acidic or alkaline, an important consideration because pH could have contributed to the original deterioration. Soil with a pH below 6.0 needs lime; alkaline soil with a pH above 7.4 needs an acidifying material such as sulfur. The soil test will indicate the specific rate of lime or acidifying material to apply. Correct soil pH at the time of soil cultivation, so the liming or acidifying material will move deeper into the soil.
- Eradicate undesirable species/weeds. Whenever possible, renovate existing lawns by applying fertilizer and broadleaf and pre-emergence herbicides that won’t inhibit seedling development, then overseed with improved varieties. If the lawn is badly contaminated with perennial weedy grasses or poorly adapted species, it is better to kill the existing grasses and re-establish a completely new lawn. Schedule herbicide applications for control of undesirable weedy species at least 3 to 4 weeks before you plan to plant unless the product label contains other instructions.
- Remove heavy thatch. A certain amount of dead organic material enhances soil-moisture retention, but a layer of thatch 0.5-inch or more thick may contribute to turf deterioration. Vertical cut to remove excessive thatch or dead vegetation resulting from the herbicide application. Make multiple passes in varying directions to remove most of the thatch and dead vegetation.

- Fertilize based on soil tests.
- Cultivate to loosen compacted soil. Sites with excessive soil compaction may need turf cultivation, usually accomplished by coring or slicing. Again, you may need to make multiple passes over the area to achieve the desired degree of soil loosening. Following coring, immediately drag the area with a mat or similar device to break up the cores and redistribute the soil over the surface.

When seeding into bare soil, the seedbed is the right firmness and ready for seeding when a footprint leaves a 0.25-inch depression.

- Scalp just before seeding to reduce competition from existing vegetation.
- Seed. Depending on the size of the area, use a drop-type spreader, a rotary-type spreader, a slit seeder—which combines soil preparation and seeding in one step—or a hydraulic seeder.

If you select a spreader or seeder, spread half of the total seed in one direction over the entire surface; apply the second half at a right angle to the first to ensure even application. After seeding, lightly drag a mat over the area to work the seed into the top 0.25 inch of soil.

The speed of establishment varies according to the time of year and watering efficiency. In late summer on warm soils, perennial ryegrass may germinate in 5 days. Fine fescue and tall fescue may appear in 7 days and Kentucky bluegrass in 10. During early spring on cold, wet soils, establishment may take two or three times longer than in summer.

- Irrigate daily for 2 to 3 weeks. The first irrigation should wet the soil to 6 or 8 inches without washing out the seed. Subsequent watering should dampen the surface whenever it has dried, which may be two to three times daily in hot weather. If you can irrigate only once a day, do so at midday.

Post-germination Care

- Mowing. You can mow perennial ryegrass in as little as 3 weeks after seeding. Kentucky bluegrass may be ready to cut in 6 weeks. New turf is ready for mowing when it grows taller than the cutting height planned for the new turf. Follow the normal mowing practice of not removing more than one-third of the leaf area at any one mowing.

- Herbicides. Cultivated farm soil averages 5,000 weed seeds per square foot, and the typical topsoil in a lawn probably has even more. Fortunately, most weeds can’t tolerate mowing and quickly die. In general, turf that has been mowed at least twice tolerates broadleaf-herbicide applications.